Thinking about Religion: Scientific Progress and the Cognitive Science of Religion

Aaron Colin Thomas Smith

Submitted in total fulfilment of the requirements of the degree of Doctor of Philosophy

2012

Faculty of Arts

University of Melbourne

Produced on archival quality paper
Abstract

My interest lies with a collection of scholarship labelled the ‘Standard Model’, which I propose constitutes an emerging explanatory framework for theoretical and empirical work on religious cognition. I map the features of the Standard Model and assess the strength of its claims to offer a program for understanding religious cognition. My conclusion dilutes the Standard Model in that I suggest it overstates the mind’s susceptibility to religious content and sidesteps other culturally prolific activities that also engage emotion, memory, belonging and belief. While I acknowledge some convergence pressures upon cultural activities, I argue that these pressures lead towards more generic tendencies such as the ability to hold belief sets, rather than the predisposition to hold religious beliefs. While I do agree that the evidence suggests that religious content will be attractive to human minds, it is neither inevitable, nor possible, without the structure of cultural reinforcement. On this view, religion is not a unique domain, but operates within the more general domain of social agency. I also note that the mind is adept at learning; we can change our minds, discard ideas we acquired in the past, and choose to become or remain an atheist.

On the basis of this case study, I argue that an explanatory framework in cognitive science demonstrates progress (towards becoming a research program) when it reveals hitherto unforeseen connections between analytical levels. Boundary-breaking, inter-level connections represent markers of progress.

The Standard Model is an overconfident but nevertheless progressive explanatory research framework guiding work on religious cognition because it has revealed previously unforeseen connections between theories and observations derived at different analytical levels. A progressive framework exposes previously unconnected propositions or theories and stimulates new empirical work around them. The Standard Model case illustrates how progress can come about through unforeseen connections as well as through predictions. Progressive frameworks make both new and more links. I suggest that a progressive framework encourages the tensions that arise when inter-level connections become messy. Tension leads to sharper empirical questions where progress is served by a framework that stimulates empirical work in trying to find resolutions. In reaching this conclusion, I also recommend a suite of seven analytical
criteria for assessing an explanatory framework in cognitive science, building on Thagard (2005a).

The Standard Model case suggests that progress in an inter-disciplinary area can be achieved without a unifying or reducing model, and may even be best seen through a complex set of relations that facilitate the development of novel predictions and the specification of inter-level connections. I argue that the lessons in the case of the Standard Model of Religious Cognition underscore the importance of a working framework—a principles-driven, neo-Lakosian ‘soft’ core—in facilitating unforeseen connections between theories and observations arising from different analytical strata.
Declaration

This is to certify that:

(i) the thesis comprises only my original work towards the PhD except where indicated in the Preface,
(ii) due acknowledgement has been made in the text to all other material used,
(iii) the thesis is fewer than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Aaron Smith
May, 2012
Acknowledgments

I remain indebted to my supervisor, Associate Professor Howard Sankey, for his intellectual rigour, thoughtful guidance, and wry humour. The time Associate Professor Sankey invested into reading and discussing my work has been greatly appreciated. Our conversations have proven some of the most stimulating and enjoyable I have ever experienced. In addition, I am grateful to Dr Neil Thomason for his advice and encouragement.
# Table of Contents

Abstract........................................................................................................................................... 2

Chapter 1: Introduction to the Cognitive Science of Religion......................................................... 12
  Introduction ....................................................................................................................................... 12
  Cognitive Science: An Approach to Cognition .............................................................................. 20
  The Cognitive Science of Religion ................................................................................................. 23
  The Standard Model of Religious Cognition ................................................................................. 27
    1. Ordinary, domain-specific cognitive functions support religious representations
       .................................................................................................................................................. 34
    2. Intuitive domain inferences are violated with minimally counterintuitive
       concepts ...................................................................................................................................... 35
    3. Agency detection leads to suppositions about the presence of supernatural agents
       .................................................................................................................................................. 36
    4. Intentionality inferences stimulate judgements about the intentions of
       supernatural agents ..................................................................................................................... 37
    5. Emotion detection assigns emotional states to supernatural agents along with
       existential implications ................................................................................................................. 38
    6. Social exchange inclinations reinforce costly commitments to supernatural
       agents and ritualised performances .............................................................................................. 39
    7. Innate moral intuitions generate the conception of supernatural agents’ wishes ................. 39

Method and Structure of the Dissertation ......................................................................................... 42
  Conclusion ....................................................................................................................................... 46

Chapter 2. The Analysis of Scientific Progress and the Cognitive Science of Religion 47
  Introduction ....................................................................................................................................... 47
  Making Progress in the Standard Model of Religious Cognition ................................................. 47
  Theories and Research Programs as Units of Analyses .................................................................. 56
  Conclusion ....................................................................................................................................... 59

Chapter 3. Approaches to Theoretic and Scientific Progress: Paradigms and Unification
  .......................................................................................................................................................... 61
  Introduction ....................................................................................................................................... 61
  Progress and Paradigms .................................................................................................................... 63
  Paradigmatic Incommensurability ................................................................................................. 66
  Unification and Reduction .............................................................................................................. 68
Conclusion ................................................................................................................................. 152
Chapter 8. Neurological Plausibility of the Standard Model.................................................. 155
  Introduction .............................................................................................................................. 155
  Neural Correspondence and Religious Cognition ................................................................. 158
  The Temporal Lobe Hypothesis ............................................................................................ 162
  The Neurotheological Hypothesis .......................................................................................... 164
    Flow States and Vicarious Experience .................................................................................. 167
  The God Centre Hypothesis ................................................................................................... 169
  Implications of the Hypotheses .............................................................................................. 170
  Rituals, Religious Experience and Cognition ........................................................................ 172
  Bring the Hypotheses Together: An Inter-field Theory of Religious Experience................ 175
  Conclusion ............................................................................................................................... 178
Chapter 9. Practical Applicability of the Standard Model.................................................... 181
  Introduction .............................................................................................................................. 181
  Why Would Anyone Believe? ............................................................................................... 182
    Variability in Religious Cognition ...................................................................................... 184
    The Mechanisms of Belief ................................................................................................. 185
  Religious Conversion ............................................................................................................. 187
  Decision-Making and Reasoning ........................................................................................... 191
  Conclusion ............................................................................................................................... 195
Chapter 10. Evolutionary Plausibility of the Standard Model ................................................. 198
  Introduction .............................................................................................................................. 198
  Evolution and Ultimate Causes of Religion ......................................................................... 199
  The Standard Model’s ‘Evolutionary Landscape’ ............................................................... 204
  Criticisms of Evolutionary Psychology ............................................................................... 207
  Group and Cultural Selection ............................................................................................... 211
  Conclusion ............................................................................................................................... 215
Chapter 11. Integrative Power of the Standard Model ............................................................ 219
  Introduction .............................................................................................................................. 219
  Inter-level Theory and Inter-disciplinary Exchange ............................................................. 220
  Inter-theoretical Connections and Integration ..................................................................... 229
  Inter-level Mapping in the Standard Model ......................................................................... 231
  Conclusion ............................................................................................................................... 237
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>258</td>
</tr>
<tr>
<td>Disciplinary Connections through the Standard Model</td>
<td>260</td>
</tr>
<tr>
<td>Levels of Analysis in Cognitive Science</td>
<td>263</td>
</tr>
<tr>
<td>Theoretical Unification and the Standard Model</td>
<td>266</td>
</tr>
<tr>
<td>Reduction and Mechanisms</td>
<td>271</td>
</tr>
<tr>
<td>The Future of the Standard Model as a Cognitive Theory</td>
<td>276</td>
</tr>
<tr>
<td>Conclusion</td>
<td>280</td>
</tr>
</tbody>
</table>

| Introduction                                                             | 282 |
| The Standard Model as a Research Program?                               | 283 |
| Problemshift in the Standard Model                                       | 287 |
| Theory Testing and the Standard Model                                    | 293 |
| Analytical Levels and a Lakatosian Hard Core                            | 295 |
| Problem-Solving and Progress in the Standard Model                      | 302 |
| Conclusion                                                               | 306 |

| Chapter 15. Conclusion and Final Comments                              | 308 |
| The Standard Model of Religious Cognition                             | 309 |
| Assessing the Standard Model of Religious Cognition                   | 311 |
| 1. Representational Power                                              | 311 |
| 2. Computational Power                                                 | 314 |
| 3. Psychological Plausibility                                          | 315 |
| 4. Neurological Plausibility                                           | 316 |
| 5. Practical Applicability                                             | 318 |
| 6. Evolutionary Plausibility                                           | 320 |
APPENDIX B. Summary of Approaches to Progress and the Performance of the Standard Model ......................................................... 392
List of Figures and Tables

Figure 2.1 Core Concepts in the Cognitive Analysis of Religion................................. 34
Table 2.1 Support for the Core Propositions of the Standard Model.............................. 41
Table 6.1 Barrett’s (2004) Categories of Modular Functionality.................................. 123
Table 6.2 Functional Domains and Supporting Evidence........................................... 126
Figure 8.1. An Inter-field Representation of Religious Experience .............................. 177
Figure 11.1 The Dynamic Relationship between Charismatic Authority, Ritualisation, and Dogmatic Systems (Sorensen 2005, p. 181) ................................................................. 225
Figure 11.2 Standard Model of Religious Cognition Inter-level Relations Map ............ 234
Figure 14.1 Degenerative and progressive problemshifts for the Standard Model ......... 289
Figure 14.2 The Standard Model of Religious Cognition Hard Core and Protective Belt. A Neo-Lakatosian Conceptualisation.............................................................. 299
Table Appendix 1. Nervous System Organisation Summary ...................................... 372
Table Appendix 2. Lobe Location and Functionality Summary ................................. 375
Table Appendix 3. Structure and Function Overview ............................................... 378
Table Appendix 4. Summary of Localisation of Brain Function .............................. 379
Chapter 1: Introduction to the Cognitive Science of Religion

Introduction
Some surveys estimate that more than 80 per cent of the world’s population holds some form of religious conviction (Barrett, Kurian, and Johnson 2001, p. 550). One explanation for religion’s prevalence suggests that an evolved set of cognitive mechanisms supports the acquisition, transmission and stability of religious concepts (Lawson 2000, p. 340). In crude terms, religion is ‘natural’. The research activity developing around cognitive explanations of religion has increased significantly as observed by cognitive science onlookers (Deacon 1997, p. 109; Pinker 1997, pp. 525-565), incorporating explanations for religious doctrine (Atran 2002a), transmission (Boyer 2005), rituals (McCauley and Whitehouse 2005; Whitehouse 2005), and evolution (Slone 2005). This dissertation focuses on the strength and development of this religious cognition research program. In this chapter, I explain the aims of the dissertation, introduce the target of interest, define and specify the cognitive science of religion, and foreshadow the structure of the analysis.

My focus lies with a collection of work on religious cognition that I label the ‘Standard Model’, a term appropriated from Boyer (2003, p. 3). Although Boyer’s term implies a level of acceptance similar to the standard model of physics, the religious cognition version remains contentious. On my interpretation, the Standard Model constitutes a set of propositions about religious cognition used by cognitive scientists as an explanatory framework. In this dissertation, I pursue three objectives associated with the Standard Model. First, I identify the Standard Model’s features. Second, I examine its strength as an explanatory framework for religious cognition by applying and further developing Thagard’s (2005a) analytical criteria. I employ the term ‘exploratory framework’ as a way of describing the Standard Model’s pre-programmatic status; a developing research program that has tethered its fortunes to a set of explanatory assumptions, principles and propositions. Third, I consider the lessons from the Standard Model as a case study in the philosophy of science. I conclude that it provides a useful and progressive framework, encouraging new hypotheses and testing predictions. However, I express misgivings about its reliance on under-substantiated assumptions imported from cognitive science, and in particular, cognitive psychology.
The case also reveals a shortage of tools for assessing scientific progress in a multi-disciplinary field characterised by work spanning numerous analytical levels. I propose a new yardstick for measuring progress in multi-disciplinary scientific programs. My position is that an emerging explanatory framework must be capable of identifying novel, boundary-breaking connections between and within levels. I suggest that a progressive framework encourages the tensions that arise when inter-level connections become messy. Tension leads to sharper empirical questions. In other words, I contend that progress is served by a framework that stimulates empirical work in trying to find resolutions. In reaching this conclusion, I also recommend a suite of seven analytical criteria for assessing an explanatory framework in cognitive science, building on Thagard (2005a).

Religious cognition means thinking about religious content. Cognitive scientists focus on the mental correlates of religious content; the symbolic, psychological ‘representations’ about domains. In this context, a domain is a distinct kind or type of content (Hirschfeld and Gelman 1994, p. 21). By studying representations about domains, cognitive scientists map the nature of thoughts about religious content. According to cognitive explanations, religious content accompanies ordinary thought processes as natural by-products (Atran 2002, Ch. 1, Boyer 2001, p. 50, Dawkins 1982, Norenzayan and Atran 2002, Pyysiainen 2003a, pp. 5-8, Sperber 1996).

Minds possess a suite of cognitive capacities attuned through natural selection to solve ‘domain-specific’ problems. For each major domain of problems, a specific cognitive mechanism offers an efficient, modularised and intuitive solution, both facilitating and constraining religious activity (Boyer 2005). Sperber and Hirschfeld (2004, p. 41) make the important distinction between the ‘proper’ domain and the ‘actual’ domain of a module. The proper domain constitutes the information the module was biologically determined to process, like faces for a face-recognition module. An actual domain includes all the environmental inputs that satisfy the modules triggering conditions, including innumerable objects and images that could be interpreted as a face. Sperber and Hirschfeld’s (p. 41-42) distinction allows them to explain false positives where a mismatch occurs between the two domains. In addition, the specification of two domains helps the authors theorise about why domain creep occurs and why modules seem to have cultural domains (Sperber and Hirschfeld 2004, p. 45). For example,
certain representations become more widely distributed than others, perhaps a result of actual domains influencing the character of proper domains.

Studies of religious cognition emphasise the operation of domain-specific mechanisms, also known as devices or modules (Pyysiainen 2003a, p. 209). For efficiency, cognitive devices mainly operate without conscious awareness, providing intuitive assumptions and inferences about the world and its contents. Information is processed, categorised and stored in unconscious templates delivering ‘minitheories’ about how best to navigate the world. Cognitive devices also ‘prime’ human experience (Van Slyke 2005, p. 5), and according to the Standard Model, create a propensity for certain patterns of religious thought.

A critical mass of religious cognition research and analysis has led to an emerging but unofficial explanatory framework. Although the framework does not claim any official status, its core elements may be considered a loose consensus amongst cognitive scientists of religion. Equally, the framework faces internal challenges in cognitive science, and external challenges from associated disciplines. My interest stems from this combination of nascence and vulnerability; the Standard Model could consolidate or falter, and an assessment at this decisive juncture represents a revealing case in the philosophy of science. I briefly introduce the Standard Model below through seven propositions consistent with Boyer (2005, pp. 4-6):

1. Domain-specific cognitive devices create religious representations (Atran, 2002a, p. 266) as a by-product. As a result, religious cognition remains ‘parasitic’ upon ordinary cognitive functions; religious cognition is not a unique or distinct category independent from other forms of cognition.
2. Domain-specific cognitive devices generate intuitive inferences, but religious representations violate these unconsciously-generated assumptions. Religious concepts are therefore said to be ‘counterintuitive’, meaning that they defy ordinary expectations about the world and its contents. Religious concepts enjoy a transmission advantage as a result because counterintuitive concepts tend to be memorable (Boyer 2001, Ch. 2, 2003, p. 18-23; Pyysiainen 2003a, p. 53).
3. The mind intuitively attributes agency and goal-driven behaviour to events and situations (Leslie 1994; 1996). Religious practitioners naturally infer the
presence and interests of supernatural agents, to whom responsibility for the unexplained may be accredited.


5. The mind’s ability to identify and interpret emotions leads religious practitioners to ascribe emotional judgements to supernatural agents. Emotions also encourage religious behaviour by reinforcing doctrinal conditioning, which in turn leads to repetitive performance. In addition, emotion-detection alleviates or amplifies existential anxiety by connecting the judgements of supernatural agents with rewards or punishments in the afterlife (Atran 2002a; Boyer 2003; Livingston 2005, pp. 75-78; Pyysiainen 2003a, 2006; Thagard 2005b; Whitehouse 2004).

6. Cognitive devices facilitate social exchange through ritual performance (Whitehouse 2002). Practitioners demonstrate their preparedness to endure costly sacrifices in order to prove worthy of both supernatural agents and social networks.

7. Innate moral reasoning and intuition provides a strong platform for conceiving the wishes of supernatural agents (Bering and Johnson, 2005, p. 136). The wishes of supernatural agents correspond to intuitive moral assumptions.

As to my first concern regarding empirical support for the Standard Model, I reveal a complex and uneven landscape. I have reviewed the Standard Model’s claims by applying a series of analytical criteria developed by Thagard (2005a). As supplements, I have added two criteria of my own. Thagard’s criteria provide a useful architecture for an assessment of the empirical and theoretical work. The seven categories are summarised below:

1. The criterion representative power refers to the Standard Model’s ability to account for a variety of cognitive representations. It helps to explain the presence of religious mental representations.
2. The criterion *computational power* specifies how well the Standard Model describes mental computations. It helps to explain the operation of cognitive devices and the way they compute or process religious representations.

3. The criterion *psychological plausibility* reflects how likely it is that the processes identified by the Standard Model are actually undertaken. It helps to explain the religious behaviour that cognitive devices encourage.

4. The criterion *neurological plausibility* refers to the Standard Model’s ability to describe the mental processes physically occurring in the brain. It helps to explain the relationship between cognitive devices, brain operations and religious thought and behaviour.

5. The criterion *practical applicability* specifies the Standard Model’s capacity to explain real world behaviour and experience. It helps to explain religious extremism and atheism, as well as prosaic religious experience.

6. The criterion *evolutionary plausibility* describes the extent to which the Standard Model can be aligned with selection pressures and the biological theory of evolution. It helps to explain the relationship between cognitive devices, evolutionary selection pressures and religious thought and behaviour.

7. The criterion *integrative power* describes the capacity of the Standard Model to assimilate evidence from different levels of explanation, where a level represents an analytical stratum. It helps to explain the relationships between theories generated by the Standard Model that operate in different disciplines.

The Standard Model claims that the mind is adept at acquiring, maintaining and transmitting religious concepts and beliefs. Religious beliefs are appealing to human minds. However, I argue that the Standard Model builds on contentious assumptions. My examination tackles the fundamental assumptions of cognitive science, including the role of evolution and natural selection, the process of adaptation, the presence of domain specificity, cognitive canalisation, and structure-function relations in the brain. While some evidence supports the proposition that the mind is attracted to religious content, I claim that the Standard Model overstates the ‘naturalness’ of religious belief. In addition, I express misgivings about some assumptions assigned to the cognitive mechanisms underpinning the Standard Model’s theoretical premises.
The emerging research program I have labelled the Standard Model of Religious Cognition confronts how to explain the persistence of religious practice. Its first premise holds that the historical and geographical patterns of religious practice reflect shared solutions to common survival and social problems in the form of an evolutionary homology. Although religion is not a direct or ‘ultimate’ adaptation, its practice emanates from a common set of cognitive mechanisms. On my assessment, however, the Standard Model overstates its case. It overlooks cultural diffusion as an explanation for similar structures in religious practice (Appiah 2009, p. 200) while overzealously conflating the multiplicity of religious manifestations to a handful of representative features. Somewhere between these two positions lies the serious and unresolved question as to why some patterns and structures diffuse and endure where others do not. I suggest that the Standard Model highlights some powerful explanations for cultural canalisation, but goes too far in claiming religion as a ‘natural’ phenomenon or ‘instinct’. Instead, I think the available evidence demonstrates that human cognition drives social engagement and identification where religion offers a prototypical but not unique expression. In my view, the evidence decisively presents religion as a socially advantageous practice. But, does religion possess something distinctive and more powerful than other social formations that encourage solidarity and group identity such as nationality, ethnicity or kin connections?

To summarise my conclusions, I think that human minds are susceptible to religious content, but no more so than other culturally prolific activities that also engage emotion, memory, belonging and belief. I present evidence suggesting a relationship between culturally widespread activities and cognitive capacities. While I acknowledge some convergence pressures upon cultural activities, they lead towards more generic tendencies such as the ability to hold belief sets, rather than a predisposition to hold religious beliefs. Religious cognition is not a unique domain, but a general domain incorporating social relationships between agents. Although some evidence suggests that religious content will be attractive to human minds, it is not inevitable. In fact, religion is not sustained by natural cognitive mechanisms alone; the structure of cultural reinforcement remains essential. I am sympathetic to Armin Geertz’ (2010, pp. 304-305) argument that we need a theory of religion capable of a more expansive view of cognition. That is, one accommodating brain, body, and culture, as well as one extended beyond the borders of individual minds. I therefore suggest that the Standard Model
overstates the case for the natural acquisition of religious beliefs while underestimating the role of cultural context. The human mind is also exceedingly adept at learning; we can change our minds, discard things we have learned in the past, and choose to become or remain atheists.

While Thagard’s criteria help reveal the scientific strengths and limitations of the Standard Model, I have taken a multi-dimensional view for the pragmatic reason that each approach to assessing a theory or research program has different emphases. As a result, I introduce numerous approaches in order to gain a ‘helicopter’ perspective of the Standard Model landscape.

As to my second concern regarding progress of the Standard Model in light of accounts presented in the philosophy of science, I report positively, although I argue that the framework suffers from a tendency to treat working hypotheses as well-established theories. I suspect that Standard Model advocates wield an epistemological conception of progress. For them, the Standard Model provides a structure around which knowledge concerning religious cognition accumulates. While I agree, at the same time, I conclude that the accounts of progress in the philosophy of science suffer from limitations and skewing effects.

Toward my third concern, I observe that the Standard Model represents an illuminating case study in the history and philosophy of science. It provides a cohesive framework for testing emerging hypotheses and for gathering empirical data. However, the Standard Model risks prematurely entrenching assumptions imported from cognitive science as well as its own theoretical propositions. The Standard Model presents a contemporary case illustrating the difficulties of judging progress in a multi-disciplinary problem characterised by work occurring at numerous analytical levels.

I defend a hybrid version of research program progress. First, progress accompanies a research program or explanatory framework containing a hard core in the Lakotosian sense, or a set of principles after Hardcastle. Programs offer scaffolding around which theoretical possibilities can be constructed. Such architecture helps with accounts of cognition, which acknowledge multiple methods. A sound architecture encourages connections between empirical observations from different levels of analysis. I favour
Hardcastle’s use of principles, having been formed around problems in cognition. They allow for greater flexibility as heuristics. For this reason, I argue for a ‘soft core’ that operates as a set of guidelines and flexes with the challenges of inter-disciplinary and inter-level research programs. For example, in this case, a successful cognitive program must be capable of accommodating, and perhaps eventually connecting with neurological accounts of cognition as well as anthropological descriptions of religious practice.

My case conclusion encourages a tension between the benefits of an organising framework and the risk of accepting or embedding inaccuracies. As a result, although I argue that the Standard Model’s propositions remain imperfect, I think it worthwhile continuing with the framework. Progress is best served by pursuing an incomplete program because it might generate the evidence needed to re-evaluate its own propositions. While strident advocates of the Standard Model seek confirmatory evidence for its propositions, researchers operating at the periphery have opened new lines of research. I do not think that this work would have been pursued without the Standard Model’s explanatory framework. Nevertheless, the Standard Model has not established a true Lakatosian hard core. Rather, the explanatory framework operates as a ‘soft’ core, employing guidelines and principles rather than theories and laws. This case underpins the importance of a soft core guiding predictions and accumulating empirical observations.

A working soft core helps to facilitate unforeseen connections between observations from different analytical levels. In addition, progress in religious cognition relies upon developments in general cognition given that the Standard Model employs assumptions from cognitive science. I repeatedly highlight the limitations and dangers of this dependence because a general theory of cognition remains absent. Having conceded this problem, I return to the practical advantages of a soft core. I conclude that the practical deployment of science includes, or even necessitates, the conscious acceptance of theoretical uncertainty or imperfections.

I also recognise the importance of explanatory frameworks or soft cores that suggest novel inter-theoretical connections. Theoretical progress in religious cognition must resolve inter-theoretical relations, in this case the capacity to reveal connections
between theoretical levels that have hitherto remained unidentified or poorly understood. In an era where science is increasingly conducted between domains and disciplines, dealing with inter-level relations is a pivotal issue in contemporary accounts of progress.

To repeat, in this dissertation I have aimed to 1) specify the Standard Model’s composition including its theoretical and empirical strengths and weaknesses; 2) employ notions of scientific and theoretical progress to reflect on the future of the Standard Model as an explanatory framework for understanding religious cognition; and 3) consider the lessons the Standard Model reveals as a case study in progress and the philosophy of science. In the following section, I provide some background specifying cognitive science approach to cognitive analysis.

**Cognitive Science: An Approach to Cognition**

Cognitive theorists sometimes liken the transmission of cultural knowledge to the virulence of a contagious disease. Infections spread not just because of exposure, but also because of the susceptibility of those exposed (Dawkins 1982; Norenzayan and Atran 2002; Sperber 1996). The successful transmission of concepts occurs through both cultural exposure and cognitive receptivity. Taking a cognitive perspective of religious concepts brings with it the assumption that physical things, events, and people are not independent of the minds that perceive them (Sperber 1996). Cognitive scientists of religion study the way people maintain and transmit mental representations about religious content, starting from the first premise that religious representations are easier to hold in the mind because they are ‘natural’ (McCauley, 2011).

According to Thagard (2005a), the central hypothesis of cognitive science may be described as the Computational-Representational Understanding of Mind: “Thinking can best be understood in terms of representational structures of the mind and computational procedures that operate on those structures” (p. 10). Mental representations are useful to study for at least two reasons. First, they symbolise the mental correlates of a domain of thought. According to Hirschfeld and Gelman (1994, p. 21), “A domain is a body of knowledge that identifies and interprets a class of phenomena assumed to share certain properties and to be of a distinct and general type.” Second, representations contain implicit content about the domain of interest. Understanding this content provides an insight into the way individuals perceive their worlds. Sometimes groups of
representations and their corresponding domains are called schemas, which provide intuitive shortcuts, or heuristics, regarding the way things work. For example, a religious schema might include the prosaic, such as how to light incense, as well as the more subtle, like how to behave in church during mass.

Computationalism asserts that mental states occur when the mind performs computations on symbolic mental representations. Crudely speaking, the mind works like a digital computer, operating according to rules directing how it deals with mental representations. Cognitive science assumes a distinction between the content of cognition and the physical structure of the brain that houses and executes cognition (see Albright and Neville 1999, p. 1ii). According to Reprov (2001, p. 40), the cognitive paradigm stimulated two significant changes in the study of the mind and brain. First, it offered a platform for the study of the mind and the brain at a time when the behavioural approach had denied their relevance. Second, it established decompositional analysis as the chief research and interpretive strategy, with computational processing as the central platform. According to Friedenberg and Silverman (2006, Ch. 1, 4), the computational approach maintains that the brain possesses specific information-processing components and functions. Successfully analysing religious cognition means establishing how religious representations get formed and processed; issues considered in chapters five and six respectively.

Cognitive scientists sometimes describe cognition in architectural terms, where the processes and rules governing thought receive structure (Jordan and Russell 1999, p. 1xxvi). The architectural metaphor leads to debates about the specificity of cognitive function. The key question is whether cognition functions through a single but general mechanism, or through multiple, specific mechanisms. As a general rule, the multiple, specific mechanism perspective dominates cognitive science, although the magnitude and nature of the mechanisms remain fiercely debated. An important example of contention can be found in the dispute between computationalists and connectionists.

The computational view emphasises mental representations and their rule-based, algorithmic manipulation. In contrast, the connectionist view sees the mind as a complex organisation of interacting subsystems, each performing a specific cognitive function, the decomposition of which represents a form of psychological explanation.
Connectionism focuses on processing units in a neural network. It assumes that cognitive operations rely on a distributed form of processing that does not need symbols or rules. Connectionism gets its inspiration from neuroscience rather than computational models. While connectionists believe that brains do perform a kind of information processing, comparisons to computer models fail due to their lack of structural and dynamic complexity (Koch and Laurent 1999). Taken to the strongest connectionist interpretation, neuroscience suggests the potential for eliminative materialism, where psychological experiences are reduced to precise brain operations for each mental state (Churchland 1981). As a reductionist view, connectionism finds the unity of science agenda more favourable.

As with all scientific disciplines, the antecedent traditions in cognitive science have delivered a philosophical legacy. As noted in chapter one, cognitive science operates at the intersection of several disciplines (Matlin 2005, Ch. 1). In particular, cognitive science assumes a computational-representational view of the mind where domain-specific cognitive mechanisms generate intuitive inferences about the world and its contents. Cognitive science aims to determine the composition and functionality of these mechanisms, as can be seen in the work associated with religion cognition.

Another key assumption for cognitive scientists is the view that the mind possesses a suite of domain-specific devices—or mechanisms or modules—that deliver intuitive inferences about domains. A domain-specific cognitive device may be seen as a specialised, encapsulated mental processor produced through evolutionary processes. Although cognitive science champions a ‘modular’ presentation of the mind, little consensus has been reached as to its operation or importance in cognition. Nevertheless, as a rule, the cognitive science of religion has claimed a strong version of modularity.

An intuitive inference is an automatic assumption that “embodies a person’s ontological commitments and provides modes of explanation for the phenomena in its domain” (Pyysiainen 2003a, p. 209). Because intuitive inferences operate automatically without conscious awareness, they are also an efficient form of decision-making. Information is processed, categorised and stored in mental templates that provide “…‘minitheories’ about navigating our environment and prime humans to experience certain types of objects in the world in particular ways” (Van Slyke 2005, p. 5). I explore modularity in
detail in chapter six, which focusses on the computational power of the Standard Model. In this chapter, I assert that modularity remains an important dimension of the Standard Model, but not as important as broader work in cognitive science would suggest. Before I progress any further, it may be instructive to cover some basics about the structure and operation of the brain. However, given that this background information is not directly pertinent to my analysis, I have placed it in Appendix A. Most attention goes to the organisation, topography, and structural functionality of the brain. A basic familiarity with the anatomy and physiology of the brain helps with the nomenclature I employ in later chapters. In addition, I outline the chief neuroscientific methods of brain analyses. Next, I outline the foundations of the cognitive science of religion.

The Cognitive Science of Religion

Despite the increasing popularity of cognitive explanations of religion over the last decade and a half (Deacon 1997, p. 109; Pinker 1997, pp. 525-565), the role cognition plays in religious belief remains fiercely debated. Lawson (2000) argued that a cognitive theory of religion needs to demonstrate “that despite the obvious variability of religion across cultures and throughout history there lay a similar specifiable commonality” (p. 340). He observed that the cognitive science of religion focuses on how human minds represent, acquire, and act on religious ideas. Resolving these three problems constitutes the central work on religious cognition, having delivered the propositions featuring in this analysis.

Understanding how individuals think about religion is important given religion’s prevalence. One survey, for example, estimated that more than 80 per cent of the world’s population holds some form of religious conviction (Barrett, Kurian, and Johnson 2001, p. 550). According to Hay (1990, Ch. 5) and Spilka, Brown and Cassidy (1992), approximately one-fourth to one-third of American and British citizens report having undergone a religious experience, while around three per cent claim to have experienced an intense mystical episode (Beit-Hallahmi and Argyle 1997, Ch. 9). Religious belief might be widespread, but the composition of beliefs varies, even within the same denomination. In fact, Barrett (1999) demonstrated the potential for differences between a person’s religious beliefs and the official line taken by the religious group to which they belong. Religious belief seems to be common, but the content of religious belief is parochial, perhaps even individual (Slone 2004, Ch. 1).
Anthropological research reinforces the importance of contextual and social variables on the formation of beliefs, as exemplified by differences in language, music, leisure and religious practice between cultures. Cognitive scientists, however, consider the relationships between environmental factors and the host potential of the mind. A cognitive explanation regards culture as both a material phenomenon and a cognitive representation of material phenomena (Sperber 1996). The term cognitive refers to mental information processing including elements such as attention, perception, learning, memory and decision-making (Eysenck and Keane 2005, Ch. 1).

Cognitive science takes a multi-disciplinary approach, drawing on several diverse fields including biology, psychology, neuroscience, computer science, philosophy, anthropology, linguistics and sociology (Bechtel and Graham 1998; Matlin 2005, pp. 1-47; Thagard 2005a, p. 10). According to Stainton’s (2006, Preface) strict interpretation, cognitive science possesses four branches: the behavioural and brain sciences such as psycholinguistics, neuroscience, and cognitive neuroscience; the social sciences concerned with the mind, including anthropology and sociolinguistics; the formal disciplines like logic, computer science and artificial intelligence; and parts of philosophy such as philosophy of mind and language. Sobel (2001, Ch.1) observed that the ideas, research and knowledge regarding the mind exceed any individual’s familiarity. Cognitive science seeks to coordinate this vast body of knowledge by providing a converging point of interest: cognition. Cognitive approaches attempt to show that ordinary, natural cognitive mechanisms account for the presence of religious concepts. As Barrett (2009, p. 76) put it, “Evolution has endowed humans with particular mental faculties and social arrangements that prop up religious illusions.”

For many scholars including cognitive scientists, religion demands a belief in supernatural agents (Rappaport 1999; Sosis and Alcorta 2003), even though they might take innumerable forms (Dawkins 2006, p. 18). Sosis and Alcorta (2003, p. 265) claimed that the following four elements occur commonly in literature from anthropology and sociology, encompassing cognitive, behavioural, affective, and developmental aspects of religious systems:

1. Belief in supernatural agents and counterintuitive concepts;
2. Communal participation in costly ritual;
3. Separation of the sacred and the profane;
4. Importance of adolescence as the life history phase most appropriate for the transmission of religious beliefs and values.

Noting the notorious difficulty with defining religion, Pyysiainen (2003a, Ch. 1) suggested that the common conception includes: ideas of non-observable, extra-natural agencies; the belief in a non-physical component of persons surviving death; and the notion of special categories of persons receiving some kind of divine inspiration. Similarly, Atran and Norenzayan (2004, p. 713) defined religion according to the following four characteristics:

1. Widespread counterfactual and counterintuitive beliefs in supernatural agents (gods, ghosts, goblins, etc.);
2. Hard-to-fake public expressions of costly material commitments to supernatural agents, that is, offering and sacrifice (offerings of goods, property, time, life);
3. Mastering by supernatural agents of people’s existential anxieties (death, deception, disease, catastrophe, pain, loneliness, injustice, want, loss);
4. Ritualised, rhythmic sensory coordination of (1), (2), and (3), that is, communion (congregation, intimate fellowship, etc.).

Most definitions of religion treat the belief in a supernatural agent as the central pillar, although some, like Dennett (2006), attempt to marry social and cognitive features. Dennett proposed that religions are “social systems whose participants avow belief in a supernatural agent or agents whose approval is to be sought” (p. 9). For Dennett, the key variable is a belief in a god or gods, as practiced within a social group. He also acknowledged that although a supernatural agent may be omnipotent, they remain anthropomorphised, an observation fundamental to cognitive explanations of religion. Sosis and Alcorta (2003) observed, however, that the belief in a supernatural agent does not fully differentiate religion from commonplace perceptual experience or from other supernatural beliefs that do not involve ritualistic and dogmatic practices. This is an issue I extend further in the next section.
For Pyysiainen (2003a, Ch. 1), the cognitive analysis of religion seeks to explain how counterintuitive concepts become objects of serious belief. Along the same lines, Atran (2002, pp. 13, 264) offered a ‘rough and ready’ characterisation of religion emphasising a community’s costly and hard-to-fake commitment to a counterintuitive world of supernatural causes and being. Atran’s rough description seems to be a suitable beginning, although it does not accommodate religious experiences. In this dissertation I will take an inclusive view of religion where it represents the combination of doctrinal concepts and a commitment to a spiritual world of the supernatural (Krippner’s 2005, p. 81). This is inclusive because it covers the three major Abrahamic traditions, Christianity, Islam and Judaism, as well as Buddhism, Hinduism and any spiritual or religious beliefs reliant on the presence of a supernatural world.

Before I venture further into the cognitive approach, a few introductory remarks about more subtle differences of interpretation between scientific models of religion are warranted. At various points, at least three explanatory accounts of religion intersect: a cognitive account; an evolutionary account; and a co-evolutionary account. While much of these three accounts overlap—including commentators—they each take a different position on the key point of religion-as-adaptation.

Two modes of evolutionary explanation warrant explanation. Mayr (1961; 1993) observed in two landmark papers that first, a proximate explanation is concerned with functional causes, including the elements and processes that comprise human social behaviour. Proximate explanations deal with ‘how’ questions. Second, an ultimate explanation is concerned with evolutionary causes, or those which shaped the development of the brain and human behaviour. Of course, the dominant force for evolution has been natural selection. Ultimate or evolutionary accounts provide explanations for the presence of a cognitive trait, or ‘why’ questions. Avoiding confusion between ultimate and proximate causes helps to unravel the evolutionary plausibility of the Standard Model.

The cognitive approach views religion as an evolutionary by-product. Religion provides adaptive advantages, but it does not comprise an adaptation, the direct result of natural selection. So while religion arrived as a side-effect of evolution, the actual adaptation was for other features like social agency and emotion-detection that were selected. In
the language of biology, selected or direct adaptations are known as ultimate causes, while those which enact the selected adaptations are known as proximate causes. Cognitive approaches to religion therefore focus on proximal rather than ultimate causes of religion. For this reason, cognitive scientists study the proximate mechanism of the mind they claim make religion so successful.

Evolutionary accounts assume that religion constitutes a biological characteristic resulting from natural selection. Religion is an adaptation. Within evolutionary accounts, arguments have been fashioned for religion as either an individual adaptation (e.g. Bulbulia 2004; Johnson and Bering 2006) or a group adaptation (D.S. Wilson 2002). Both emphasise religion as an adaptation for detecting and controlling cooperation and defection, but place the causation differently. In theory, resolving the challenges of cooperation and defection could come about from both individual and group-level adaptations. I address each in more detail in forthcoming chapters. In the next section, I examine the Standard Model in depth.

The Standard Model of Religious Cognition

Transmission. Dennett’s (2006) *Breaking the Spell: Religion as a Natural Phenomenon* may prove a late entry due to its lay popularity as some core arguments draw heavily on the previous work. Similarly, Dawkins (2006), *The God Delusion* selectively employs the cognitive position.

The earliest sophisticated cognitive explanation of religion I located preceded all of the above work. On the basis of case studies on religion in West Africa, Horton (1967; 1993) explained beliefs that express invisible agency. He postulated that the invisible agents are mental theories used to make sense of unexplained phenomena and that they reflect a strong predisposition to apply an intentional stance toward the world.

At the vanguard of cognitive accounts of religion, Boyer (2001, p. 50) argued that no single theory explains all forms of religious thought. He acknowledged several contending views including religion’s potential to provide explanations for mysterious and puzzling natural phenomena, existential comfort, social order, and even the possibility that religion is a cognitive illusion. Similarly, Atran’s (2002, Ch. 1) list of religion’s functions included the social (bolstering group solidarity, group competition), economic (sustaining public goods, surplus production), political (mass opiate, rebellion’s stimulant), intellectual (explaining mysteries, encouraging credulity), and emotional (terrorizing, allaying anxiety). Boyer and Atran believe that these conventional explanations for religion fail, or at least present an incomplete picture. They instead favour a cognitive approach, discarding religion as a unique phenomenon in a class all of its own. Instead, ordinary cognitive mechanisms deliver religious concepts just as they produce the non-religious (Pyysiainen 2003a, pp. 5-8).

Leaders in the study of religious cognition like Boyer, Atran, Pyysiainen and Whitehouse, maintain that a cognitive approach offers greater scope for explaining the diversity of religious concepts and behaviours. For example, cognitive theories explain rituals and their symbolic content (McCauley and Whitehouse 2005), religious concepts and intuitive inferences (Whitehouse 2005), the acquisition and transmission of religious concepts (Boyer 2005), as well as the success or failure of religious doctrine (Slone 2005). According to Boyer, all of these theoretical developments occurred on the back of the Standard Model, where scholars utilised a common but ‘simple strategy’ (2005, p. 6).
Those committed to a cognitive account maintain that religious thought and behaviour rely on ordinary forms of cognition available to normally-equipped individuals (Slone 2005). Irrespective of its diverse cultural manifestations, religious concepts and the thinking accompanying them occur as a result of the very same brain functions responsible for mundane thinking. In fact, cognitive theorists assume that cognitive capacities work through domain-specific adaptations. Certain kinds of thinking offered advantages in the past, conferring upon their possessors a survival and procreation benefit. Through the evolutionary process, these cognitive abilities became modularised for efficiency in dealing with specific everyday problems, but also encouraged the creation and transmission of concepts associated with supernatural agency and ritual. As the processing software behind the computation of religious representations, I examine modules, or cognitive devices, in chapter five. Later in chapter ten, I consider their putative presence from an evolutionary perspective.

Cognitive scientists of religion set themselves the central challenge of using evolved psychological mechanisms to explain the significant features of religious content, organisation and transmission (Slone 2005, p. 199). According to cognitive scientists, panhuman cognitive mechanisms lead to predictable consequences for human behaviour. As a result, the Standard Model begins with the assumption that religious belief and activity remain contingent upon common cognitive apparatus. Religion is not special, but it is natural. The strong version of this perspective reflected in the Standard Model claims that religious beliefs can be acquired, maintained and propagated because they engage supportive cognitive mechanisms.

Boyer (2005), a leading cognitive scientist of religion, identified an approach to religious thought and behaviour that he considered common to all cognitive explanations. He claimed that in general, two theoretical assumptions underpin cognitive models. First, they remove the possibility of a unified cognitive domain under one set of organising principles. Instead, cognitive theorists assume that different domains of religious thinking and behaviour, such as rituals or morality, receive support from numerous cognitive mechanisms. Second, cognitive models deflate religion. Boyer argued that the cognitive features exemplified in religious thought and behaviour would exist in the absence of religion. As a result, Boyer, like all cognitive theorists, explains religion in terms of enduring cognitive functions that facilitate and constrain religious
activity. Based on what he considered the seminal work since 1990, Boyer proposed seven converging properties of the cognitive model (Boyer 2005, pp. 4-6):

1. “Religious concepts are widespread, not because they are an adaptation of human minds, but because they are an optimally salient and inferentially-rich by-product of normal brain function” (p. 5).
2. Supernatural concepts are “salient and inferentially productive” (p. 5) because they combine violations of some natural expectations about the world with sturdy expectations that are held as true, leading to an optimally memorable set of concepts.
3. Supernatural concepts describe “intentional agents” (p. 5), building upon a “tweaking of the standard theory of mind” (p. 5).
4. “Religious morality is parasitic upon evolved moral intuitions that are there, religion or not” (p. 5), reinforced by assumptions about the wishes of omniscient supernatural agents.
5. “Religious rituals are constrained by agency assumptions” (p. 5) about the presence of supernatural agents, also encouraging the use of symbolic instruments and human participants.
6. “Religious concepts are connected to concepts and theories about death that derive from nonreligious sources” (p. 6) which can also be associated with intuitive perceptions of danger.
7. “Religious concepts are optimally suited for the building of coalitional affiliation” (p. 6), providing clear group-membership markers of commitment.

The themes Boyer identified reflect prosaic aspects of cognition and their role as foundations for the exercise of religious beliefs and assumptions. In his own words (Boyer 2003, p. 123):

Religious believers and sceptics generally agree that religion is a dramatic phenomenon that requires a dramatic explanation, either as a spectacular revelation of truth or as a fundamental error of reasoning. Cognitive science and neuroscience suggests a less dramatic but perhaps more empirically grounded picture of religion as a probable, although by no means inevitable by-product of the normal operation of human cognition.
Consistent with Boyer, Slone (2005, p. 199) argued that cognitive scientists hold commitments to several key interpretations about supernatural agency in religion. First, religious systems employ rituals that include culturally relevant but counterintuitive supernatural agents. Second, supernatural agent concepts within religious systems range in complexity from those found in theology to those inferred through intuitive experience. Third, mental representations of supernatural agents stimulate intuitive and abstract concepts such as ‘God is everywhere’, thereby allowing people to hold multiple and even contradictory notions about supernatural agents simultaneously. Murray and Goldberg (2009, pp. 183-184) provided a similar summary of what he called the ‘standard model’. Religious ideas play powerful cognitive roles because they are counterintuitive, invoke agency, stimulate inferences, and represent active, engaged and anthropomorphistic supernatural agents. To cognitive scientists these interpretations mean that religion is more ‘natural’ than theology. Although perhaps an over-simplification, cognitive scientists would argue that religion reflects a generic predisposition built upon a cognitive foundation, whereas theology comes from a social construction built upon a cultural foundation.

Most recently, Barrett (2011, p. 231) claimed four ‘tenets’ frame the cognitive science of religion approach. First, it rejects a strong version of cultural relativism instead insisting that the human mind operates with a suite of universal biases and predilections. Second, and by consequence of the first tenet, some important aspects of cognition occur outside of cultural forces, like various forms of agent detection and face recognition. Third, indigenous “mental tools” (p. 231) constrain cognition, shaping its general expression and delivering universal patterns. Extending this tenet into a fourth, Barrett proposed that cognitive science seeks to explain recurrent patterns of religious expression appearing across cultural barriers. In sum, the research program aims to pinpoint how evolved mental tools encourage the spread of religious concepts.

To cognitive scientists, generic predispositions trump social constructions. For example, Tremlin (2006, Ch. 3) emphasised those features of religion that align with the mind’s natural inclinations. The most powerful attributes of religion connect with the mind’s intuitive knowledge bases and the inferences they stimulate, helped along by the memorable, counterintuitive features of religious content. Moreover, the abstract, theological aspects of religion common in doctrine fail to assist in the acquisition and
transmission of religious concepts. As Anttonen (2000) argued, religious scholars confuse the issue by adopting the sacred as a superordinate category. Rather, he maintained, a cognitive perspective places the focus on the cross-cultural commonalities that explain why certain objects become sacred in the first place. The cognitive approach treats every religious domain as subject to the same cognitive constraints. Summarising the Standard Model, therefore, relies on a cogent description of these cognitive constraints and their implications for religious belief.

I present the Standard Model through seven general cognitive principles and seven corresponding propositions specific to religious cognition. The propositions maintain consistency with Boyer’s list, but incorporate a stronger emphasis on their underpinning cognitive assumptions.

First, domain-specific functions govern cognition and create religious mental representations. Religious cognition does not take an independent form, but rather occurs as a by-product of ordinary, domain-specific cognitive functions. Second, the mind generates intuitive inferences about domains, where those containing the kind of counterintuitive concepts found in religion, hold a memorability and transmission advantage. Third, the mind attributes agency and goal-driven behaviour to events and situations, encouraging religious practitioners to surmise the presence and interests of supernatural agents. Fourth, layered upon the cognitive ability to attribute agency, the mind also infers intentionality, where religious practitioners can imagine the intentions and judgements of supernatural agents. Fifth, the mind’s ability to identify and interpret emotions leads religious practitioners to ascribe emotional conditions to the judgements of supernatural agents. In addition, emotion-detection helps to alleviate existential anxieties by connecting the intentions and judgements of supernatural agents with rewards or punishments in the afterlife. Sixth, the mind’s indigenous inclination to seek social exchange encourages religious practitioners to perform rituals and demonstrate their preparedness to endure costly sacrifices and prove worthy of both supernatural agents and peers. Seventh, the mind’s innate moral reasoning and intuition provides a strong platform for conceiving the wishes of supernatural agents.

To summarise, according to the Standard Model, the mind possesses a variety of specific cognitive functions that create inferences about the environment. Some of these
inferences encourage the belief in a covert but interventionist supernatural agent. In addition, the mind is inclined to attribute a goal to the clandestine work of the supernatural agent. Furthermore, because the mind readily identifies and interprets emotions, religious practitioners suppose that the achievement or failure of a supernatural agent’s goal will lead to personal ramifications in the afterlife. This powerful presumption in turn stimulates practitioners to invent or replay symbolic displays of loyalty, where the greater the sacrifice, the more loyalty a practitioner demonstrates. Moreover, normal cognitive mechanisms responsible for social exchange help practitioners imagine the wishes of supernatural agents and act suitably. The seven principles and propositions are illustrated in Figure 2.1, described in further detail in the following section, and summarised in terms of their chief advocates in Table 2.1.
1. Ordinary, domain-specific cognitive functions support religious representations

Domain-specific cognitive devices create religious representations as a natural by-product (Atran, 2002a, p. 266). As a result, religious cognition relies upon ordinary cognitive functions ensuring that religious cognition is not a unique or distinct category independent from other forms of cognition. This proposition leads to the general prediction that religious cognition relies upon the functionality of specific cognitive devices or modules. More precisely, innate cognitive devices encourage certain kinds of religious behaviours.

The Standard Model begins with the assumption that domain-specific devices govern cognition. The Standard Model further claims that the mind does not act as a generic instrument in which a single multi-purpose cognitive mechanism resolves all problems, irrespective of their nature. Adherents to the Standard Model view the mind as a cluster
of independent, cognition-specific devices supporting religious representations. This view presumes the absence of an independent and unique form of religious cognition. Atran (2002a) infamously summarised the position by proposing that religion is ‘parasitic’ upon ordinary cognitive capacities. He wrote: “The evolutionary canalization of emotions, cognitions, and social commitments into a natural basin of possibilities, from which interacting individuals select their cultural paths, favors the emergence of religion for the life of our species” (p. 266).

Religious thinking cannot be explained by any single ‘magic bullet’. Rather, it encompasses a set of cultural concepts that fall on ‘fertile’ mental soil. The Standard Model provides a basis to address these receptive mental systems through a cluster of causal assumptions (outlined subsequently) emerging from the assumed presence of domain-specific mechanisms or devices. For example, objects and events stimulate inferential devices, which act to make ontological category classifications. When inferences about categories or domains are violated in certain ways, as occurs with some pivotal religious concepts, the consequent religious mental representations produced tend to be more memorable (as outlined in Proposition two). Proposition one receives attention in chapter five, but remains instrumental to all components of the Standard Model.

2. Intuitive domain inferences are violated with minimally counterintuitive concepts

Domain-specific cognitive devices generate intuitive inferences, but some religious representations violate these unconsciously-generated thoughts. A religious concept meeting this criterion can be described as ‘counterintuitive’, meaning that it defies ordinary expectations about the world and its contents. Proposition two leads to the general prediction that religious concepts enjoy a transmission advantage because counterintuitive concepts tend to be memorable (Boyer 2001, Ch. 2, 2003, p. 18-23; Pyysiainen 2003a, p. 53).

Boyer (2001, Ch. 2) developed and later expanded (2003, p. 18-23) the theory of cognitive optimality with the objective of explaining what makes religious concepts readily communicated. The theory has become central to the Standard Model. Boyer, like all cognitive theorists aligned to the Standard Model, claims that the devices underpinning cognition favourably stimulate certain kinds of representations. In a
colloquial sense, Boyer thinks that the mind is susceptible to hosting concepts that assume a particular form. A concept easily acquired and represented by a mind may be considered memorable or cognitively optimal. Such representations occur when the intuitive inferences generated about domains become marginally violated through what Boyer termed minimally counterintuitive concepts (MCI). The argument presumes that the mind unconsciously generates assumptions about the world and its contents as a way of efficiently navigating large volumes of complex stimuli and responding rapidly. However, sometimes concepts contradict these instant inferences. For example, the concept of a ghost contradicts normal assumptions the mind generates about human physicality. According to the Standard Model, such concepts seem more attractive and memorable.

Pyysiainen (2003a, p. 53) defined ‘counterintuitive’ concepts as those violating panhuman intuitive expectations. Rather than attempting to define religion in all of its diverse forms, cognitive scientists view religion as the “human ability to form counterintuitive ideas, meta-represent them, and treat them symbolically” (Pyysiainen 2003a, p. 53; also see Dennett 2006, Ch. 2). Minimally counterintuitive concepts drive the Standard Model and its explanations of how religious representations form and propagate. Proposition two and its predictions are examined in detail in chapters five and six.

3. Agency detection leads to suppositions about the presence of supernatural agents
The mind possesses a powerful capacity to intuitively attribute agency and goal-driven behaviour to events and situations (Leslie 1994; 1996). Proposition three leads to the general prediction that religious practitioners naturally infer the presence and interests of supernatural agents, to whom responsibility for the unexplained is accredited.

Driven by a cognitive device, the capacity for agent detection occupies a central position in the Standard Model’s explanatory framework. Leslie’s (1994; 1996) theory of agency has proven influential. It describes the attribution of mental states to others as an independent cognitive capacity, and not a feature of general intelligence. To Leslie, attributing agency arrives through an activation of the agency detection device known as ‘theory of mind’. According to the Standard Model, the mind’s capacity to attribute agency and goal-driven behaviour to events and situations encourages religious
practitioners to assume the intervening presence of supernatural agents. According to Dennett (1996, Ch. 2), we possess minds designed for registering agency in uncertain circumstances, which leads to presumptions that supernatural agents take an active role in our lives. In fact, believing in the interests and presence of supernatural agents may be seen as the ‘overpopulation’ or hyper-stimulation of agency. Proposition three and its predictions are examined in chapter six, and in chapter seven where it bolsters the efficacy of ritual performance.

4. Intentionality inferences stimulate judgements about the intentions of supernatural agents

Building on the previous proposition, cognitive devices encourage assumptions about the intentions of supernatural agents (Boyer 2001, pp. 45-46; Dennett 1987, 2006). Proposition four leads to the general prediction that religious practitioners imagine the intentions and judgements of supernatural agents and interpret events in accordance with doctrine.

Arriving with the agency detection function, or what Dennett (1987; 2006) referred to as an intentional stance, human minds treat other participants in the world as agents with limited beliefs about the world, specific desires, and enough common sense to act rationally to achieve those beliefs and desires. As a result, humans not only infer agency, they also attribute intentionality in order to explain and understand the unique behaviours that can be observed in others. Allocating intentionality to another agent provides a rationale for their action, thereby improving social interaction by anticipating behaviour. To Standard Model advocates, the agency device and its intentionality function, make it easy for religious practitioners to imagine the goals and subsequent judgements of supernatural agents.

Inferential systems work by tuning attention and perception to relevant environmental cues, leading to reasoning about their importance. Boyer (2001, pp. 45-46) argued that inference systems facilitate social interaction and provide a platform for key religious concepts. Accordingly, all humans possess the mental processing required to practice religious thought. In fact, the intentionality specialisation inherent in human minds bolsters the reception and transmission of highly specific cultural messages like those native to religion. Conversely, the most successful religious concepts engage
intentionality inference systems. Proposition four and its predictions are examined in chapter six, while its implications are considered in chapters seven and nine.

5. Emotion detection assigns emotional states to supernatural agents along with existential implications

The mind possesses cognitive devices which identify and interpret emotions, and encourage religious practitioners to ascribe emotional states to supernatural agents. Emotions also strengthen religious behaviour by reinforcing doctrinal conditioning. In addition, emotion-detection alleviates or amplifies existential anxiety by connecting the judgements of supernatural agents with rewards or punishments in the afterlife (Thagard 2005b). Proposition five leads to the general prediction that emotion-detection amplifies religious behaviour and reinforces doctrinal conditioning, in turn encouraging repetitive ritual performance.

The ability to comprehend and assign emotional states represents an additional layer of cognitive structure built upon the inference systems designated so important to the Standard Model. Religious practitioners can ascribe emotions to supernatural agents and connect these states to personal implications either now or in the afterlife. In this sense, the capacity for emotion detection can alleviate or heighten existential anxiety depending upon whether a religious practitioner believes their thoughts and deeds have pleased a given supernatural agent or not. Although perhaps an oversimplification, religious concepts with emotional content enjoy success because they “excite the human mind, linger in the memory, trigger multiple inferences in the precise way that will get people to hold them true and communicate them” (Boyer 2001, p. 329). Standard Model theorists do not believe that a religion-specific emotion detection system exists, or that any specific predisposition or cognitive devices render religious beliefs inexorable. Faith and belief appear as side-effects of the way the mind manages common inferences and emotions. Standard Model theorists also agree a strong link operates between religious commitment and the underpinning emotional benefits of belief. Religious concepts, according to Thagard (2005b), become infused with emotion. Consistency between thought and action means diminishing logical tensions between beliefs. More importantly, reconciling thought and action makes religious practitioners construct systemic intellectual commitments that ensure emotional coherence. Proposition five is
examined in chapter six and seven but also plays a major role in my analysis of religious experience in chapter eight.

6. Social exchange inclinations reinforce costly commitments to supernatural agents and ritualised performances
Cognitive devices facilitate social exchange and ritual performance (Whitehouse 2002). Proposition six leads to the general prediction that religious practitioners will endure costly sacrifices in order to prove worthy of both supernatural agents and social networks, enhancing group solidarity and commitment.

With a cognitive capacity for making intuitive social inferences comes the propensity to make sacrifices and costly commitments to important social actors. In a religious context, costly commitments extend to supernatural agents, often through overt, ritualised demonstrations of obedience and sacrifice. The Standard Model’s cognitive approach to ritual assumes that the cognitive devices involved in ritualised activity match those guiding social engagement. Religious rituals differ from the non-religious because they require representations of supernatural agents possessing counterintuitive characteristics, the presence of which affects ritual content and quality.

Routinised rituals get reproduced on ‘autopilot’, drawing on automatised habits, in the process removing the need for critical interpretation. These habitual rituals are the ones most widely disseminated and interpreted by religious leaders. According to the Standard Model, routinised rituals provide optimal cognitive conditions for the attribution of meaning by religious authorities (Whitehouse 2002). The very automaticity of the rituals discourages internal critical interpretation, thereby safeguarding the externally imposed interpretation. Moreover, the routinisation provides an ideal learning pathway, delivering a stable product through a standardised formula. Proposition six and its predictions are examined in chapter seven, while some of its implications are analysed in chapters eight and nine.

7. Innate moral intuitions generate the conception of supernatural agents’ wishes
Cognitive devices generating innate moral reasoning drive a natural inclination to conceive the wishes of supernatural agents (Bering and Johnson, 2005, p. 136). Equally, proposition seven leads to the general prediction that the imagined wishes of
supernatural agents corresponds to intuitive moral assumptions. The deeply held values that reflect the combination of early life learning and an inherent capacity for emotional empathy may be attributed to a supernatural agent. Religious practitioners respond by behaving in line with the recommendations of doctrinal experts.

Cognitive devices encourage religious practitioners to attribute communicative meaning to random events rationalised as a punishment or reward for behaviour delivered by powerful supernatural agents. Hardwired moral intuitions provide a structural guide for taking these attributions a step further until they reflect the imagined desires of a supernatural agent. Bering and Johnson (2005, p. 136) commented: “Any moralizing supernatural agency is but one more expression of an ancestrally adaptive psychological mechanism that was explicitly designed to cope with the sudden awareness that other minds in the community are keeping careful tabs on the self’s actions in the moral domain.” The Standard Model depicts representations of supernatural agents as outcomes of the same systems as those involved in representations of natural agents. Moral judgements exemplify the point as intuitive principles developed early in life. As a result, people tend to hold moral views they find difficult to articulate, but can more definitively attribute to gods, ancestors or other supernatural agents. Proposition seven and its prediction are examined throughout chapters five to seven. Table 2.1 summarises the main advocates for each of the seven propositions.
Table 2.1 Support for the Core Propositions of the Standard Model

<table>
<thead>
<tr>
<th>Proposition</th>
<th>Advocates</th>
</tr>
</thead>
</table>

**Method and Structure of the Dissertation**

In the following chapter, ‘The Analysis of Scientific Progress and the Cognitive Science of Religion’, I introduce the relevant work on scientific progress, locate my forthcoming analysis in the literature, and highlight the concepts instrumental to my arguments. I also note how the Standard Model will be examined as a case study in the philosophy of science.

In chapter three, ‘Approaches to Theoretic and Scientific Progress: Paradigms and Unification’, I map the diverse range of scientific philosophies of progress. Given the volume of work on progress, I aim to provide some general guidelines that later aid in identifying the status of the Standard Model.
Following on from the broad consideration of scientific and theoretical progress, chapter four, ‘Approaches to Theoretic and Scientific Progress: Inter-theoretical Connections’, examines perspectives of theory development across different analytical levels. In this chapter I assess proposals for theory assessment while discussing how progress might manifest in an inter-disciplinary theory of cognitive science. Since no consensus exists about what constitutes scientific progressivity, I draw on various models and interpretations. I strive for a macro analysis that delivers an overarching assessment of the Standard Model, while keeping in mind its fragile assumptions as well as its empirical triumphs.

Throughout my analysis I maintain that cognitive science employs some contentious assumptions, many of which contribute to the Standard Model's foundations. Since a universal theory of cognition is unavailable, some contradictions from disciplines such as anthropology and neuroscience must be exposed. Given that the Standard Model relies on an uncertain platform, I employ a framework to help examine its propositions and underpinning theories. I have selected Thagard’s (2005a) framework as an organising structure because it provides objective criteria against which any theory of cognition can be evaluated. In evaluating the Standard Model’s performance, I wield a range of progress perspectives in order to consider a wide field of possibilities. The review conducted in chapters three and four not only highlight previous approaches to determining theoretical progress, but also establish some common concepts and terminology that I use throughout the assessment.

Chapters five through nine utilise Thagard’s framework as a vehicle to critically evaluate the Standard Model. Thagard's criteria provide a way of comparing different explanations about how cognition works. Although the Standard Model does not seek to explain general cognition, it does try to explain how individuals think about religious concepts, including their acquisition, representation and transmission. I use Thagard's criteria as an organising guide for my analysis of the Standard Model's performance. For example, any theory of religious cognition must account for the mental representation of religious concepts, describe the way in which religious concepts solve and explain problems, show how the mind processes religious concepts, explain the unique character of religious practice, demonstrate consistency with the physiological...
operation of the brain, and clarify why religious beliefs exist in every culture but not in every individual mind.

Chapter five, ‘Representative Power of the Standard Model’, assesses the Model’s accounts of cognitive representations. A superior account explains numerous different types of religious representations, or as Thagard asked, “How much information can a particular kind of representation express?” (2005a, p. 15). The chapter explores the Standard Model’s position on religious representations, including, for example, minimally counterintuitive concepts and supernatural agents.

Building on representative power, and using Thagard’s second criterion, chapter six, ‘Computational Power of the Standard Model’, evaluates how well the Model describes the way religious representations are processed in the mind. Since the effectiveness of a given solution can be evaluated on the basis of speed and flexibility, faster computational processes that can solve problems in multiple domains are superior. Computational efficiency holds the key. The chapter focuses Standard Model claims about processing mechanisms, such as assumptions of domain-specificity and cognitive modularity, as well as agency inferences.

Chapter seven, ‘Psychological Plausibility of the Standard Model’, applies Thagard’s third criterion to consider the relationship between processing and religious practice. Psychological plausibility builds upon computational mechanisms by explaining the idiosyncratic ways in which religious practitioners think and act. In the absence of direct access to religious practitioners’ thoughts, chapter seven draws on anthropological accounts of religious activity, and in particular, the intersection of cognition and ritual performance.

Any explanation of the Standard Model’s account of religious representations, their processing, their translation into practice, and their unique psychological manifestation, relies on the brain’s structure and operation. Chapter eight, ‘Neurological Plausibility of the Standard Model’, employs Thagard’s fourth criterion to examine the Standard Model’s conception of the neural events underpinning religious cognition. The chapter introduces the neural correlates of religious cognition, from spiritual experience to prosaic thoughts.
As Thagard (2005a) observed, a theory describing how people think also has to work in practice. Chapter nine, ‘Practical Applicability of the Standard Model’, appraises the Model’s capacity to explain religious behaviour and non-behaviour by drawing on Thagard’s fifth and final criterion. The Standard Model’s propositions explain the acquisition, transmission, robustness, and durability of religious concepts. However, as Pyysiainen (2003b) observed, successful theory of religious cognition must also explain non-belief. In this chapter I address whether the Standard Model has sufficient flexibility to accommodate atheism as well as the vast and divergent range of belief sets that religious practitioners hold. A powerful explanatory framework should explain religious extremism as easily as atheism. Here I counter arguments by CSR advocates such as McCauley (2011) who, in my assessment, overplay assumptions about the naturalness of religion.

I have introduced two further criteria of my own. The first, in chapter ten, ‘Evolutionary Plausibility of the Standard Model’, speculates on the extent to which the Standard Model can be mapped against selection pressures. The chapter considers the evidence supporting the Standard Model’s proposition that religious concepts arrived as an evolutionary by-product, the accoutrement of mundane cognition and not the consequence of a specific adaptation, or of cultural or group selection. It also ventures further into the contentious issue of domain-specific devices and their modular nature. Finally, I explain the development and current composition of religious cognition in terms of biological selection.

My second criterion outlined in chapter eleven, ‘Integrative Power of the Standard Model’, explores the Model's capacity to assimilate evidence from different levels of explanation. The chapter focuses on the relations between different theory levels, including for example, the correspondence between representations, domain computation and neurological activity. I use McCauley’s typology (1986) of inter-theoretical relations, constituting explanatory pluralism, microreductive contexts, scientific evolution, and scientific revolutions, to organise the examination.

Chapter twelve, ‘The Standard Model of Religious Cognition: Thagard’s Criteria Assessment’ summarises and reviews my assessment of the Standard Model’s performance. On the back of this overarching assessment, in Chapter thirteen,
‘Theoretical Progress in Cognitive Science and the Standard Model’, I reconsider the utility of prominent philosophical accounts of progress in light of the Standard Model case. This in turn leads to a final commentary regarding the Standard Model as a research program, which is undertaken in chapter fourteen, ‘The Standard Model of Religious Cognition: Progress in the Program’. Finally, in chapter fifteen, ‘Conclusion and Final Comments’, I summarise the position I have taken in this dissertation, as well as final theoretical, philosophical and practical implications.

Conclusion

In this chapter I introduced the aims and objectives of this work, namely to i) specify the Standard Model’s features and empirical strength; ii) employ notions of scientific and theoretical progress to reflect on the future of the Standard Model as a framework for understanding religious cognition; and iii) consider the lessons the Standard Model reveals as a case study concerning the philosophy of scientific and theoretical progress. I provided a detailed summary of the position taken by advocates of the cognitive science of religion. I also outlined the structural and methodological approach I have employed.

Central to my later analyses, in this chapter I introduced the platform assumptions common to the cognitive examination of religion. I arrived at seven propositions cohering around my interpretation of what Boyer (2003, p. 3) termed the ‘Standard Model’ of religious cognition. Boyer (2003, p. 3) claimed that the Standard Model describes the recurrent features of mental representations about religious concepts held in roughly similar forms across cultures. Although I identified seven propositions for religious cognition as the platform of the Standard Model, I acknowledged that other propositions appear in work on religious cognition. However, I tried to establish some commonalities around the foundational views that enjoy the greatest consensus amongst cognitive scientists. In the next chapter, I provide the background to my analysis of the Standard Model’s scientific progress with the aim of highlighting the key concepts and issues salient to this case in preparation for the a more detailed exploration in chapters three and four.
Chapter 2. The Analysis of Scientific Progress and the Cognitive Science of Religion

Introduction
To summarise my opening remarks, to the cognitive scientist aligned to the Standard Model, some of the mind’s many cognitive devices have side-effects conducive to religious thought and practice. These cognitive devices and resultant side-effects interact in mutually reinforcing ways. In fact, the collective impact has delivered common religious patterns across all human cultures, even though they manifest in divergent preferences and behaviours (Boyer 2001, Ch. 1). From the perspective of religious cognition, the most powerful cognitive devices animate social behaviour, emotional connection, the ability to assign agency to events, make inferences about the thoughts of others, and establish universal moral suppositions. Together these cognitive devices create patterns of behaviour, of which religion presents a prototypical example.

The legacies of several specific approaches to understanding cognition feature heavily in the cognitive science of religion and the Standard Model. I argue in this chapter that the performance of these theoretical claims will prove critical in deciding the fate of the Standard Model. As with all science, progress relies on the past for its future. This chapter therefore serves as a foundation by outlining and justifying the inclusion of key notions associated with progress from the philosophy of science. While the explicit assumptions underpinning the Standard Model are about the content of science, I use this chapter to tease out the more tacit assumptions related to the best ways of achieving progress. The latter I examine in detail in the following two chapters focused on the philosophy of scientific progress.

Making Progress in the Standard Model of Religious Cognition
One approach to assessing scientific progress involves studying research over time in historically-sensitive frameworks or structures, described variously as ‘paradigms’ (Kuhn 1962), ‘research programs’ (Lakatos 1970), ‘research traditions’ (Laudan 1977), and ‘themes of science’ (Holton 1988). Accordingly, progress in a research tradition depends upon the vagaries of its historical circumstances. Laudan (1977, p. 97) commented, for example, that no research tradition had ever “… been characterized by a permanent series of principles during all its evolution.” The philosophers of science
noted above would claim that any analysis of the Standard Model represents a ‘snapshot’ of progress in time. They would not, however, agree on the best indicators of the Standard Model’s success, potential, status or progressivity as a research program, or even if it constitutes a program at all.

Bird (2007, p. 64) attempted to consolidate the various approaches to characterising progress under a tripartite model. First, the epistemic approach takes knowledge as the central feature. Second, the semantic approach takes truth or verisimilitude as the central feature. Third, the functional-internalist approach takes fulfilling functions and solving problems as the central feature. Bird (2007, p. 68) noted that the epistemic and semantic approaches can coincide when solving a scientific puzzle means acquiring a certain sort of knowledge. After all, scientific knowledge provides solutions to problems. However, he concluded that the epistemic approach, which gives precedent to the accumulation of knowledge, remains the superior measure of progress.

For my purposes, I think that scientific progress may be usefully viewed from two positions. First, progress represents an evaluative criterion used for assessing the success or momentum of a research program. Progress serves as a decision-making tool and may help in identifying the most promising areas of research activity or the most intractable problems. The evaluative approach excels when differentiating between competing research programs or theories dealing with a common research problem. Progress assumes a decisive role in choices about theory and data. Second, progress can be used to analyse the relations between aspects of a research program or competing programs. For example, criteria associated with performance help specify the relations between parts within or between research programs. Both of these positions combine Bird's epistemic and functional-internalist approaches.

I examine progress in the evaluative form through Thagard’s criteria, deconstructing the key propositions, arguments and evidence for the Standard Model. Towards the second form of progress, I analyse the relations between theory and data from various disciplines as they tackle aspects of religious cognition from different angles. In the first form of progress I deal with the intra-level possibilities of evolution or revolution in the Standard Model. In the second form of progress I deal with the inter-level issue of reduction or irreducibility and the connections between disciplinary theories and
approaches. Shortly, I shall indicate why both intra- and inter-level issues of progress demand attention, and where they intersect with conceptions of progressivity in research programs.

One prominent view, argued by Lakatos (1970), claimed that progressivity comes in the form of empirical success where a superseding theory explains more content than its predecessor. More recent, tighter variations suggest that a new theory should also accommodate fewer anomalies than its predecessor (Kuipers 2000), while providing greater approximate explanation by correcting flawed consequences of the earlier theory (Nowakowa and Nowak 2000). Following the empirical growth tradition, Holton (1988) viewed progress as the accumulation of thematic ideas about a domain, revealed through its unique methodological approaches and expressed in categorical structures, principles and facts. Taking a further step, Kitcher (1993) proposed that successful theories unify empirical content from different domains; progress ventures beyond expansion incorporating synthesis and integration. Perhaps, as Niiniluoto (1999) suggested, in a contemporary twist on Occam’s Razor, progress occurs when theories explain more using less structure.

An alternative perspective on increasing empirical content arrived with Laudan’s (1977) historically-sensitive, problem-based interpretation of progress. Laudan emphasised the theoretical opportunities attached to major scientific problems because they structure and define a research tradition. He claimed that anomalies cannot simply be reduced to contradictions between theoretical knowledge and its empirical foundation (p. 24). In fact, anomalies present the most compelling problems to focus upon. Progress, according to Laudan, corresponds to the problem-solving ability of a research program and its theories, leading to an estimation of its success.

The implications for scientific theory change and progress assessments depend upon the approach employed, whether prioritising Lakatos, Laudan or others. As a result, I will not use one approach exclusively as I seek a broad assessment and interpretation of the Standard Model. I argue that wielding numerous, sometimes competing accounts of progress, will lead to a more balanced conclusion.
A problem in establishing progress in a scientific program lies with the apparent futility of new theory development. Lakatos (1970, p. 5) observed, for example, that all theories are born refuted. Countless theories once accepted have now been discarded. The history of science seems to inductively suggest that current theories, and even their more comprehensive successors, will end up on the scrapheap. It is easy to see why some philosophers of science avoid endorsing conceptions of progress involving theories as closer approximations to the truth.

Of the many issues and implications associated with scientific progress, I will not tackle the realism debate. Scientific realists think that theories describe reality and possess a truth value. For example, even flawed theories may be valuable to a research program if they present a closer approximation to ‘truth’ than rival theories. Furthermore, observational data provide a crucible in which theories are fired. While some realists hold that progress reflects an ‘accumulation of truths’, some non-cumulative accounts of progress prefer the notion of ‘truthlikeness’. Popper’s (1972) interpretation of truthlikeness, or verisimilitude, defined progress in terms of a theory’s proximity to truth, measured by comprehensiveness. Another version preferred by van Fraassen (1980) proposes that true observational statements are empirically confirmed but not reflective of ‘truth’ in the larger, theoretical sense. On this account, progress accompanies greater empirical content.

Kuhn (1962) avoided the idea of truth by conceptualising science as a problem-solving venture. He argued that ‘normal’ science proceeds within paradigms towards the cumulative resolution of problems. Periodically, paradigms accumulate a critical mass of anomalies. At this point, the existing paradigm is replaced through a ‘revolution’, which displays progress because more problems get solved through the new paradigm. Although Kuhn provided some signposts for progress, he did not go as far as Laudan (1977), who suggested that any given theory’s problem-solving effectiveness should be assessed on the basis of the number and significance of empirical problems it resolves, minus those it causes. Scientific progress, in Laudan’s estimation, reflects the operationalisation of this formula.

Given the range of assumptions about scientific and theoretical progress, I introduce McCauley’s (1986) typology of inter-theoretic relations to help differentiate between
versions of progress. The typology employs two fixed dimensions especially pertinent to the Standard Model case. According to McCauley, theory development must overtly or tacitly presuppose distinctions between levels of analysis or context, and between levels of continuity. By inter-theoretic context, McCauley means that a theory can relate to either a single analytical level (intra-level) or multiple levels (inter-level). For example, a theory would fall into the intra-level category if it were concerned only with a phenomenon—in this case religious thought—at a single level of analysis, like the neuroscientific level. However, an inter-level theory incorporates multiple levels of analysis like neuroscience and psychology. In this way, a differentiation can be made on the basis of the context (or levels) at which a theory applies. I argue that this form of differentiation is essential to any account of progress aiming to deal with phenomena targeted by more than one discipline or interpretive lens.

McCauley presented a second dimension he labelled theoretic continuity. A new theory will relate to existing theories with either low or high continuity. With little or no continuity, the new theory will replace an existing theory with limited or no overlap between the two in a kind of Kuhnian revolution. With high levels of continuity, a new theory will build upon or correct the deficiencies of an existing one in an incremental or evolutionary fashion. The evolutionary development of theories corresponds more with Lakatos' conceptualisation of progress in research programs.

Inter-level theoretic relations may also experience low or high continuity. With low continuity comes multiple and disparate theories explaining the same phenomenon. Any new theory will neither replace nor build upon others. In contrast, high continuity means that theory relations at different levels of analysis arrive in connections and intersections, potentially at least, (partially) reductive in nature. When a theory shows high continuity between inter-level contexts, progress arrives when it can provide more and deeper links between numerous levels of analysis.

Lakatos (1970, p. 132) suggested that scientific progress accompanies continuity between successive accounts held together by a consistent research program providing methodological rules that act as ‘positive heuristics’ advising what should be pursued, as well as what should be avoided in the form of ‘negative heuristics’. Progressive research programs contain a ‘hard core’ (p. 133), constituting its almost inviolable
theoretical principles. In practice, a hard core resists falsification because it tends to generate outcomes congruous with its predictions. Accordingly, the real work occurs at the periphery, or what Lakatos called the ‘protective belt’. Here, assumptions can be modified in light of observations and correspondence to hard core predictions. While the protective belt comprises refutable aspects of the research program, progress comes when modifications strengthen the hard core, leading to a “consistently progressive theoretical shift” (p. 134). With each step greater empirical content supports the hard core, some of which might even be retrospectively corroborated, displaying a “consistently progressive empirical shift” (p. 134). As a result, a research program's progress is measured by its ability to generate novel predictions confirmed by empirical evidence. A progressive research program also preserves and strengthens its hard core, providing ongoing consistency in its methodological approach. Conversely, degenerating research programs cannot sustain a stable hard core, fail to make novel predictions, and/or cannot verify them. Degenerating programs fall vulnerable to replacement in Lakatos’ less dramatic version of a Kuhnian revolution; a form of progress McCauley classifies as low continuity.

I argue that a thorough account of progress demands an account of inter-theoretic relations through context and continuity; between successive theories, and between different levels of analysis. The demarcation exposes often hidden assumptions about theoretic relations central to evaluating progress.

McCauley's theoretical relations help reveal the important variables associated with progress. At an inter-level context, theory develops within the same analytical level, while at an intra-level context, theory transgresses the boundaries of a single level. Thus, McCauley's typology specifies that theoretical progress can occur in four forms, from the intra-level perspective of scientific evolution (high continuity) and revolution (low continuity), to the inter-level perspective of microreductive contexts (high continuity) and explanatory pluralism (low continuity). McCauley's typology shows that progress must be assessed relative to the analytical level and the process of theory development/replacement. I argue that the inter-level context should be of primary concern to the Standard Model despite the fact that it has received less attention in the literature than the debate about intra-level evolution or revolution. For example, an impressive measure of the Standard Model's progress would be an ability to connect
previously unconnected observations, facts and theories acquired from different analytical levels. On my assessment, the Standard Model shows signs of some victories as a unifying explanatory framework, even if it is through what Stepin (2005, p. xiii) described as “paradigmatic grafting” from one science to another. In fact, Stepin conceived of scientific programs as complex systems where progress transpires without internal crisis, instead due to interactions between disciplines.

I suspect that the domain level offers the most revealing unit of progress analysis, even if theories and research programs dominate thinking; an observation driven by my conclusion that inter-level theory connections through domains, or key phenomenon or problems, such as religious cognition, drive progress in multi-disciplinary pursuits. Shapere’s (1974) formulation of a scientific field has relevance here, where the eventual ordered array of theoretical and empirical knowledge begins without coherence, but assumes structure as blocks of information connect. Shapere (1982, pp. 178-182) later employed the notion of domains to point out that theories tend to be assessed on how well they account for problems within their own domains. Scientific knowledge is shaped by existing and dominant domains because “… method not only determines the course of science, but is itself shaped by the knowledge attained in that enterprise” (Shapere 1982, p. 181). Similarly, as Hooker (1975, pp. 153-155) observed, scientific fields or ‘theoretical worldviews’, influence the conditions of observation, instrumentation and interpretation. In an escalating structure, well-defined conceptual categories inspire theories and methods, which in turn inform experiments and observations. I note that the reciprocal effects of worldview and method appear in the development of the Standard Model. The impact generates a cognate structure, but unhelpfully overlooks evidence from other fields.

With inter-level theoretical progress in mind, I pay particular attention to theories examining cognition from different explanatory levels such as neuroscience and anthropology. The evidence from other level accounts of religious cognition plays a role in corroborating Standard Model predictions. My forthcoming analysis introduces numerous analytical levels, with particular emphasis on psychological, anthropological, biological and neuroscientific perspectives.
Since inter-level theories describe a phenomenon from numerous explanatory levels, I pay special attention to the Standard Model’s flexibility. I consider the likelihood that the Standard Model will generate an inter-field theory of religious cognition that unites previously unconnected theories through a common point of explanation. Hardcastle’s (1996) presentation of theory-building in cognitive science plays a role in my examination of theoretical inter-connections. Her account emphasises the heuristic role of theoretical principles and the utility of explanatory extensions between promising, but unconnected theories. As I later observe, the Standard Model will not necessarily fail without a reductive account of religious cognition.

While Hardcastle thinks progress comes with more connections between theories at different analytical levels, facilitated by explanatory extensions, greater theoretical unification would also provide a powerful measure of progress. For example, progress would be noteworthy where the Standard Model unifies two or more previously unconnected theories from different levels. A weaker interpretation views unification as a matter of degree. Two theories become more unified as they become more inter-dependent. As a result, I also document inter-level connections as evidence of potential theoretical unification.

Inter-level reduction remains an obstacle in cognitive science. In the context of religious cognition, reduction would explain the psychological experience of religious thought through neurological processes. When inter-theoretic reduction seeks to explain higher level phenomena through lower level phenomena, paradigms and methodologies may not necessarily align. A lack of correspondence between different ways of explaining the same phenomenon complicates, and sometimes precludes, reduction. I consider whether a theory of religious cognition could ever lead to a one-to-one correspondence between the physical and mental. Correspondence could eventuate in a physical to mental mapping where psychological states are cast aside in favour of explanatory physical conditions.

I also consider the possibility that inter-field theories can create overarching and non-reductionist heuristics, or can identify the theories that should be discarded amongst a set of plausible options. I suggest that the Standard Model represents a plausible candidate as an inter-field theory.
Progress faces an ever-present paradox in inter-disciplinary fields like cognitive science. Locating interactions and connections between disciplines is constrained by the necessity of their specialisation. In order for empirical work to occur at a sufficiently detailed level, disciplines sub-divide into specialisations. However, specialisation also means isolation, and therefore restricted opportunities for observing theoretical intersections. For theories that do successfully cross disciplinary boundaries, relations must extend into and between at least two theories. I head into the analysis aware of varying perspectives on strongly integrated inter-disciplinary theories of cognition. As I will show in chapter three, inter-disciplinary theories in cognitive science can include anything from general heuristics to reduction-based unification. The most common middle ground holds that inter-disciplinary theory connections mark theoretical progress in cognitive science, but they tend to be messy, non-reductionist affairs exemplified by incomplete, tangential inter-connections. My examination of theoretical progress in the Standard Model wrestles with the degree to which integration is attempted, and the degree to which the integration reduces, unifies, explains, or eliminates. I come down on side with Hardcastle and her presentation of complex, inter-level connections and the bridging efforts needed to make them work. For the Standard Model, I see a future characterised by inter-connections uncovered by the framework, rather than the unification of inter-level explanations.

It becomes obvious early in the examination of the Standard Model that the unit of analysis can easily become ambiguous. The term ‘proposition’ is used in its conventional rather than philosophical sense. Although the propositions I offered in the previous chapter collectively shape the research program, they do not define it or enforce non-permeable boundaries around it like the presence of statements containing non-eliminable theoretical components. In addition, the seven propositions inter-link and overlap, making their separation and individual analysis troublesome, possibly even unfair. I therefore examine the performance of the Standard Model, using Thagard’s criteria for structure. This approach allows me to characterise the overall performance of the Standard Model rather than reduce it to sub-theoretic components. It also assists in my objective of assessing the overarching performance of the research program, and in speculating about its potential.
Theories and Research Programs as Units of Analyses

Analysing research programs means charting the longitudinal productivity of work around a particular domain. When looking at scientific activity as a research program it is helpful to differentiate between four ideal kinds of programs: descriptive, explanatory, design and explicative (Kuipers 2007, p. 2). Descriptive programs describe a domain of phenomena through observable facts acquired through experimentation. Explanatory programs go a step further aiming for predictions about observable facts. As a result, explanatory programs favour deductive methods, building upon or aside descriptive programs. Numerous, potentially competing, explanatory programs may even emerge from a common descriptive foundation. Design programs involve the conception or construction of physical products and have less relevance to my work with the Standard Model. Explicative programs focus on concept exposition and tend to involve disciplines such as pure mathematics or philosophy. For my purposes, the Standard Model research program represents a combination of description and explanation. In the next chapter, I apply Kuipers (2007, p. 63) suggestion that research programs contain five components including a domain, problem, idea, heuristic, and model. Given that these components escalate, they also represent five qualitative measures of strength in research programs.

In order to understand a research program's potential for scientific progress, several additional elements also warrant study. Kuipers (2007, p. 12-14) provides some useful definitions which help to differentiate between terms. He specified that an observational hypothesis is a law-like statement not containing theoretical terms. An observational theory is a coherent set of observational hypotheses where, to become a ‘proper theory’ (Kuipers 2007, p. 13), the hypotheses contain at least one non-eliminable theoretical term. Furthermore, a strong theory may be claimed against a weak theory on the basis of a superior claim to completeness, where the hypotheses' formulation for a certain domain hold as the (relatively) strongest possible.

Experimental laws or hypotheses may also be distinguished from theories. Theories use theoretical, non-eliminable terms to explain hypotheses (Nagel 1961). However, in practice, separating the two seems troublesome as it demands theory-free observation. For my purposes, I find Kuipers’ approach more helpful because it accepts that collectively hypotheses and theories must stand in light of empirical observation. This
view also seems consistent with Harman’s (1965) argument that inductive inference is inference to the best explanation. A hypothesis or a theory becomes worthy of support when it provides the best explanation of the evidence. Thagard (1978, pp. 79) added three criteria to bolster the choice of best explanation. First, consilience helps to ascertain how much a theory explains. A superior theory explains more evidence than competitors, and a “maximally consilient hypothesis or theory explains any fact whatsoever” (p. 85). Second, simplicity marks a superior hypothesis or theory where it offers greater informativeness than alternatives with less additional explanation. A simpler explanation needs fewer initial conditions in deducing an explanandum from the hypothesis than competitors. Third, analogy helps reveal the best explanation because it appeals to similar kinds, where one hypothesis or theory relates to another in contiguous or associated fields.

Of course, numerous and sometimes divergent positions can be found about the best ways to assess hypothesis and theory performance. Popper (1963, pp. 33-39) provided a classic benchmark claiming that every genuine theory test involves an attempt at falsification. Popper argued that measuring the scientific status of a theory relies upon testing with the intent to refute. Others believe that sound theories possess certain key characteristics. Kitcher (1982, pp. 46-47), for example, proposed that better theories: 1) are unified, in that a single set of problem-solving strategies resolves a large set of problems; 2) are fecund, in that they open up new lines of inquiry and stimulate productivity, and 3) contain auxiliary hypotheses that can be tested independently of the problem it was devised to resolve. Similarly, Watkins (1989, p. 6) argued that science aims to develop deeper, more unified theories delivering greater predictive power than their rivals.

Kuhn (1977, pp. 320-339) also took a criteria-based approach, defending five criteria for informing theory evaluation. Although he did not use the term progress, Kuhn (1977) argued that theoretical knowledge can be seen through: 1) exactness of a theory (theory consequences must be in accord with experiments and observations); 2) consistency; 3) a broadening field of application (the consequences of theory must venture beyond the limits of the facts that the theory originally intended to explain; and 4) fruitfulness (the theory’s ability to uncover new events and correlations not previously anticipated). However, Kuhn acknowledged an imprecision in his five
criteria, leaving them subject to individual interpretation where “two men fully committed to the same list of criteria for choice may nevertheless reach different conclusions” (1977, p. 324). To Kuhn, his criteria perform like influencing values rather than as rules governing theory choice. Perhaps Niiniluoto’s (2007, p. 182-193) 10 ‘basic virtues’ of a theory offers the most comprehensive taxonomy of evaluative criteria available. However, his list like Kuhn’s, seem vulnerable to inconsistent measurement and interpretation. Equally, I think the virtues worthy of reproduction here because they provide an inclusive inventory of assessment perspectives.

Niiniluoto (2007, p. 182-193) claimed that a theory should possess the following virtues: 1) consistency in that it contains no internal contradictions; 2) truth in that there is a correspondence between reality and its interpretation; 3) probability in that there is a low likelihood that the empirical content represented by the theory was the result of chance, and that there can be a rational degree of belief in a given hypothesis based on the available empirical evidence; 4) information content in that a large content is needed to defend hypotheses that are falsifiable; 5) empirical content and empirical success in that the theory should contain some empirical claims that can be validated by observation leading to empirical success; 6) explanatory and predictive power in that the statements and laws provided by a theory explain phenomena and make correct, new predictions about phenomena without the aid of empirical content; 7) problem-solving capacity in that practical scientific problems are resolved as a consequence of a theory; 8) simplicity in that the theory is economical and parsimonious; 9) accuracy in that the predictions made are accurate relative to empirical observations; and 10) approximate truth and truthlikeness in that the theory has greater relative correspondence to the truth than previous versions.

In contrast, Laudan (1981, pp. 144-145) counselled that history reveals that the previous measures fail in practice. He noted that 1) theory transitions are often non-cumulative, 2) theories are not discarded because of anomalies nor accepted because of confirmation, 3) theories are changed due on conceptual grounds as much as empirical support, 4) that the principles of scientific rationality are unfixed and fluid, 5) that there is broad array of approaches to science fitting in the middle ground between acceptance and rejection of a given theory, 6) there is a broad middle ground between laws and conceptual frameworks, 7) approximate truth is so hard to define that it makes an
Implausible scientific aim, and 8) that the co-existence of rival theories is a rule rather than the exception making theory evaluation a comparative rather than absolute process. Laudan concluded that science progresses to the extent that successive theories solve more problems than their predecessors.

In the course of examining the propositions advocated by the Standard Model under Thagard’s functional criteria, I will address each of the previous approaches to progress. A summary table of my conclusions also appears in Appendix B.

**Conclusion**

According to Kuipers (2007, p. 63), research programs contain five components including a domain, problem, idea, heuristic, and model. They help summarise the Standard Model’s claims. For example, the scope or domain of the program concerns the properties of religious cognition. Consequently, the key problem lies in revealing the content, organisation, and spread of religious phenomena using the idea that religious belief and activity are contingent upon the cognitive apparatus upon which they operate. In fact, religious beliefs are relatively easy to acquire, keep and pass along because they engage supportive cognitive devices. The seven propositions I presented specify the operation of cognitive devices upon religious thought, and act as heuristics generating empirical predictions to be tested. Collectively, the domain, problem, idea and heuristics specify the Standard Model, or what I consider the dominant explanatory framework for the cognitive science of religion.

I argue throughout the forthcoming chapters that the Standard Model can also be usefully presented in a neo-Lakatosian form, including a hard core and protective belt. The core comprises basic assumptions employed to construct theories and hypotheses. The less certain zone of theorising consists of a middle-level protective belt of propositions designed to direct empirical activity. On this view, the protective belt serves as a link between new empirical work and the already established assumptions. Over time, a ‘progressive’ research program’s core expands to encompass more of the protective belt, while new predictions arise at the periphery. I find a Lakatosian-style formulation helpful because my analysis suggests that the Standard Model’s propositions are employed as Lakatosian hypotheses, generating predictions and empirical content. In fact, the Standard Model treats the fundamental assumptions of
cognitive science—incorporating a computational-representational view of the mind, domain-specific cognitive devices, and a functionalist worldview—as the hard core. I suspect that a strict interpretation of a Lakatosian hard core would actually look more like the Standard Model’s propositions, which operate like theories. This is one of the reasons why I conclude that the Standard Model uses a softer core more like Hardcastle’s (1996) principles and with an application more like Kuiper’s (2007) heuristics.

Next, however, I introduce the concepts and general analytical tools that will aid in my consideration of both scientific and theoretical progress. The following chapter provides a sketch of relevant notions in scientific progress, while chapter four presents those views pertinent to theoretical connections at multiple levels of analysis.
Chapter 3. Approaches to Theoretic and Scientific Progress: Paradigms and Unification

Introduction

In this chapter I address the notions of scientific progress in general, and theoretical progress in particular. I review a range of accounts and foreshadow how each might prove useful in my assessment of the Standard Model. Naturally, progress can be interpreted in different ways as a result of adopting different assumptions. For my purposes, a versatile conceptualisation of progress helps ensure balance in my analysis. I employ numerous accounts and versions of progress to frame the Standard Model’s future, and to use the case evidence to temper philosophical conceptualisations of progress. Where this chapter examines general perspectives on progress, the next chapter focuses on accounts and versions of inter-theoretical progress, leading into my examination of the Standard Model informed by Thagard’s criteria. This chapter and the next lay important groundwork since I conclude that progress in inter-disciplinary research can be measured by an explanatory framework capable of highlighting previously unconnected theories from different analytical levels.

A comment on terminology is warranted. Both scientific and theoretical progress can be described with a seemingly endless variety of terms, each advancing a different perspective. For example, scientific progress can be described in terms of change and transitions, new developments, increases in quantity or quality of theories, volume of empirical activity, the formation of new fields and disciplines, practical impact, and levels of knowledge. However, I am most interested in two kinds of progress. First, progress in a scientific program, with an emphasis on the development of an explanatory framework around a general problem. Second, theoretical progress, which implies an interest in a cognitive, knowledge-based set of explanatory statements dealing with a specific problem. A complication is that theoretical progress may be considered a subset of a program’s progress. The success or failure of key theories will influence the future of a research program.

In a colloquial sense the term ‘progress’ implies a sequential and upward-directed succession of stages where each is superior to its predecessor. Losee (2004, p. 1) observed that it is almost uncontroversial to claim that science automatically progresses,
containing an inherent ‘goodness’ about the process that increases over time. Yet, the
nature of this progress and goodness remains a matter of substantial dispute as it applies
to programs and their constituent theories. For the moment, I use the term theory in line
with Greenwald et al. (1986, p. 217) to mean statements about problems or phenomena
that express relationships among concepts. A statement becomes theoretical to the
extent that it generalises beyond its supporting operations or procedures for
measurement. However, assumptions about theoretical progress expose several pivot-
points of controversy that defy simple definitions.

First, disagreement rages over whether theories make true statements about phenomena
that exist objectively. Assumptions of realism also imply a progressive aspect to science
where newer theories treat older ones as approximations that require correction or
clarification (Rosenberg, 2005, p. 70).

Second, disputes continue over the nature of theory change or replacement, whether
smooth and continuous or abrupt and radical. The former suggests that newer theories
fluidly update their predecessors, while the latter assumes that newer theories
undermine previous ones. Losee (2004, p. 4) argued that at the extremes, progress may
either be incremental or discontinuous. Those who subscribe to the former focus on the
gradual incorporation of past achievements into current theories. For adherents to the
latter, current theories become consumed by the revolutionary developments of superior
competitors.

Third, contention revolves around the level at which theories undergo change or
replacement. One extreme expects older theories to be replaced by newer theories at the
same descriptive or analytical level. The other extreme presumes that theoretical
progress transpires when a diverse group of phenomena are described by a smaller
number of fundamental principles. On this treatment, progress accompanies the
reduction of one theory to another operating at a lower-level. Lower-level theories
therefore unify by explaining higher levels of empirical observation.

The first disagreement about realism reflects important metaphysical assumptions about
science. However, my analysis will remain silent on this issue. My focus instead will be
on continuity and level of theoretical change. In fact, the way theories change at the
same analytical level, and connect at different analytical levels, will comprise central themes in my examination of the Standard Model’s progress as a scientific program. These two aspects of theoretical progress form a prominent part of this chapter and the next.

The following part of this chapter examines progress and paradigms. In this section I review the arguments for continuous and discontinuous theory change. I discuss the view that the criteria used for theory appraisal stand relative to the paradigm hosting the theory. In this case study, a ‘paradigm’ perspective highlights the inextricable relationship between the Standard Model and its underpinning cognitive science paradigm, a point I revisit in various forms throughout this work. I also make special mention of the potential tensions that exist between the cognitive science paradigm and competing interpretations of cognitive mechanisms. The paradigms discussion leads to the final part of the chapter, which discusses incommensurability and its potential to obstruct progress in a multi-disciplinary framework such as the Standard Model.

**Progress and Paradigms**

Kuhn’s (1996[1962]) *Structure of Scientific Revolutions* argues that the structure of scientific development relies upon a series of fundamental assumptions, all of which invoke the importance of historical activity and a foundation of received beliefs. Within this context ‘normal science’ unfolds. Research may lead to an inadvertent suppression of novelty during an “attempt to force nature into the conceptual boxes supplied by professional education” (p. 5). However, a shift occurs in shared assumptions when anomalies, which cannot be contained within the predominant conceptual boxes, begin to subvert the existing tradition of theoretical doctrine. Such shifts Kuhn labelled scientific revolutions. Part of my interest in paradigms revolves around whether the Standard Model will deliver a form of revolution.

Underpinning ‘normal science’, paradigms display the achievements of a particular scientific community, which become the foundation for its practice: “The successive transition from one paradigm to another via revolution is the usual developmental pattern of mature science” (Kuhn 1962, p. 12). Moreover, transitions reflect significant upheavals because they abandon a shared paradigm of scientific practice. As a result, a discipline relinquishes its conventional and traditional avenues of inquiry that had
formerly provided an “intertwined theoretical and methodological belief that permits selection, evaluation, and criticism” (pp. 16-17). Initially paradigms suffer severe limits, capable of resolving only some problems. However, over time they either become more comprehensive or start to reveal serious anomalies that eventually encourage competing paradigms. Kuhn argued that paradigms guide the puzzle-solving processes associated with normal science. These include the determination of facts, the matching of facts with theory, the articulation or application of theory, and ultimately, the re-formulation of theory or its abandonment at the hands of a new paradigm that solves more problems than the current theory.

Challenges to paradigms arrive in the form of new theories attempting to resolve anomalies that the prevailing paradigm cannot adequately explain. As the failure of a paradigm to satisfactorily explain anomalies grows, a crisis point emerges offering an opportunity for a new paradigm to bring about a scientific revolution, “a noncumulative developmental episode in which an older paradigm is replaced in whole or in part by an incompatible new one” (p. 92). Kuhn viewed crises as the ‘essential tension’ driving scientific research.

On Kuhn’s view, two competing paradigms cannot be reconciled. Fundamentally incompatible, the acceptance of a new paradigm demands the renunciation of an older one. Where normal science within a paradigm is cumulative, scientific revolution between paradigms is transformative. Kuhn observed that the “normal-scientific tradition that emerges from a scientific revolution is not only incompatible but often actually incommensurable with that which has gone before” (p. 103).

Kuhn considered science to be a succession of uneventful but incremental developments punctuated by periodic, revolutionary leaps. Thus, progress occurs during both ordinary and revolutionary periods. In contrast, Popper (1981) agreed that progress occurs through both revolution and incorporation, but held that progress occurs when any single episode achieves both incorporation and revolution. The former comes about through a new theory’s conflict with its predecessor, and the latter through the predecessor’s replacement.
Popper was reticent to discard a theory or model without a superior one to assume its place. One difficulty, however, lies with the complexity of religious cognition. For example, if religious cognition operates as more than one kind of phenomenon, then a replacement for the Standard Model will not come about until a replacement for the central propositions of a computational-representational version of cognition arrives. Another argument might suggest that a cognitive theory of religion challenges the dominant cultural and anthropological paradigms. The key question then becomes whether the Standard Model will constitute a revolution because it has solved anomalies that social scientific models cannot.

A Kuhnian position emphasises that any criterion used for theory appraisal will be relative to an overarching paradigm. This means that theories tend to face assessment against tests they will likely pass. For example, the Standard Model founds its position upon the cognitive science paradigm, using its assumptions as a platform to its propositions. According to Kuhn, puzzle-solving science limits itself by too much concern with explaining predetermined solutions. Paradigms run the risk of supplying their own answers: “The man who is striving to solve a problem defined by existing knowledge and technique is not just looking around. He knows what he wants to achieve, and he designs his instruments and directs his thoughts accordingly” (p. 96). As a result, my analysis pays attention to the potential tensions that exist between the cognitive science paradigm and competing interpretations of cognitive mechanisms. For this reason I introduce two criteria additional to Thagard’s, which specifically address the relations between cognitive interpretations of religion and others operating from different analytical levels and disciplinary paradigms.

Another approach would suggest that progress might arrive with incorporative development where the Standard Model evolves as a research program along the lines suggested by Lakatos (1970). He argued that a scientific research program consists of a core of axioms and principles along with an evolving set of hypotheses, adopted in applying the core. Within an existing research program, a constituent theory can only be eliminated by a superior theory. Such a superior theory would have to account for the successes of its predecessor, generate greater empirical content than its predecessor, and have some of its excess content corroborated. The Lakatosian viewpoint suggests that research programs are essential to progress. I later argue that the Standard Model does
not qualify as a Lakatosian program and should be regarded as a program ‘in the making’.

In my analysis, I strive to determine the degree to which the Standard Model relies upon the cognitive science paradigmatic position. In addition, I consider whether the Standard Model may be subverted if the cognitive science paradigm weakens. Equally, if the cognitive science paradigm strengthens, so too will the credibility of the Standard Model’s propositions. My analysis also reviews the Standard Model’s paradigmatic development. For example, although advocates claim that the Standard Model continues to increase in comprehensiveness, and in Kuhn’s words, its fruitfulness, chapters five through eleven uncover some serious anomalies. I highlight the extent to which such incompatibilities reflect paradigmatic disputation, as well as the Standard Model’s potential to adapt, or submit to, a contesting paradigm. To foreshadow a key finding, I question whether the Standard Model has presented a plausible theory accounting for the fundamental, practical problems of belief and non-belief. I further question the strength of the cognitive paradigm underpinning the Standard Model.

**Paradigmatic Incommensurability**

Kuhn’s (1996 [1962], pp. 1-9) perspective prioritises the replacement of a disciplinary matrix or ‘super-theory’ (Curd and Cover 1998, pp. 211-226) comprising exemplars, heuristics, ontological assumptions and methodological principles. According to Kuhn, rival paradigms cannot share their meanings due to an incommensurability of standards or vocabulary. The incommensurability thesis stipulates that the content of alternative scientific theories cannot be compared because they lack a common vocabulary (Sankey 1997, pp. 426-427). In this case study, incommensurability relates to the Standard Model’s ability to provide a unifying framework for previously divergent theories from different disciplinary and analytical levels. On the surface, some form of incommensurability would seem a potential challenge for the cognitive science of religion, which seeks to wield research and analysis from several disciplines including cognitive and behavioural psychology, neuroscience, computer science, philosophy and biology.

In contrast to Kuhn, Feyerabend (see for example 1981), thought that incommensurability constitutes a problem in the semantic variance of terms employed
to express different theories. Two theories may be considered incommensurate when the terms used to identify each also preclude their comparison. For Kuhn (1962), however, the problem goes well beyond terminology as the whole approach to a problem fails to align between rival paradigms, including standards of theory appraisal. Vocabulary still has relevance, but because meanings change between paradigms. Both Kuhn and Feyerabend, as anti-realists, discarded the idea of an independent and theory-neutral language that can be used in science across disciplines or paradigms. Lyotard (1984, p. xxiii) wrote: “To the extent that science does not restrict itself to stating useful regularities and seeks the truth [i.e. correspondence with ‘reality’], it is obliged to legitimate the rules of its own game.” But to observers such as Feyerabend, no such rules exist.

Incommensurability leads to serious consequences for science and its practice. First, incommensurability between two competing theories precludes their comparison and therefore a rational or empirical choice between them. Second, if competing theories offer different explanations or claims, how a progressive outcome might be achieved becomes uncertain.

A potential incommensurability problem might be found in fields not yet possessing the vocabulary or methods required to examine their own anomalies. In particular, emerging fields or problem-driven research programs face difficulties in evaluating theories that cannot be tested with conventional equipment and techniques. For example, neuroimaging methods in neuroscience, while improving rapidly, cannot report data on individual neuronal activity. As a result, the gap between cognition and neuronal activity may appear so distant as to give the impression of incommensurability between cognitive and neurological accounts, even though the problem is one of measurement. With adequate technological development to remove the temporary inconvenience of methodological incommensurability, theories that describe phenomena at different levels can be connected. I argue in later chapters that the Standard Model may provide some clues to facilitate such inter-connections, although I fall well short of declaring it a unifying framework. On the basis of this case analysis, the prospects for unification across different analytical strata appear unpromising.
Unification and Reduction

One prominent interpretation of theoretical progress in the form of unity and reduction emerged with the Vienna Circle’s logical positivists (Carnap 1934; Morris 1946; Nagel 1961; Neurath 1946). One aspect of logical positivism pertinent here holds that propositions in science should describe observable phenomena best summarised in terms of physical laws. Such a unificationist outlook assumes that science systematically reduces all phenomena to its most basic theoretical elements. In the end, progress will be revealed by fewer unifying theories. For example, Oppenheim and Putnam (1958) proposed a hierarchy of scientific theories ending only with the physics of particles. On this conception, not only are theories reducible from higher to lower levels, but there is also a structural relationship between different levels, like a kind of theoretical architecture. Similarly, Mayr (1982, pp. 61-65) described a form of constitutive hierarchies where units at a lower level combine to form units at a higher level with more complex properties and functions. However, not all versions of unification necessarily assume a metaphysical position involving a limited number of physical kinds. For example, Carnap (1934, pp. 44-56) advocated a unity of language and laws, where reduction plays a central role. Morris (1946, p. 515) even suggested that the unity of science movement could play an important interpreting and clarifying role in cultural problems.

Unificationism according to Moss (2001, p. 2), takes the view that the social sciences inadequately explain human behaviour at a lower theoretical level. In fact, some unificationists claim that the social and human sciences cannot be considered ‘science’, and fail to align with the methods of physics, chemistry, neuroscience and molecular biology. For example, E.O. Wilson (1998, p. 6) observed, “The ongoing fragmentation of knowledge and the resulting chaos in philosophy are not reflections of the real world, but are artifacts of scholarship.” In the end, all phenomena must be reducible to the same scientific theories.

In Wilson’s estimation, the essence of all systematic inquiry, thrown together under the heading of science, is method rather than knowledge or dogma. He wrote: “Science is the organized, systematic enterprise that gathers knowledge about the world and condenses the knowledge into testable laws and principles” (1998, p. 57). Accordingly, two features distinguish scientific endeavours from the non-scientific. First, science
elicits knowledge that can be repeatedly demonstrated; selectivity plays no role. Second, science produces measurable outcomes. Furthermore, according to Wilson, scientists can assess the strength of theories on the basis of four qualities. First, parsimony refers to a complete theory, explained using the fewest units or processes. Strong theories possess an economy in that they are as simple and efficient as possible. Second, generality refers to a theory’s coverage, where the more it explains, the stronger its claim to accuracy. Third, consilience concerns the relationship between the theory and those from other disciplines, where the more consistency between different areas the better. Finally, strong theories make predictions that have not yet been tested, but can be, thus providing an avenue for acquiring additional ‘hard’ evidence. From this perspective, unity and reduction feature at the core of progressive theory development. Wilson (1998, p. 58) proclaimed: “The love of complexity without reductionism makes art; the love of complexity with reductionism makes science.”

Fodor (1998) complained that Wilson fails to acknowledge the difference between vertical and horizontal consilience. The former, Fodor observed, exemplified in cases such as the molecular theory of heat, provides the paradigm for the unification argument. On the other hand, the more common scientific form of consilience is horizontal, where threads of different scientific disciplines at a common explanatory level become joined. For these inter-disciplinary connections, reduction does not need to be invoked. Fodor cited the robustness and flexibility of what he called the ‘hyphenated’ disciplines. He pointed out that these inter-connected disciplines produce more theories than there were prior to their formation. The web of causal explanation works sideways in extension, not up and down. As Bechtel’s (1993) analysis of post-war developments in cell biology concluded, reductionistic approaches to integration within the field ironically caused more fragmentation and disintegration, leading to even more fields and sub-fields.

By his own account, Fodor has little time for pluralism or relativism. He argued that scientific progress can be messy. Events and phenomena may well fall into patterns at both the micro level and at different levels of organisation. In his words, science demands an ‘ineliminable multiplicity’ of discourses in order to describe how things actually work. A heterogeneous world requires a heterogeneous description. Both, Fodor, speculated, might just be irreducible, a point of central implication for all work
in cognition as well as to my arguments for inter-level theoretical connections. In the next section I shift focus from reductionism to the notion of scientific disunity, which proposes an extreme view of anti-reductionism.

**Disunity of Science**

Arguably, no commentator in the philosophy of science has been more outspoken about the disunity of science than Feyerabend (1975). He remarked in the conclusion of *Against Method* that all methodologies have their limitations and that the only rule that survives is ‘anything goes’. While a literal portrayal of Feyerabend’s conception of science, this often-cited comment fails to capture the texture of the argument for which it stood. Feyerabend did consider science to be an anarchistic endeavour. But this did not mean that he thought science was a waste of time. However, Feyerabend did argue that scientific progress occurs independently from the imposition of law and order style rules to its conduct. Feyerabend provided numerous, detailed examples of historical cases in science where the relations between idea and action were not causally connected through rigid methodologies. Hence, ‘anything goes’ represented a liberation from an impossible constraint, rather than an endorsement of chaos and whim. It reflects an acceptance that science may progress in unexpected ways. Feyerabend’s militant view has inspired some softer contemporary perceptions of science as a creative pursuit. Wylie (2000, p. 220), for example, contended that scientists exploit both the integration and fragmentation of science, particularly when it comes to finding evidence for claims. The credibility of these claims is a by-product of a substantive “trade in tools and techniques, empirical insights, models, and theories … “ (Wylie, p. 227).

Several important assumptions reside behind Feyerabend’s thinking about how science should best wield its tools and analyses. Relevant to this work, Feyerabend maintained that theories play the decisive role in science. As a first step, Feyerabend rejected the consistency conditions typically associated with theory development; new hypotheses should not have to be consistent with accepted theories. In fact, hypotheses contradicting well-established theories offer the only way that certain kinds of evidence can be acquired. Taking this position to an extreme means that if a few contradictory hypotheses are a good thing for science, then lots of them must be even better. Thus, Feyerabend claimed that theory proliferation improves the prospects of theoretical progress. Equally, if theory proliferation leads to better theoretical outcomes, then unity
will do the opposite. As a corollary, the uniformity of science curtails the free agency of theoretical development. The more competing cognitive theories of religion, the better the winning theory will eventually have to be. Moreover, a proliferation of theories associated with the Standard Model provides greater confidence that some will prosper.

Feyerabend proposed that no theory ever agrees with all the facts of empirical observation and measurement. He concluded that more theories are better than fewer because competition leads to more robust theories in a kind of survival of the fittest. In addition, the history of ideas in science sometimes need to be challenged or laced with political or ideological agendas in order to challenge the comfortable status quo. Extreme though it may sound, Feyerabend (1975, p. 189) called for an ‘anarchistic epistemology’, wherein science makes no greater claim to truth than any other form of thought or inquiry.

Feyerabend would find an ally in Dupré (1993), who opened his book, *The Disunity of Things* with an unambiguous statement denying “that science constitutes, or could ever come to constitute, a single, unified project” (p. 1). Dupré rejected the deterministic view that the universe of material structure will ultimately become fully intelligible. In contrast, Dupré declared that science has uncovered a fundamentally disorderly universe. Science is not a project that might eventually be pieced together into a grand, unified synthesis. In addition, the absence of unity in science cannot be dismissed as a human intellectual limitation, or blamed on the magnitude of problems an under-developed science faces. Rather, Dupré contended, the disunity of science mirrors the disunity of the universe itself, or what he labelled the ‘disorder of things’. In a more recent work concerning biology and evolutionary psychology, Dupré (2001) argued for the empirical study of the mind, which he claims reveals no basis for reduction or unification.

Dupré’s ‘disorder of things’ relies on a criticism of scientific classification. Classification—the specification of different natural kinds of things in the world—has not yielded neat, orderly, unique or hierarchical arrangements. Dupré maintained that countless legitimate and objective ways of classifying things in the world could be developed. Even if this perspective is too radical, Dupré at least exposes a definitive problem for the Standard Model in distinguishing a specific, single kind of religious
cognition amongst a multiplicity of cognitive activities, mechanisms and corresponding labels. The case of the Standard Model reveals innumerable forms or kinds of religious cognition. Placing the overarching label of ‘religious cognition’ across them all may not prove sufficiently precise. In fact, an equally liberal pluralism across structural levels of organisation might also be worth entertaining. I find attractive the ground somewhere between extreme plurality and neat unity, arriving in the form of inter-field and inter-level theories. On this view, enough correspondence between theories occupying different levels helps to establish intersections, but not enough to lead to reductions. I explore inter-level relations and their role in this case in the next chapter, but for the moment McCauley’s (2007) classifications of cross-scientific relations provides a useful lead-in.

McCauley (2007, pp. 105-106) aimed to show that relations between theories and scientific disciplines are complex and cannot be captured in the traditional, neat models of reductionism or through ‘new wave’ reductionism. On the latter model, the reducing theory does not explain the reduced theory but rather explains an analogue of the reduced theory using the conceptual structures of the reducing theory. As a result, the reducing theory corrects the reduced theory while explaining a (close) version of it at the same time. But, according to McCauley, it is implausible that a single model can accommodate all cases of reduction. So, linear, logical empiricist-style reduction cannot capture the range of reductions possible, and neither can new wave models. Additional, more sensitive accounts of reduction such as explanatory pluralism and mechanistic explanation are needed, both of which I detail in the following chapter. For the Standard Model case, the implications from McCauley’s judgements relate to the nature and form in which progress can occur. Despite the range and strength of reductionism positions, most suggest that irreducibility of the mind would be a precipitous conclusion. In fact, the character and complexity of religious thought does not constitute an immovable obstacle in explaining mental experiences through neural operations.

**Conclusion**

I observed early in this chapter a need to distinguish between the various assumptions describing progress in science (Losee, 2004, p. 2). The important work revolves around identifying the conditions under which scientific progress occurs. In turn, these assumptions lead to guidance about how a scientific method should be structured, as
well as what comprises strong theories. In the first instance, what constitutes ‘good’ science depends upon whether incorporative or revolutionary views of progress receive favour. These two views represent assumptions about the nature of scientific ‘goodness’ that accompanies progress. An incorporative assumption views scientific progress as the convergent approximation to truth achieved by successive theories. In contrast, a revolutionary assumption assumes that scientific progress comes with improved problem-solving, achieved through successively replaced theories, irrespective of how well they relate to each other.

It might be uncontroversial to conclude that progression in science can variously be categorised as either incorporative or revolutionary. Progress sometimes accompanies the incremental aggregation of empirical data and the gradual improvement of key theories. Equally, episodes of revolution culminating in a supplanted disciplinary matrix can also be observed. The history of science reveals no easy formula for describing the conditions under which theory progress occurs. Nevertheless, I shall argue in later chapters that researchers connected to the Standard Model take an epistemological approach to progress.

On the other hand, the revolutionary replacement of a disciplinary matrix may not necessarily transpire as an all or nothing affair. As Losee (2004) observed, attempts to establish necessary or sufficient conditions defining either progressive incorporation or progressive revolution have been unsuccessful. For each proposed condition, the availability of counter-cases cannot be ignored. For my case study revolving around an emerging explanatory framework, or what perhaps might loosely be seen as a disciplinary matrix or research program ‘in the making’, the problem of inter-level theory relations also requires attention. A successful Standard Model must be capable of bridging both horizontal and vertical levels of cognitive analysis. In order to make an assessment, I will need to further consider the unity/reduction debate along with the implications of inter-disciplinary connections. Like E.O. Wilson, I ask whether the ‘fault-lines’ that separate branches of learning are impermanent contrivances ([E.O.] Wilson 2001, p.13).
Chapter 4. Approaches to Theoretic and Scientific Progress: Inter-theoretical Connections

Introduction
The first part of this chapter scrutinises a version of theoretical development directly relevant to the Standard Model, inter-field theories. I argue that inter-field theories provide a plausible mechanism describing how progress in developing research frameworks can be assessed. The approach favours connections between theories without reduction, allowing for the development of inter-theoretic relations between both the same and different levels of analysis. Such a possibility appears salient to the Standard Model given its reliance on multiple disciplines to provide corroborative evidence. However, the emergence of a general inter-field theory of cognition may just as easily undermine the propositions central to the Standard Model. Nevertheless, forging intersections between disparate theories under the Standard Model merits pursuit because success shows the model’s potential as an explanatory framework.

The middle part of the chapter introduces some additional, formative notions of progress pertinent to my claim that this case exposes a weakness in philosophical accounts accommodating theory relations, especially between analytical levels. I comment on the usefulness of problem-solving as a driver of theoretical progress, but conclude that resolving practical problems presents a troublesome measure for an emerging explanatory framework. Even though the Standard Model provides explanations for most religious phenomena, it has yet to generate powerful, novel predictions, or tie up the myriad of loose ends it stimulates. I note that the Standard Model introduces more questions and problems than it resolves, but suggest that this constitutes an appropriate outcome for a developing research program. Inevitably, however, a cognitive theory of religion must explain the practical problem of belief as it exists alongside atheism. On my assessment, the Standard Model cannot presently deliver even if its future shows some promise.

The final part of the chapter considers McCauley’s typology of inter-theoretic relations. I observe that his dimensions of inter-theoretic context and inter-theoretic continuity provide a useful system of classifying approaches to theoretical progress. As a result, I
adopt McCauley’s typology and its terminology throughout the remainder of the dissertation.

**Local Connections: Inter-field Theories as Scientific Progress**

The practice of science has led to a proliferation of specialised sub-disciplines. For some, like Wylie (2000), such disciplinary fragmentation provides indisputable evidence that progress accompanies prosaic, localised relations between research fields, acting as knowledge “trading zones” (p. 231). Wylie proposed that inter-field connections provide the “lifeblood of systematic, empirical research; they are what make the coordinated activities of these fields greater than the sum of their parts, even if they do not constitute a unified whole” (p. 231). While inter-field relations might be mundane and modest, they also capture the reality of much scientific activity.

Inter-field connections may also be described in Swanson’s (1991, p. 280) terms, based on complementary but disjoint structures. The term complementary refers to the relationship between two separate scientific arguments, which when combined yield insights that remain covert or unclear when considered independently. Disjoint arguments hold no content in common. Swanson claimed that scientific advances arrive when points of common intersection can be found between disjoint arguments focusing on common phenomena. The resulting inferences reflect a novel inter-field connection, never explicitly exposed before. Unlike the Kuhnian position where cross connections between paradigms fail, Swanson's disjoint arguments do not face incommensurability. An absence of common content only means that the intersection point has yet to be located. Swanson noted that the “ever-increasing fragmentation of science into mutually-isolated specialities probably assures a limitless supply and combinatorial growth of implicit connections, some of which may be unknown solutions to important problems. These solutions are worth seeking” (1991, p. 280). In fact, stimulating novelty in a domain may have as much to do with its defects as its methodological merits. Progress can occur without a unifying theory where connections between fragments stimulate novel insights. An explanatory framework based on propositions like those in the Standard Model may be all that is required for progress to transpire in ‘bits and pieces’.

A further example can be found in Darden and Maull’s (1977) version of theoretical
development, which does not require reduction. Inter-field theories, they claimed, provide a common heuristic where one set of phenomena can stimulate hypotheses concerning another, consequently bridging the two. Inter-field theories arise when different fields each provide incomplete explanations for the same phenomenon. When combined to form an inter-field explanation, three outcomes become possible. First, the new inter-field theory answers certain questions posed in one field that cannot be answered without drawing on another field. Second, the new inter-field theory reveals important domain items or variables previously not considered salient. Finally, the new inter-field theory predicts new domain items for one or both fields.

Darden and Maull maintained that a key to progress lies in locating the relations between scientific fields by developing inter-field theories. They defined a field as an area of science consisting of “general explanatory factors and goals providing expectations as to how the problem is to be solved, techniques and methods, and, sometimes, but not always, concepts, laws and theories which are related to the problem and which attempt to realize the explanatory goals” (p. 44). A field also contains its own special vocabulary that explicates its characteristic elements. Darden and Maull’s use of the term ‘field’ has broad correspondence with Toulmin’s use of ‘discipline’, Lakatos’ ‘research program’ and Kuhn’s ‘paradigm’. However, Darden and Maull introduced some additional parameters. First, a field may or may not contain theories, although strongly confirmed theories will take a central role until a more comprehensive theory emerges. Second, while competing theories may be present within fields, they do not compete with those theories generated by other fields. Finally, fields do not become reduced by other fields, but may be related.

Inter-field theories are purpose-driven, making explicit and explaining relations between fields that intersect around common phenomena and problems. Relations can take four forms. First, a relation may exist between the physical locations of entities or processes postulated in two or more fields, potentially through a part-whole relation. For example, the study of religious cognition would be revolutionised were neuroscientists able to locate a tangible ‘God’, or religion, module. Second, a relation may exist between the physical nature of an entity or process postulated in two or more fields. For example, a modular theory of cognition like agency-detection could connect with a specific neural architecture. Third, a relation may exist between an entity or process structure, and its
function, where each falls within the purview of different fields. For example, a model devised in computer science may be employed to explain neural activity or cognitive processes. Fourth, relations may exist between the entities or processes postulated in one field, and an effect observed and investigated in another. For example, theories in evolutionary psychology seek to explain the human behaviour observed in religious anthropology.

For an emerging explanatory framework such as the Standard Model, generating inter-field theories to explore relations between fields presents tangible evidence of program development and scientific progress. To that end, cognitive scientists of religion use the Standard Model to establish inter-field relations for several reasons. The first reason is that the relationships between two fields may already be acknowledged—a kind of ‘background knowledge’—before any work has begun. In this situation, the inter-field theory would represent a natural and formalised extension of background knowledge. An obvious example appears in the relationship between neurology and cognition. Clearly, there must be a correspondence between the two; it just has not yet been fully described.

The second and more compelling reason to pursue an inter-field theory appears when two fields share an interest in explaining different aspects of the same phenomenon or problem. Indeed, two fields may even approach the same fundamental problem from different but potentially complementary perspectives. For example, the representational view of the mind prominent in cognitive psychology has commonalities with models utilised in computer science. The combination has yielded the computational-representational perspective of the mind.

The third reason is that certain problems in any given field cannot be fully resolved using only the concepts and methods indigenous to that field. For example, a biological explanation for observable cognitive faculties like language may shed light on the selection pressures leading to its manifestation, and perhaps help separate the innate from the learned. In addition, psychological interpretations of religious or ‘mystical’ experiences become richer with neuro-imaging data.
On Darden and Maull’s (1977, p. 59) conception, inter-field theories stimulate theoretical development by:

1. Solving the theoretical problem which led to their generation by introducing new ideas about the nature of relations between fields;
2. Resolving questions central to a field that cannot be answered using the concepts and techniques from that field alone;
3. Focussing attention on previously neglected parts of the domains located in one or both fields;
4. Predicting new items worthy of investigation in the domains of one or both fields;
5. Generating new lines of research which may lead to further inter-field theories.

In later chapters, I will show how the Standard Model has encouraged the development of inter-field theories associated with religious cognition. Notwithstanding the limitations of the Standard Model, which I also detail in later chapters, its propositions provide a framework for locating potential inter-field connections. To begin with, a successful inter-field theory need not concentrate on reductive relations. Two theories may intersect through a common phenomenon or problem to create an inter-field relation. Unifying the two theories, or eliminating one through reduction, is unnecessary. To Darden and Maull, generating theories that may have gone unnoticed during the exclusive pursuit of reduction, represents a marker of theoretical progress. They wrote: “Provided with a new analysis of the relations between fields, it becomes natural to view the unity of science, not as a hierarchical succession of reductions between theories, but rather as the bridging of fields by inter-field theories” (1977, p. 60).

If Darden and Maull’s conception of scientific progress eventuates for the Standard Model— as a series of inter-field theories—we will see further fragmentation and even a proliferation of new theories. A single unifying theory of religious cognition will not reside at the core of a successful Standard Model. In addition, since theories explaining religious cognition in particular, and cognition in general, remain under-developed, the
emergence new inter-connections could stimulate a completely novel line of research, and perhaps even a new field altogether (Darden 1978, pp. 154-155).

I think it pertinent to acknowledge Darden and Maull’s reliance on both biology and the historical analyses of science in their arguments about the significance of inter-field relations. For example, inter-field frameworks may not generalise beyond biology. In addition, it remains unclear how well inter-field frameworks predict promising sites for future research. Recognising a new field or an influential new inter-field theory comes more easily after the fact. Darden and Maull’s original formulation does not offer criteria to differentiate a superior inter-field theory from an inferior one. In contrast to a reductive approach, inter-field theories work to connect the ingredients of separate theories without any assumptions about the hierarchical relations. In addition, connections between theories extend beyond logical relations to the formation of new theoretical angles and concepts.

Another challenge lies with determining how a suite of inter-field connections and theories may collectively be evaluated as an explanatory framework or research program. For example, numerous promising inter-field connections reside within the Standard Model. Some of these may become fully fledged theories in their own right, perhaps even surviving the fall of the Standard Model should it occur. Others will fade or be replaced.

Bechtel (1984) provided some clues about how to approach the evaluation challenge. He pointed out that Darden and Maull’s concept does not locate theories as the fundamental unit of interest in scientific progress. Instead, theories serve as vehicles for solving problems that arise in fields. Importance lies with the phenomenon that needs to be explained, rather than the theories employed to do the explaining. Connecting or integrating theories means revealing how key phenomena can be related to explanations from multiple fields. Bechtel claimed this as the great strength of the inter-field theory concept. It encourages investigations of part to whole, causal, and structure to function relations. For example, in his historical analyses of the inter-field theory linking vitamins and coenzymes, Bechtel (1984, pp. 268-269) argued that two re-conceptualisations brought about the pivotal insights. The first introduced vitamins as dietary substances, and the second revealed that coenzymes operate as transport
vehicles. Bechtel concluded that these re-conceptualisations stimulated a novel and powerful series of theoretical inter-connections. I consider Bechtel’s analysis important because it attaches theoretical progress to a novel insight, in his case, two ‘re-conceptualisations’. The leap came with a new way of thinking, a classic ‘eureka’ moment. Inter-field theories reflected the outcome, but should not be credited as the catalyst. Perhaps this is where an emerging explanatory framework such as the Standard Model could fit in by priming researchers to consider inter-field connections they had never before anticipated. While frameworks cannot replace genuine human creativity, they may help trigger it. In later chapters I take this suggestion further and offer some examples where I think it might have occurred.

Other commentaries on inter-field relations focus on objections to unity and reduction as assumptions behind scientific progress. For example, Grantham (2004, p. 134) declared the reduction model ‘doubly mistaken’ because theories can be at least partly unified without reduction, and because unifying science requires more than theoretical unification. To support his argument, Grantham highlighted three versions of theoretic unification that do not require reduction, including inter-field theories, types of conceptual refinement, and explanatory extensions (where one theory explains statements presupposed by a second theory). The lesson, according to Grantham (2004, p. 134), is that philosophers studying scientific unification need to be clear about both the entities entering into the process of unification, and the precise relation(s) constituting their unification. The entity-relation function suggests that non-reductive models of unity will not assume an all or nothing form, as Kincaid’s (1990; 1997) version of inter-level theory integration shows.

Kincaid (1997, pp. 100-108) proposed that unification is a matter of degree. Two theories become more unified as they become more interdependent. Unity therefore reflects the degree of integration, which corresponds with the number and significance of inter-level connections. In the case of reduction failures, unity may still be successfully pursued via integration. Fields should be considered more unified with a higher density of connections. In turn, inter-connection density offers a proxy for theoretical progress. I give some attention to connection density in the forthcoming chapters using Thagard’s evaluative criteria. My assessment reveals few dense inter-connections attributable to the Standard Model’s framework. It also displays a final
complication associated with inter-connections. Fields can either be unified through theories leading to new ontologies, concepts and generalisations, or through heuristic connections, where for example, hypotheses can be generated in one field from developments in another (Grantham 2004, p. 143). Partial unification through inter-connection can occur despite the failure of reduction attempts. More importantly for my assessment, degrees of inter-connection also represent incremental measures of theoretical progress.

Consistent with Darden and Maull (1977, pp. 43-48) and Grantham, I note that the Standard Model case de-emphasises unity of theories in favour of unity of fields. My reasoning revolves around connections. Fields contain theoretical and non-theoretical components, thereby offering a broader scope for uncovering potential sites of connection, like general heuristics or methodological approaches. Focussing on fields also aids what Grantham called ‘practical’ unification, or connections between the non-theoretical aspects of fields. Fields can be practically connected in three ways. First, heuristic dependence occurs where the theories and/or methods of one field may be used to guide the generation of new hypotheses in another field. Second, inter-field dependence occurs where the methods and/or data from one field may be employed to confirm hypotheses in another field. Third, methodological integration occurs where new methods are developed to test hypotheses arising from data, which have emerged from two fields. As a result, in addition to the density of inter-connections, other proxies of progress include the presence of heuristics, corroborations, and new methodologies. My analyses throughout chapters five to eleven notes where each appears.

**Interpretations of Progress**

According to Laudan (1977, p. 11), scientific progress necessitates problem-solving. Of the problems faced by scientists, Laudan distinguished between empirical problems and conceptual problems. Empirical problems relate to the contents of scientific domains under investigation. Conceptual problems relate to theory. A theory may solve a problem with only an approximate answer. As a result, any research approach where successive theories solve problems within a domain may be viewed as progressive. In a later work, as an alternative to Kuhn’s total and simultaneous replacement of theories and paradigms, Laudan (1984, pp. 50-66) proposed a ‘reticulation model’, involving a dynamic but gradual and piecemeal adjustment. The reticulation model anticipates the
kind of progress inter-field theorists describe. Solutions to both empirical and conceptual problems arrive in fits and starts, creating a fluid, non-linear and perhaps even messy theoretical terrain. Of course, this introduces the question of what constitutes a solution.

Kitcher (1993, Ch. 4) suggested three types of solutions: practical, conceptual, and explanatory. Each solution represents a form of progress. Practical progress comes through the design and use of scientific instrumentation. Conceptual progress occurs through the development of categories representing the contents and relations of physical systems. Explanatory progress comes with improved or alternative patterns of explanation. In later chapters I comment on the utility of problem-solving as a driver of theoretical progress, and note a range of successes and failures associated with the Standard Model’s resolution of conceptual and empirical problems.

Popper (1982, pp. 19-20) offered another perspective, differentiating between three kinds of decisions associated with theoretical progression: adjudicating between competing theories, justifying theories, and demonstrating one theory’s superiority over another. In the end, Popper discarded the justification issue and focused on resolving the adjudication problem through the preference problem. This approach allows the emphasis to fall upon the justification of a preference rather than a theory. According to Popper, theory justification means that a theory is true, whereas preference justification merely indicates a better approximation to the truth than other options (p. 138). Popper (1982, p. 58) claimed that competing theories should be judged on how much empirical corroboration they achieve. As a practical assessment of progress, and notwithstanding underpinning assumptions about realism, Popper’s approach seems easy to apply. I conclude, in line with Popper, that at the very least, an increase in corroboration represents an essential element of progress. In the case of the Standard Model, I take the further step of suggesting, like Losee (2004; 2005), that empirical corroboration needs to venture across as many analytical levels as possible and, perhaps, form the seed of an inter-field theory.

**Inter-theoretic Relations and Progress**

As I noted in chapter one, I need to differentiate relations between successive theories at a single level of analysis, and theories at different levels of analysis. I also need to
distinguish between theories that evolve over time, and those that face replacement. McCauley’s typology helps in both these aims.

McCauley (1986, p. 190) conceptualised inter-theoretical relations on the basis of two continua: inter-theoretical context, which specifies the level at which relations occur, and inter-theoretical continuity, which specifies the nature of transitions between successive theories. McCauley’s two dimensions of inter-theoretical relations combine to create a typology constituting four quadrants, as illustrated in Figure 4.1.

Figure 4.1. McCauley’s Inter-theoretic Relations

<table>
<thead>
<tr>
<th>Inter-Theoretic Context</th>
<th>Inter-Theoretic Continuity</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intralevel Theory</td>
<td></td>
<td>1. Scientific Evolution</td>
<td>2. Scientific Revolutions</td>
</tr>
<tr>
<td>(same level theory replacement over time)</td>
<td></td>
<td>• New theory updates or corrects old theory</td>
<td>• New theory eliminates the old theory</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Increasing comprehensiveness of theories over time</td>
<td>• Paradigmatic change</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major assumption: Eventual unity of knowledge</td>
<td>Major assumption: Paradigmatic incommensurability means that different theories compete to explain a given phenomenon at the same level, but do not interact.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuous at the same level</td>
<td>Discontinuous at the same level</td>
</tr>
<tr>
<td>(different level theories at the same time)</td>
<td></td>
<td>• Different theoretic perspectives intersect irrespective of the levels</td>
<td>• Multiple and disparate explanations of phenomena</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Possible theoretic interconnection but constrained within disciplinary boundaries</td>
<td>• Inter-disciplinary excursions are heuristic approaches to discovery</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Major assumption: Connections can be made between levels and represent intersections.</td>
<td>Major assumption: Theoretical connections are at best loose heuristics.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continuous at different levels</td>
<td>Discontinuous and at different levels</td>
</tr>
</tbody>
</table>

By inter-theoretic context, McCauley means that a theory can be concerned with either a single analytical level (intra-level) or multiple levels (inter-level). For example, an intra-level theory concerns a phenomenon at a single level of analysis, like an anthropological theory of religion. However, an inter-level theory involves multiple levels of analysis like anthropology and psychology. The principle of inter-theoretic context helps to expose how levels of analysis can complicate the relationship between theories. Any
new theory seeking to update or replace an existing one must be able to account for at least the same phenomena, if not more.

By inter-theoretic continuity, McCauley means that a new theory will relate to an existing theory with either low or high compatibility. Little or no continuity indicates that the new theory will replace an existing theory with little or no overlap. A commonly cited example is the replacement of Newtonian physics with Einsteinian physics. In contrast, high levels of continuity mean that a new theory may build upon or correct the deficiencies of an existing one. Such a development in theoretical terms is more incremental or evolutionary in nature.

Inter-level theoretic relations may also assume low or high continuity. Low continuity means the presence of multiple and disparate representations of the same phenomenon, and that a new theory will neither replace nor build upon others. In contrast, high continuity assumes that the relations between theories at different levels of analysis are, at least partly, reductive in nature. High continuity between inter-level contexts reveals progress with more and deeper links between numerous levels. The major philosophical theme underpinning continuity is paradigm incommensurability, while the central theme underpinning context is reductionism / unification.

Quadrant 1 represents high inter-theoretic continuity at an intra-level context (Scientific Evolution). In this form of inter-theoretic relations, the mapping between theories remains consistent, and a new theory corrects the old, providing a more comprehensive and principled account of when and why it fails. Theoretical progress is continuous. Earlier theories are reinterpreted and revised rather than eliminated. Theory continuity reflects the overlap between old and new.

Quadrant 2 represents a low inter-theoretic continuity at an intra-level context (Scientific Revolutions). According to McCauley (p. 192), all intra-level contexts ultimately result in the total elimination of some theories. Over time intra-level contexts suffer from an increase in incommensurability, where the mapping of one theory to the next is poor, leaving a low inter-theoretic continuity. Here, scientific revolutions preclude inter-theoretic translation.
Quadrant 3 represents a high inter-theoretic continuity at an inter-level context (Microreductive Contexts). Inter-level contexts do not lead to theory eliminations. They involve cross-scientific contexts aiming to connect theories operating at different analytical levels. Under conditions of high inter-theoretic continuity, inter-level explorations successfully establish connections. In so doing, they justify the assumption that different level theories describe phenomena sharing a common explanandum. According to McCauley (p. 193), once theories at adjacent levels become sufficiently robust to address the observable behaviours of a phenomenon, they begin to “constrain one another’s form”. As a result, the reigning theories at immediately adjoining levels exert the most influence because their conceptual proximity allows them to accommodate and corroborate rather than correct or eliminate. Despite the potential for partial replacement, inter-level forces tend not to instigate changes in an established theory at any given level. They do, however, point to alternatives.

Quadrant 4 represents a low inter-theoretic continuity at an inter-level context (Explanatory Pluralism). Inter-level contexts with low levels of inter-theoretic continuity are unlikely to lead to theory transition. McCauley noted: “Radical incommensurability in some intertheoretic contexts, namely, interlevel ones, neither requires the elimination of theories on principled grounds nor provokes such eliminations, in fact” (p. 194). In inter-level contexts, lower-level theories attempt to explain a particular phenomenon, not the upper-level theory. As a result, the phenomenon rather than the theories receive elaboration. With inter-theoretic discontinuity, lower and upper-level theories provide incompatible accounts of a common phenomenon. This is not all bad as significant conceptual discontinuity between theories at different, and especially adjoining levels, stimulates more empirical research, which leads to the modification of the existing theories, improving conceptual continuity.

McCauley’s typology covers significant ground and adeptly summarises a large portion of the possibilities for theoretical progress outlined in this and the previous chapter. Accordingly, claims of reduction and theoretical connection need to be viewed within contextual parameters and with a clear presentation of the theoretical continuity between successive theories. For this reason, I adopt McCauley terminology and classifications throughout the forthcoming analysis. The Standard Model assumes a
high level of intra-level continuity, but has not yet accommodated incompatible observations generated by different inter-level theories. It may also be worth noting that the history of science provides numerous examples where theoretical progress accompanied greater specialisation, fragmentation and disintegration, leading to more fields and sub-fields. The Standard Model might represent only a theoretical consensus in terms of its core principles. Its future might be fragmented versions rather than an integrated framework.

Conclusion

As my analysis of the Standard Model unfolds, I record the symptoms of theoretical progress in all of their versions. However, following McCauley’s overarching typology of inter-theoretic relations, I will examine theoretical progress from the intra-level perspective of scientific evolution and revolution, as well as the inter-level perspective of microreductive contexts and explanatory pluralism. In regard to the former, I will seek to uncover and identify tensions in the Standard Model’s relationship with competing theories that might foreshadow a paradigmatic crisis. Paradigmatic tension would undermine the Standard Model while incorporative symptoms would suggest its reinforcement. Because the Standard Model commits to a computational-representational account of cognition, tensions with competing accounts of general cognition seem inevitable. Popper’s notion of progress would demand the presence of a sufficiently developed alternative to the Standard Model. However, if religious cognition comprises more than one kind of phenomenon, then a replacement for the Standard Model will only come about with a replacement for computational-representational, modular cognition.

The relations between inter-level contexts could prove decisive for the Standard Model by establishing important corroborating or non-corroborating evidence. Although contrary evidence from neuroscience may not eliminate the Standard Model’s account, it would foreshadow some obstacles. At the least, inconclusive but incompatible evidence will encourage a pluralistic interpretation, where we must await the arrival of additional empirical work. The inter-theoretic relations between both intra-level and inter-level contexts may also become complicated by semantic or methodological incommensurability. As Schaffner (1967, pp. 137-140) counselled, inter-level theories
describe entities on more than one level of abstraction, and which exhibit different organising principles. Both factors encourage novel terminology and interpretations.

Notwithstanding the potential for theories of religious cognition to become mired in incommensurability, some degree of incompatibility must occur in order to reveal new inter-level connections. After all, the Standard Model stakes its claims as a multi-disciplinary theory that accommodates and corroborates observations made using different tools, procedures and traditions. The Standard Model will give rise to an inter-field theory of religious cognition where hitherto unconnected theories intersect with a common explanandum. If, as Grantham and Kincaid proposed, unification is a matter of degree, and two theories become more unified as they become more inter-dependent, then documenting the number and significance of inter-level connections will be relevant. In this way, non-reductionist inter-connections can be made. Furthermore, inter-field theories may be used to create overarching heuristics (Darden, 1998, pp. 62-63). Heuristics provide explanations of scientific statements, but they can also be employed to identify the theoretical candidates that should be dropped amongst a set of plausible options.

A final inter-field alternative might arise through what Kinoshita (1988, pp. 49-51) called cluster relations. Distinguishing cluster relations from part-whole relations, Kinoshita observed that some scientific fields appear to share the study of a single pivotal phenomenon, albeit with an emphasis on different aspects, or with different techniques, methods or aims. Accordingly, the different fields which share the study of a single phenomenon may be considered members of a cluster. Cluster members share a cluster relation brought about by a unifying case that offers a kind of apotheosis for collective appreciation. Members welcome other members providing they accept the unifying case. Perhaps religious cognition provides a unifying case for progress in general theories of cognition. I consider this possibility pertinent given that the Standard Model assumes that religious cognition is parasitic upon ordinary cognitive mechanisms. Finally, in addition to a general assessment of progress in the developing research program represented by the Standard Model, I need to consider what constitutes a sound theory in cognitive science. It is time to look within the paradigm under scrutiny through the first of Thagard’s criteria.
Chapter 5. Representative Power of the Standard Model

Introduction
Having detailed the central propositions of the Standard Model as well as the relevant approaches to progress, this chapter begins the critical examination of the Standard Model’s content. I have argued that an assessment of scientific progress in a developing program such as the Standard Model must thoroughly dissect its scientific content. This chapter constitutes the first to pursue this objective. At the same time, in each chapter I expose the philosophical approaches to progress that help explain the status of the Standard Model case. Conversely, I highlight weaknesses in both the Standard Model’s scientific content and in the progress concepts employed in the philosophy of science. During the next seven chapters I unfold an argument about the importance of inter-level relations. Specifically, I defend the position that an explanatory framework in cognitive science shows progress when it exposes hitherto unforseen connections between disciplinary and analytical levels, thereby stimulating new predictions and empirical activity around high potential research sites and questions.

Cognition comprises two elements, the content of the mind, and the processing of that content. The former, mental representations, are considered in this chapter, while the latter are tackled in the following chapter. The analytical approach I use draws on Thagard’s (2005a, p. 15) framework designed for evaluating theories of mental representation. The first of Thagard’s five criteria, ‘representative power’, refers to a theory or model’s ability to account for a variety of cognitive representations. Accordingly, a superior theory explains a variety of different types of religious cognition. I aim to evaluate how well the Standard Model explains the mind’s representation of religious concepts. The forthcoming treatment of representative power assesses the Standard Model’s capacity to explain the presence and composition of religious mental representations. On Thagard’s representative power, the Standard Model will be deemed robust if it can account for the mind’s capacity to create and maintain a variety of different religious concepts.

In the first part of this chapter I examine the Standard Model’s explanation for the existence of religious representations. Perhaps ironically, the Standard Model claims that a specific form of religious cognition does not exist. Religious cognition cannot be
considered a sui generis or unique form of cognition because religious representations are a version of ordinary representations. Nevertheless, the Standard Model does offer a method for differentiating between the two using the mind’s treatment of intuitive concepts compared to counterintuitive concepts as a basis. I argue that although a useful point of distinction, the intuitive / counterintuitive argument is too fluid and, at times contradictory. The Standard Model struggles to sharply define religious representations.

In the second part of this chapter, I raise four concerns about the Standard Model’s description of religious representations and its commitment to counterintuitivity. First, the use of counterintuitivity does not adequately differentiate between religious and non-religious representations. In fact, I suggest that the attribution of counterintuitivity to certain concepts creates more ambiguity than it resolves.

Second, the Standard Model’s treatment of religious representations relies on an account of implicit and explicit cognitive processes through intuitive and reflective beliefs, respectively. However, the relationship between intuitive and reflective beliefs remains unclear, such as how intuitive representations affect reflective representations, and how the latter interact with the counterintuitive. This set of relationships needs more clarity. The Standard Model cannot satisfactorily explain how individuals’ beliefs can completely change or evolve over time, or with reflection.

Third, according to the Standard Model, the transmission power of religious representations connects with their memorability, which in turn, accompanies counterintuitivity. However, counterintuitivity cannot by itself explain the transmission success of religious representations. After all, there must be an almost unlimited number of counterintuitive concepts that fail to catch on. In addition, counterintuitivity helps little in explaining atheism, a practical problem I consider in chapter nine. Quite obviously, many individuals do not find religious counterintuitive representations memorable, or at least not convincing. These individuals may not have been exposed to, or may have rejected outright, doctrinal justifications for the presence of supernatural agents and events. For some atheists, counterintuitive religious concepts are rejected because they are counterintuitive. Conversely, for the committed religious adherent, counterintuitive religious concepts are evidently not counterintuitive at all. A religious practitioner does not consider a religious concept memorable because it is
counterintuitive, but rather because it is true. My interpretation here implies a greater role for cultural indoctrination, learning and teaching than the Standard Model acknowledges.

Fourth, the Standard Model claims that a range of cognitive devices act upon, or compute, religious representations. None, however, operate exclusively for religious concepts. If the Standard Model is correct in assuming that religious representations are parasitic upon ordinary cognitive computation, then isolating religious representations from the non-religious will always be problematic. I examine the computational issues in the next chapter. For the present, I want to foreshadow the problem of characterising religious representations when the mind’s computational processes cannot differentiate them from others.

On the basis of the four issues raised above, I conclude that the Standard Model possesses a weak representative power, constrained heavily by a reliance on counterintuitive concepts. The Standard Model also faces the troublesome task of isolating a representational form that operates like any other but for the presence of a counterintuitive element. Indeed, it would be a great deal more helpful if all counterintuitive representations were religious in nature. Equally, it would also be more useful if all religious representations were counterintuitive, but this is not the case either. In the concluding section of the chapter, I summarise these arguments, highlighting the implications for programmatic progress.

**Establishing the Boundaries**

A common starting point in analysing religion lies with Durkheim (1961[1915]), who claimed that religion controls social action by organising people into social groupings. To Durkheim, religion affects a society’s composition. At the same time, religion offers a symbolic expression of society. Religion’s power lies with its capacity to converge and enforce social norms. According to Durkheim, psychological explanations for religion fail to account for social behaviour. Equally, cognitive scientists do not like Durkheim’s social theory because they believe that social facts ultimately need psychological explanations (Pyysiainen 2003a, pp. 55-75).
Disciplinary traditions emphasise different interpretations and definitions of religion. Where Durkheim focused on social functionalism, more recent sociological explanations favour social construction (Berger 1990). For anthropologists, an uncontroversial starting point might be to classify religion as a sub-unit of culture. To them, the term culture refers to the collection of fundamental values and attitudes common to members of a social group, and which consequently set its behavioural standards (Geertz 1973, 2000). In this respect, religion and cultural context must be inextricably interconnected. Wilson (1976) observed: “Religious belief is one of the universals of human behaviour, taking recognizable form in every society from hunter gatherer bands to socialist republics” (p. 176).

Geertz (1973, p. 89) defined religion with reference to five characteristics: 1) A system of symbols which 2) establish powerful, pervasive and long-lasting moods and motivations through the 3) formulation of conceptions about a general order of existence that 4) clothe these conceptions with such an aura of factuality whereupon 5) the moods and motivations seem uniquely realistic. More recently, but with a similar outlook, Hinde (2005) offered a functional description of religion comprising six components: structural beliefs which refer to events or ideas that exist outside time, such as the concept of the Trinity; narratives that build upon the structural beliefs, organising them into contexts; rituals; moral codes; religious experience; and relations between participants. Every one of these components need not be present or equally represented.

Another line of thought more consistent with the cognitive approach, began with Tylor in 1876, and was continued by Bloom (2005). Their intentionally minimalist definition describes religion as the belief in spiritual beings. Variations in kinds of supernatural agents seem common enough, but the types of knowledge attributed to them remains relatively consistent (Purzycki and Sosis 2011, p. 89). Cognitive scientist, Atran (2002, p. 4), provided a more concise definition: religion is a costly and difficult to fabricate commitment to a counterfactual world of supernatural agents who provide the impetus for mastery of individuals’ existential anxieties. To Atran, religious beliefs need only a minimal violation of conventional and sense-driven notions of the world. Religion enables individuals to imagine ‘minimally impossible worlds’, which relieve fears about
death (Norenzayan and Atran 2002). How counterintuitive concepts become accepted lies at the heart of cognitive interpretations of religion.

**Explanations for Religious Representations**

In order to assess the Standard Model’s account of different types of religious representations, I begin with its explanation for their presence. I also investigate the assumptions used to dismiss competing accounts of religion’s incidence. Boyer (2001, Ch. 1) acknowledged several views explaining why religious representations enjoy success. First, religion provides explanations. Religious representations come about in order to explain puzzling natural phenomena and experiences, the origins of things, and why ‘evil’ and suffering exist. Second, religion provides comfort by allaying anxiety. Third, religion provides social order through cohesion around particular moral and social values. Finally, religion relies upon a cognitive illusion where religious representations appear as mental ‘accidents’ and refutation requires more effort than belief. Boyer’s potential explanations for the occurrence of religious thought corresponds to those proposed by Atran (2002, p. 264), which included social, economic, political, intellectual, and emotional reasons. The issue, as Atran explained, is that although these explanations can been observed in different cultural circumstances, religion reflects only one of numerous cultural phenomena which may be at work. For both Boyer and Atran, conventional explanations inadequately account for the presence of religious representations. In particular, Standard Model theorists ask why so many people hold irrational beliefs about the presence and intervention of supernatural agents. The answer they contend lies with our cognitive architecture, and the adaptations that shaped it in our evolutionary past.

Standard Model advocates like Boyer and Atran claim that a comprehensive explanation must describe how religious concepts become entrenched in individual minds. While acknowledging that an effective account of religious representations will have something to say about social relations, Boyer and Atran cast doubts over the direction of causality. For example, Boyer maintained that all societies have established parameters concerning behaviour and morality. In many cases where the same rules apply, such as with the prohibition of murder, different religious beliefs can be found. In fact, evidence suggests that social order can be established in the absence of religion, or even with the presence of competing religions. While religion exerts an influence over
social values and its prescriptions for proper social behaviour, for Standard Model theorists, the relationship is not causal. Rather, religious beliefs gain a foothold because some of the concepts presented have become acceptable. Minds do not begin open. The mental belief gatekeeper becomes relaxed when extraordinary religious claims first appear plausible. Boyer, Atran and other Standard Model affiliates focus on understanding what makes human minds so selective in determining which religious claims seem plausible irrespective of background knowledge and conditioning.

In dismissing the conventional explanations for the presence of religious representations, the Standard Model emphasises four assumptions of its own. First, religious representations rely upon the mind’s ordinary cognitive processes. Second, the intuitive inferences produced from the processing (computation) of religious representations are connected to social and survival instincts. Third, religious representations link to supernatural concepts. Finally, the mind’s cognitive devices selectively emphasise particular religious representations. Of these four assumptions, this final one presents the most difficulties because it predicts a finite type of religious representations. The mind’s cognitive devices funnel the diversity of religious content to a constrained number and type of religious representations. The Standard Model therefore insists that cognition determines the content of religious thought rather than cultural forces. Persistent religious representations are limited to those which the mind’s inferential systems support. However, given the sheer magnitude and complexity of religious representations, it is difficult to see how all functional explanations can be dismissed when explaining all forms of religious expression (Hinde 2005, p. 31). The cognitive approach to religion presupposes that the same mental phenomena explain the vast diversity of practices and thoughts around what we badge ‘religion’. As Appiah (2009, p. 196) noted, “They presuppose we are interested in the causes and effects of Buddhism, Christianity, Judaism, Hinduism, Islam and Taoism, as well, no doubt, as the less-often-mentioned range of ‘traditional religions’ from Patagonia to Hudson’s Bay, from the Cape of Cairo, from Sri Lanka to Mongolia, from New Guinea to New Zealand.”

Although it might seem obvious what practitioners believe, religious representations are not necessarily transparent. For example, when people think about the supernatural, they engage a suite of unconscious mental machinery, at least some of which operates during
mundane thinking. If religious thinking does not mobilise some super-normal form of cognition, its account must first explain all of the invisible processes that make up ordinary cognition before it can turn its attention to explaining religious thinking. As Boyer (2001) noted, the Standard Model has to explain ‘airy nothing’.

Perhaps Boyer’s quip would have more aptly referred to ‘everything’ rather than nothing. If religious representations use ordinary cognition, then religious representations are merely ordinary representations containing religious concepts. On this basis it might be premature to dismiss functional explanations for religion. Any dismissal should be on the basis of whether ordinary cognitive representations provide functional roles. Perhaps religion itself did not develop to solve functional reasons like anxiety relief, but its underpinning cognitive functions that support it may have. Moreover, even if functional explanations for religion are weak where cognitive explanations are strong, it would be hasty to exclude religion’s obvious functional roles. Irrespective of why religion came about, it does serve functional purposes, and if the Standard Model is to explain religion, it must be able to account for these functional purposes through cognitive representations and computations.

The Standard Model emphasises cultural canalisation. Cultural concepts funnel through inhibited cognitive capacities producing a restricted set of ‘preferred’ representations. Standard Model advocates have therefore sought to establish what it is about these preferred religious representations that make them easier for the mind to host. The answer is that religious representations can be separated from other forms of representation on the basis of counterintuitive content.

**The Composition of Religious Representations**

**What is a Religious Representation?**

On the Standard Model, mental representations carry meaning about objects, agents or events, such as jihad, holy water, God or Christmas (Hampton and Moss 2003, p. 507). The challenge for the Standard Model lies with differentiating religious mental representations from other kinds, given its starting assumption that religious cognition is a form of ordinary cognition. However, the challenge is to some extent circumvented by defining counterintuitive representations as quintessentially religious. The Standard Model stipulates that the cognitive study of religion aims to determine how
counterintuitive representations become beliefs (Atran 2002, Ch. 4; Boyer 2001, Ch. 2; Pyysiainen 2003a, Ch. 2). For example, Day (2005, p. 89) observed: “The backbone of Boyer’s analysis—and of what has quickly become the ‘standard’ cognitive model of religious thought—is that religious concepts are intrinsically counterintuitive.” Nevertheless, counterintuitive content may be a necessary but not sufficient characteristic of religious representations. For example, counterintuitive religious representations and counterintuitive non-religious representations must share the same cognitive processes (Franks 2003, pp. 42-50). At the same time, innumerable concepts associated with religion do not possess a counterintuitive element. If we accept that the concept of ‘God’ is counterintuitive, the concept of ‘commandments’ is not. As a result, the Standard Model excludes a significant amount of religious content by focusing exclusively on the counterintuitive. Standard Model advocates like Day (2005) claim that religious mental representations hold power because they defy natural ontological expectations by combining three conditions.

First, each religious representation engages at least one ontological category. Second, each representation defies intuitively delivered expectations about the engaged category/ies. Third, intuitive expectations transfer from other categories to the one being compromised. Putting the three together, for example, the concept of a ghost activates the category ‘person’, but also contradicts the category because ghosts possess super-normal characteristics. Although the concept calls for a ghost to be unlike a normal person in appearance and capabilities, ghosts tend to be conceptualised (mentally represented) in the same way as an ordinary person, complete with a functioning mind and corresponding psychological needs.

To explain their interest in counterintuitivity, Standard Model advocates introduce two pivotal cognitive processes (Barrett 2004, Ch. 3, 4; Barrett and Keil 1996; Pyysiainen 2002, p. 115; Sperber 1996, pp. 69-71). One process is spontaneous, automatic and intuitive, providing a rapid assessment of circumstances without the need for conscious awareness. Automaticity shapes success by drawing mental inferences about the environment and making predictions based on patterns accumulated from experience. The system activates during intuition, moments of creativity and imagination, and visual assessments.
In contrast, the second process is reflective, conscious and systematic. This system generates propositions using inference and explanation rather than prediction. Accordingly, the system follows basic rules, including the use of logic and causality during cognitive functions such as deliberation, explanation, and strategy formulation (Evans 2003; Lieberman et al. 2002; Lieberman and Pfeifer 2005).

In short, the intuitive system drives direct and spontaneous inferences about religious concepts, whereas the reflective system encourages more measured and thoughtful inferences. When the intuitive system engages with a religious concept, an automatic and simplified response occurs. However, the response will not necessarily portray an individual’s religious beliefs accurately, which are also influenced by the contemplation and consideration accompanying reflective thought. The division between intuitive and reflective beliefs implies that most belief arises from unconscious, automatic cognitive processes. To committed Standard Model theorists like Barrett (2009, p. 81), reflective beliefs typically emerge from the cumulative weight of intuitive beliefs converging on the same candidate belief. I find this position plausible especially when considering the role of memory, which has already been shaped by intuitive beliefs and reinforced by reflection.

Standard Model adherents like Boyer (2001, Ch. 2) focus on intuitive cognitive processes. For him, religious representations are clearly counterintuitive in that they involve a definitive challenge to a category’s ontological status. However, Boyer assumes some uncertainty about how people would behave in reaction to the intuitive violation. For example, a ghost’s representation might be counterintuitive, but that does not mean that the inferences made about a ghost would be similar for everyone. Presumably, interpretations would depend on the individual concerned and their reflective thoughts about the incident. Perhaps, as Sperber (1996) suggested, the relationship between the intuitive and counterintuitive can be murky. Just because a category violation occurs does not mean that a clear-cut representation will arrive. According to Sperber, an interpretation is unnecessary as the intuitive and counterintuitive may never get fully resolved. Deciding that one has seen a ghost may not be all that straightforward, as it could have been an almost limitless number of things. Similarly, an individual might think they had seen a ghost in the heat of the
moment as their intuitive processes delivered a counterintuitive representation, but upon later reflection might reach another conclusion.

The relationship between intuitive and reflective cognitive processes is difficult to reconcile with the importance of counterintuitivity. For practitioners, religious representations tend not to be rationalised away during reflection. Moreover, the reflective process might be an essential ingredient in the persistence of religious representations. Novice religious practitioners are exposed to strong cultural conditioning reinforcing and validating religious concepts, counterintuitive or not. For example, imagine a child is introduced to the concept of God in Sunday school. When he or she questions peers, parents or the instructor about the counterintuitive concepts introduced, the original message is likely to be repeated. God is likely to assume an anthropomorphic form in a child’s mind, like a human but with vastly augmented powers. Naturally the child begins to ask questions about the way God does things: Why won’t God answer my prayers? Why doesn’t He reveal Himself? Why do bad things happen to people in the Church? Each of these questions presents challenges to a child learning a religious doctrine. To those favouring cultural or social interpretations of religion, if the child continues their practice, it is due to indoctrination and the conditioning effects of repeated exposure. To cognitive scientists of religion, the answers to the child’s questions provide counterintuitive content. On the Standard Model, these counterintuitive properties establish a memory ‘hook’.

The memory hook view implicit to the Standard Model may not, however, sufficiently account for the inter-relationships between intuitive and reflective cognitive processes. Many children receive religious education but abandon religion later in life, or even when the education discontinues. Boyer might be correct that the violations to intuitive domains that accompany many religious representations—counterintuitivity—enhances memorability. But with the capacity for a reflective cognitive process, and without consistent cultural or environmental reinforcement, some young adults discard religion even though they remember the stories and the details that were so effectively embedded within counterintuitive representations. Some children fiercely believe that a monster lives under their bed, but relinquish the idea as they grow older. To make matters more complicated, there may be a difference between what a religious
practitioner thinks they believe and what they actually believe (Barrett 1999; Barrett and Keil 1996), a possibility taken further in chapter nine.

On the one hand, it is helpful to define religious representations in sufficiently general terms that each discipline or field can be confident of examining the same phenomenon. On the other hand, we also need a definition with adequate complexity for different branches of enquiry to properly wield their tools (Anttonen 2002, p. 14). The common ground for the moment remains the principle of counterintuitivity. The concept appears useful, but does not fully explain persistent religious representations. For example, from a cognitive perspective as McCauley and Cohen (2010, p. 789) questioned, what are the scientific grounds for identifying specific phenomena as religious? As I shall argue, counterintuitivity presents a starting point but not a complete analytic template for pinpointing religious cognition. I can also foreshadow my suggestions that part of the Standard Model’s appeal lies with its conclusion that there is nothing extraordinary about religion.

**Minimally Counterintuitive Concepts**

The Standard Model claims that religious representations contain a counterintuitive element, making them ‘preferred’ conceptual representations (Atran 1996, pp. 234-243). Boyer (1994, pp. 117-124) and Sperber (1996, pp. 69-74) classify such representations as ‘cognitively optimal’. On the cognitive optimality theory Boyer proposes, embedding a counterintuitive concept within a group of intuitive concepts gives the total conceptual unit a memorability advantage. Concepts containing entirely intuitive content are not as memorable as those possessing some counterintuitive content as well.

According to Boyer, certain patterns in concepts have a dramatic impact on their memorability and likely transmission. Moreover, the most successful concepts align with the mind’s system of thought and memory. Specifically, Boyer’s thesis hinges upon what he calls minimally counterintuitive (MCI) concepts. These concepts introduce minor violations of intuitive expectations about the world and its contents. For example, most adults have developed an intuitive schema about the category or domain that might labelled ‘animals’. Within this domain there would likely be a set of representations about the concept ‘dog’. Boyer would argue that for a dog to violate our intuitive representations, it would have to do something counterintuitive, like walk
around on two legs. A dog walking on two legs would constitute a minor violation to an intuitive concept, or a minimally counterintuitive concept, in contrast to a maximally counterintuitive concept, which violates numerous aspects of a domain, like a dog that can talk or fly.

Boyer’s cognitive optimality predicts that culturally successful concepts belong to a small number of recurrent templates, each with a minimally counterintuitive concept in common. He identified five conditions that all must be in place in order to qualify a concept as MCI (Boyer and Ramble 2001, pp. 180-181): 1) a pointer to a particular domain or category concept (a dog); 2) an explicit representation violating intuitive expectations, either, i. a breach of relevant expectations for the category (a dog that walks on two legs), or ii. a transfer of expectations associated with another category (a dog that behaves like a cat); 3) a link to (non-violated) default expectations for the category (the dog is otherwise like any other); 4) a slot for additional cultural information (the dog could have been trained to perform); and 5) a lexical label (the dog that can ‘walk on two legs’).

The five preceding conditions imply that supernatural concepts do not encompass an endless catalogue of possibilities. Rather, they constitute a contained ‘supernatural imagination’, built upon general assumptions. A kind of cognitive contradiction comes into play here. For example, believing in a ghost demands both violations to general assumptions of the domain alongside others holding true for that domain (Boyer and Ramble 2001, p. 119). Religious representations simultaneously invoke the intuitive and counterintuitive; they make sense and defy sense at the same time.

For Boyer and other cognitive scientists of religion like Pyysiainen and Day, memorability accompanies a special relationship between intuitive and counterintuitive concepts. For example, they claim greater memorability for minimal domain violations, like a ghost’s ability to walk through walls and behave with agency despite the absence of a physical brain. Furthermore, minimally counterintuitive content distinguishes religion representations from others (Pyysiainen 2001, p. 18), leading to Standard Model proponents to declare a link between MCI and cognitive optimality.
Observations from experimental psychology, provides suggestive but limited support for the super-normal memorability of minimally counterintuitive concepts. Problematic, however, has been an inconsistent operationalization of MCI in studies (Barrett 2008, 308). In one pivotal experiment, Barrett and Nyhof (2001) asked their respondents to remember and repeat stories containing intuitive as well as minimally counterintuitive events and objects. Their subsequent content-analysis of the retold stories revealed that participants could recall 92 per cent of the minimally counterintuitive items and 71 per cent of the intuitive items. Adding a different twist to the hypothesis, Norenzayan and Atran (2002) found that under ordinary conditions, intuitive ideas enjoyed a better recall than the minimally counterintuitive. On the other hand, the minimally counterintuitive ideas held more robust in that they faded from memory at a slower rate after immediate recall. Norenzayan and Atran speculated that minimally counterintuitive ideas may have a long-term survival advantage over intuitive or maximally counterintuitive ideas.

Other free-recall experiments lend support to Boyer’s prediction that MCI content augments the cognitive optimality of concepts. Boyer and Ramble’s (2001) cross-cultural study showed that counterintuitive content is relevant in different cultures, producing similar recall effects despite variances in belief commitment, transmission modes, and other local factors. The study also revealed better recall rates for ‘domain-level’ (more fundamental, like ‘gravity’) violations than for those linked to ‘basic-level’ (more specific, like ‘everyday objects’) expectations, which suggests that counterintuitive content might work best when it contradicts deep and fundamental intuitive expectations. In later work, Norenzayan, Atran, Faulkner and Schaller (2006) tested MCI concepts in the success of cultural narratives such as myths and folktales. In experiments, a minimally counterintuitive cognitive template including mostly intuitive concepts combined with a minority of counterintuitive concepts produced a memory advantage after a week. Lesser memory performance was recorded with both an entirely intuitive concept template, and a maximally counterintuitive concept template. Introducing a contextual variable, Berger and Heath (2005) hypothesised that idea success depends on a ‘habitat’, or set of environmental cues that encourage recall. Their experimental data revealed that idea success fluctuates with changes in habitat over time. Ideas with habitats more conducive to encouraging recall will lead to greater concept memorability.
Despite the encouraging results from empirical work connecting memorability with MCI concepts, caution seems warranted. To begin with, the definition of a counterintuitive concept, as well as the total unit of cultural transmission in which it resides, remains more fluid than ideal for experimental testing. For example, what constitutes a standard unit of religious information? Is it a story, an incident, a character, a statement, or does it not matter as long as the ratio between the intuitive to the MCI holds? Furthermore, what exactly is the ratio and can it change? Noah’s Ark might be a chiefly intuitive concept with the added counterintuitive feature of accommodating two of every animal. But would some individuals consider the Ark entirely counterintuitive? Surely an individual’s prior cultural experiences would have a decisive impact on what they interpret as intuitive and counterintuitive. Furthermore, prior experience and reflective thought can re-structure intuitive inferences, making any standardised classification of an ideal content ratio for any given individual impossible to establish.

In addition, no experiments so far isolate MCI concepts as the dependent (unchanging) variable. I find this troubling given that a suite of cognitive, cultural and linguistic (independent) variables influence learning as well. For example, attention, repetition, sensory channel, affective activation, and the message advocate all constitute well-established variables in memory formation, not to mention contextual issues associated with the concepts, from the weather to the use of humour. Individual factors, such as short-term memory capacity, processing speed, and general intelligence (see for example Conway et al., p. 165), may also be relevant. We do not know how any of these variables influence MCI. The claim that MCI content enhances the memorability of religious concepts also implies that it plays a role in religion’s pervasive practice. MCI memorability might be a novel prediction, but it remains some distance from Lakatos’ ‘stunning’ or Mayo’s ‘severe’ tests due to its imprecise formulation. In short, cognitive optimality needs to go much further before it offers powerful predictions.

I find the use of counterintuitivity (and MCI) as the defining characteristic of religious representations problematic. Non-religious counter-examples can be easily identified. Take, for example, a favourite pair of football boots that seem normal in every way except that their owner considers them ‘lucky’. Conversely, all religious representations do not contain MCI elements. Many central characters in religion are mortals, and their actions stay consistent with ordinary expectations. Similarly, many components of
religion, like churches or temples, do not defy any intuitive inferences. Defining religious representations using counterintuitivity leads to ambiguity and contradiction if only because so much content in religion gets excluded.

Another problem occurs when some concepts containing high proportions of counterintuitive content become accepted and transmitted. All religions contain stories incorporating significant levels of counterintuitivity, from Moses parting the Red Sea to Siddhartha Gautama transforming into the Buddha under the Bodhi tree. Heath, Bell and Sternberg (2001), demonstrated the role of high levels of counterintuitivity in their experimental work on urban legends. Subjects reported the strongest conviction to pass on the most shocking and disgusting urban legends. If memorability connects to any kind of unusual concept including the maximally counterintuitive, then the cognitive optimality theory fares little better than a loose principle declaring that novel ideas stick in the mind. Although I will pursue it in chapter nine, I also note the obvious but monumental difference between remembering a religious concept and believing it. No doubt many atheists can recall important stories from the major religions.

A desire for greater explanatory scope might discourage an emphasis on MCI concepts as the central feature of religious representations. For example, cognitive optimality theory allows for a single, salient violation of the intuitive. If I want to refute the existence of a rock, I can kick it and easily determine its effect on my foot. There would be no domain violation as this would be quite intuitive and natural. No doubt, a rock that has no impact on my foot would certainly be memorable and worth talking about, but why is it necessarily more memorable than an intuitive outcome? Intuitive expectations about domains command great memorability precisely because they operate intuitively. A child does not take long to learn about gravity, but understanding how planes work takes longer. Counterintuitive concepts work because any violation of an intuitive concept is surprising.

As Barrett (2008, pp. 314, 330, 331) noted, three further issues confuse the boundaries of MCI identification. First, a concept does not have to be counterintuitive to causally produce a counterintuitive response. For example, a religious relic such as a statue can be intuitive but interaction with it could produce a MCI. Consider the bronze statue of St. Peter in Rome’s St. Peter’s Basilica. St. Peter’s right toes have been worn down by
centuries of pilgrims who touch the foot to receive a blessing. In this case the concept of St. Peter’s toes is intuitive, but touching them introduced the MCI concept of a blessing. An extension of this complication pertains to the inferential potential of a concept, or the concept’s ability to readily generate inferences in a wide spectrum of contexts. Clearly, not all concepts possess a similar inferential potential, but it is unclear how they relate to MCI concepts. For example, the concept of invisible supernatural agents delivers a high level of inferences because it can be applied as an explanation in numerous contexts from the weather to ghosts. In contrast, the Shroud of Turin, Jesus’ putative burial shroud, commands a more limited set of inferences due to its specific context. Barrett (2008, p. 330) speculated that perhaps inferential potential first increases with counterintuitiveness then declines. Finally, the empirical work thus far does not explain where mnemonic advantages unrelated to MCI concepts fit in, such as when a concept incorporates humour or sex.

The cognitive optimality theory lies at the centre of the Standard Model’s presentation of religious representations. On this account, a single violation of an intuitive domain will provide memorability and transmission advantages. However, the boundaries between the intuitive and counterintuitive remain ambiguous. The theory also creates difficulties as a defining feature of religious representations because non-religious MCI concepts may readily be found. Laudan’s practical problem-solving approach, where successive theories resolve more anomalies than they create, helps to put MCI concepts into context. For example, while MCI concepts and cognitive optimality resolve some problems, they also create some serious ones too. However, some help may be found when supernatural agent inferences are introduced to the mix.

**Inference, Attribution and Supernatural Agency Representations**

The Standard Model assumes that ‘Theory of Mind’, the ability to draw inferences about the contents of others’ thoughts, plays an instrumental role in religious cognition. Advocates argue that the mind’s social features evolved in response to selection pressures which rewarded social behaviours. I note in chapter 10 the evidence from developmental psychology suggesting that predictions about others’ behaviours begin from an early age. In fact, the Standard Model assumes that theory of mind also delivers inferences concerning the inanimate and unobservable. Theory of mind includes (Heberlein and Adolphs 2005, pp. 157-194):
1. Attributing intentionality and theory of mind;
2. Perceiving that something is animate or has agency;
3. Recognising emotion in another person;
4. Attributing personality traits, stereotypes, or social group membership;
5. Performing socially relevant logical reasoning;

‘First order’ theory of mind provides intuitive inferences about the intentions of others, and emerges early in childhood, approximately around four or five years of age (Bering and Johnson 2005, p. 133). ‘Second order’ mechanisms, which develop a few years later, allow speculations not only about the intentional states of others, but also about what others might be speculating about oneself. For Standard Model researchers, theory of mind explains the emergence of supernatural agency, having led humans to attribute a communicative meaning to events, the punishment or reward for behaviour delivered by powerful supernatural agents.

Inferential systems work by tuning attention to environmental cues, stimulating assumptions and predictions about their importance. The Standard Model claims that religious concepts rely on the support generated by inference systems. However, as the next chapter explores in detail, no religion-specific inference systems exist. We have no reason to assume that the mind possesses a specific predisposition to find religious representations more compelling than other inferences. Faith and belief emerge as side-effects of ordinary inferences. For example, assumptions about the intentions of supernatural agents occur as a by-product of a mind adept at attributing agency. Nevertheless, Standard Model advocates think that the mind has a tendency to exaggerate agency and the representations that accompany them (Dennett 2006, pp. 109-110). Barrett (2004, p. 31) made a case for a cognitive module he named a ‘hyperactive agent detection device’ (HAAD). The HAAD performs an important survival duty in locating possible hazards, but also encourages over-caution. It therefore leads to overzealous agency attributions. For example, Barrett proposed that the HAAD stimulates religious practitioners to attribute supernatural agency to the personal events of their lives.
Animals and humans, according to Guthrie (2002, pp. 60-61), share the error of granting agency to the inanimate. But this predisposition might not be error so much as essential. Evolution has programmed animals to respond strategically to what Guthrie called perceptual ambiguity. Flight or fight prioritises safety. With this fundamental cognitive inclination hardwired, Guthrie contended, humans and animals share a propensity for perceptual illusion: “… all of us inevitably think we see agents where, in reality, none exist” (Guthrie 2002, p. 61). As a result, some religious representations occur because of a deeply engrained and powerful capacity for agency-detection.

For Standard Model leader Boyer (2002, pp. 68-71), the ordinary cognitive mechanisms driving thinking and reasoning about agent behaviour also support representations about supernatural agents and their intentions. All humans create inferences about agents. Some inferences go too far, overstepping rational predictions to produce counterintuitive notions about supernatural agents from ghosts to gods. The ability to generate inferences about an agent is more important in Boyer’s case than whether the agent actually exists or not. Inferences lead to concept representation, from which belief follows when the concepts prove useful. Belief does not precede inference. In fact, inferences provide an opportunity for belief to take root. To Boyer, religion’s commonality does not offer evidence for a special need in humans to be religious. However, it does offer evidence that religious notions are memorable, particularly when culturally or socially useful. Religious representations prosper on the back of intuitive understanding and inferences that already exist in good supply for survival and social purposes.

Individual minds nevertheless shape and interpret religious representations. In fact, representations vary significantly. In conceptualising narratives about God, Barrett (1998), and Barrett and VanOrman (1996) showed experimentally that adults can hold an anthropomorphic concept of God inconsistent with their stated beliefs in His omnipresence, omniscience, and omnipotence. In one example, a subject recalled a narrative as if God could not be in two places at once. Barrett theorised that adults have two concepts of God, one theologically correct and the other consistent with the mind’s natural inclination to represent supernatural agents as super-human agents. The anthropomorphisation of God arrives intuitively and may be difficult to avoid irrespective of learned doctrine. In a latter study, Barrett (2002) determined that
Christian subjects tended to pray for psychological support rather than direct physical intervention. He reasoned that the Christians in his sample represented God in terms of their intuitive expectations, in this case, as a distant psychosocial agent rather than a physical agent.

Human development psychologists have studied what they call the ‘cognitive prerequisites’ for acquiring religion. Kelemen (2006, p. 104), for example, studied how children use agency to engage with imaginary companions and objects attributed with personalities. She concluded that children around the age of five are intuitive theists. However, Kelemen cautioned that it remains unclear whether children represent supernatural agents as human agents with super-human properties, or as a conceptually distinct group unrelated to humans. The capacity to imagine and socially engage with physically absent agents emerges in childhood. A more extreme view claims that pretend play and pretence prepares children for the cultural beliefs of adulthood (see Bodgan, 2005).

Religious practitioners do not tend to question the existence of absent supernatural agents. Standard Model advocates maintain that supernatural agents seem plausible because ordinary inference systems support agency attribution. Moral judgements exemplify the point. Individuals can hold intuitive moral views that they find difficult to articulate, but can more easily attribute them to gods, ancestors or other supernatural agents. The deeply held values that reflect the combination of early life learning and an inherent capacity for emotional empathy may be attributed to a supernatural agent.

An alternative but complementary theory was offered by Upal (2010, p. 194) emphasising context more than content. On this view, counterintuitive concepts do not enjoy a memorability advantage. Rather, concepts violating learned cultural schemas and scripts will be better remembered. One advantage in prioritising context lies in an answer to the common criticism of MCI theory I raised in the previous section: some highly successful religious concepts go well beyond minimal counterintuitivity. The context-driven theory claims that recall for maximally counterintuitive concepts occur because the contextual role the concept plays increases counterintuitiveness (Upal 2010, p. 200). Equally, some MCI concepts suffer memorability losses once they become embedded within a culture. Just like the once maximally counterintuitive computer has
faded into cultural ordinariness, the next breath-taking technology will shortly become passé.

On the Standard Model, god concepts are represented through the same generic mechanisms that provide inferences about any other personal agent, but with some additional counterintuitive properties as well. As a result, the Standard Model requires no special religious cognitive mechanisms in order to account for representations of any supernatural agent. Despite his general allegiance to the Standard Model, Barrett (2004, Ch. 3) proposed that God is not represented as an unusual person, but rather as a member of a different domain, a sui generis category. Barrett’s view struggles to accommodate an evolutionary perspective, given that interactions with god/s must have been less than with other humans (Pyysiainen 2006). God as a sui generis domain seems problematic at a practical level. Ordinary human inferences precede god inferences. Tremlin (2006, Ch. 3) introduced another possibility in the form of ‘aggregate relevance’. Supernatural agency comes about not just as a matter of a single kind of cognition, but through the combined activation of several crucial mental inference systems. For Tremlin, the more inference systems activated, the greater the plausibility of supernatural concepts. Furthermore, supernatural agent representations create a cascade effect of new inferences encouraging practitioners to assume that supernatural agents pay particular interest to their thoughts. Religious representations may therefore occur in self-reinforcing cycles. Practitioners represent supernatural agents, in so doing conceiving their wishes. But practitioners also wonder what supernatural agents want next. Bering and Johnson (2005, p. 118) claimed that all cultures create supernatural agent representations with four common features. First, supernatural agents cannot be deceived; you cannot trick God. Second, supernatural agents are preoccupied with moral behaviour. Third, supernatural agents punish behavioural transgressions. Finally, supernatural agents seek a social contract with believers, where rewards accompany allegiance. These features suggest that religious representations lead to the fear of supernatural punishment, which in turn inhibits individuals from engaging in selfish actions. However, in order for religious practitioners to reach this point, they have to imagine the will and thoughts of supernatural agents.

Religious representations come about through intuitive inferences about supernatural agents at multiple theory of mind levels, which develop at an early age. The Standard
Model account of religious cognition places a high significance on the mind’s inferential, or computational capacity. As a result, the computation of religious representations requires deep examination, and features in the following chapter.

Conclusion
On the Standard Model, a religious representation is an intuitively generated mental inference about a category of religious information. These occur on the platform of intuitive representations about domains, but with the addition of MCI inferences, leading to attributions about the presence and thoughts of supernatural events or agents. I highlighted several weaknesses associated with the Standard Model interpretation, which limit its representational power. A clear definition of the unit of representation remains absent. Although cognitive optimality makes some promising predictions, they do not pass a rigorous test of novelty. In Kuiper’s (2007, pp. 12-14) language, the hypothesis has not been adequately specified, as I will now summarise.

First, the definition does not do enough to differentiate religious representations from other kinds. Part of the problem lies with the paradoxical importance of both intuitive and counterintuitive representations. The Standard Model maintains that religious representations are not unique and do not invoke specific religious cognitive mechanisms. In fact, religious representations form on the basis of intuitive expectations about religious domains. At the same time, an intuitive representation becomes quintessentially religious with the addition of a counterintuitive element. According to the Standard Model, the combination improves concept memorability. However, the line between intuitive and counterintuitive is not adequately differentiated, a problem worsened by the presence of minimally counterintuitive elements in non-religious concepts. As Whitehouse (2004, p. 46) cautioned, religious traditions tend to avoid simple concepts and “peddle more complex bodies of knowledge in their stead.” Nevertheless, the relationship between the intuitive and counterintuitive must be developed with greater precision. Alternatively, if religious representations do not require religious cognitive mechanisms, then perhaps it would be more profitable for the Standard Model to abandon the attempt to distinguish religious representations from the non-religious. Such a venture might lead to more integration between religious and non-religious cognition, rather than more differentiation.
Second, thinking about supernatural agents can be both intuitive (implicit) and reflective (explicit). Explicit beliefs like the presence of God rely on interpretations of a mental state, in contrast to implicit assumptions like the expectation of gravity. The Standard Model’s treatment of religious representations acknowledges the relevance of implicit and explicit processes through intuitive and reflective beliefs. However, the relationship remains unclear. In particular, the Standard Model must address how intuitive representations affect reflective representations, and how the latter interacts with the counterintuitive. After all, sometimes religious practitioners do change their beliefs upon experience and reflection. Consciously available beliefs constitute only a fraction of the cognitive representations associated with religion (Boyer 2003). As a result, theologies, dogmas and academic interpretations of religion do not necessarily articulate religious representations. The religious representations held by practitioners may not necessarily correspond with what they ‘believe they believe’ anyway. In fact, neuroimaging studies reveal brain patterns during prayer consistent with normal interpersonal interactions (Schjoedt et al., p. 330). Practitioners converse with God as if he were more like Superman than an omnipotent being (Barrett and Keil 1996). I consider the Standard Model’s position on how reflective thought influences belief in chapter seven on psychological plausibility. The role of emotion is also considered in chapter seven, while the influence of religious experience is evaluated in chapter eight dealing with neurological plausibility.

Third, the Standard Model’s view of religious representations focuses on the relationship between cognitive functions and the intuitive representations they create or facilitate. The role of teaching receives little consideration, however (Rolston 2005, p. 13). Upal (2005) argued that a successful theory of religion must be underpinned by an understanding of the social mechanisms that operate at the individual level. The representation of minimally counterintuitive concepts goes some way to explaining this relationship through the cognitive optimality hypothesis. However, research has not examined the way MCI representations are taught. For example, repetition effects might be more important than concept counterintuitivity. In part, the Standard Model’s account of religious rituals provides the answer, and is critically assessed in chapter seven regarding psychological plausibility.
Finally, religious representations are not the product of an exclusive ‘religious cognition’. Nor are they the only inferences used in making judgements about the presence of supernatural agents. We may assume that humans have the capacity for theory of mind, agency detection and social exchange, but religious representations must engage other systems as well. Moreover, we have no way of reliably assigning a representation to a mental system. Boyer (2003, Ch. 3) argued that religious thought is natural because it stimulates a collection of distinct mental systems rather than any one unique and specific process. Similarly, religious representations appear as predictable by-products, rather than dramatic departures, from ordinary representations. Separating religious representations from others will always be contradicted by a shared, underpinning mechanism. I turn to the computational mechanisms governing the processing of religious representations in the following chapter.
Chapter 6. Computational Power of the Standard Model

Introduction
According to Thagard (2005a, pp. 15-19), computational power refers to the operations performed on mental representations. Thagard defined a computation as the “Physical process with states that represent states of another system and with transitions between states that amount to operations on the representations” (2005a, p. 230). Although unclear at first, Thagard meant that cognitive representations are mental symbols that stand for something, and computations are the processes that manipulate these symbols into something useful for decision-making. Representations as explored in the previous chapter reflect the ‘what’ dimension of cognition, while computations identify the ‘how’ dimension of cognition. To Thagard, the effectiveness of a given computation can be evaluated on the basis of speed and flexibility. Faster computational processes that can solve multiple problems are preferable to both slower processes, as well as those with a single or narrow influence. Similarly, superior solutions come from computations with greater efficiency or economy. In this chapter I build on the previous by examining the Standard Model’s stance on the computational mechanisms acting on religious representations which deliver religious thought.

On the Standard Model, religious cognition cannot be explained by any single ‘magic bullet’ (Boyer 2001, p. 50). Rather, religious cognition constitutes the way the mind’s computational system operates upon the variable cultural concepts associated with religion. As I noted in the previous chapter, counterintuitive religious concepts and those connected to supernatural agents hold the greatest importance. Boyer (2001, Ch. 3), Atran (2002, Ch. 3), and Pyysiainen (2003a, Ch. 7) sought to explain the mind’s computational systems through causal assumptions arising from the concept of domain-specificity. This approach claims that the mind contains specialised systems (‘mechanisms’, ‘devices’ or ‘modules’) capable of producing automatic inferences about objects or phenomena. In fact, religious objects and concepts stimulate inferential systems, which act by classifying them into specific ontological categories or domains. Religious representations are therefore manipulated by innate, functionally-specific computational devices capable of performing dedicated but restricted tasks efficiently. In order to assess the computational power of the Standard Model, I elaborate upon its conception of the computational devices performing the work.
In this chapter I draw attention to some incoherence in the Standard Model’s account of computation. I also note its reliance on assumptions drawn from cognitive science. I argue that the Standard Model’s computational power remains moderate at best. The Standard Model’s version of computation delivers useful descriptions of religious cognition, but does so based upon speculative assertions. Although the case for domain-specific devices has been overstated, I do concede that it offers testable predictions, some of which seem solid against empirical observation. However, my conclusion invokes conditions and cautions, my biggest reservation relating to the presence of computational devices in the first place.

I begin the chapter by examining the functionalist assumptions inherent in the Standard Model. The functionalist version of computation focuses on how representations undergo processing; a view challenged by the connectionist paradigm as I outlined in chapter two. While the functionalist version more easily generates predictions about cognitive outcomes, the connectionist version more easily integrates with neurological accounts of cognition. I also return to this issue in chapter eight on neurological plausibility. Both chapters introduce and debate issues of inter-level relations which form a central role in my thinking about how a developing explanatory framework such as the Standard Model can demonstrate progress.

In the second section of this chapter, I explore the antecedents of device computation, or ‘modularity theories’, while in the third section, I examine how cognitive devices compute religious representations. For the Standard Model, representation-processing by domain-specific devices creates religious thought. I venture further in the fourth section by examining the details of domain specific device function. Domain-specific devices with dedicated functionality, and fast, efficient processing, can account for an impressive range of cognitive abilities. On the other hand, I highlight numerous ambiguities about device activity that undermine the Standard Model account. In the final two sections of the chapter, I consider strong and weak versions of domain specific device computation. Despite the Standard Model’s predisposition toward strong adaptationism, I consider it unfavourably narrow. The debate on adaptationism relates only to computation in this chapter, but I return to it in chapter ten. In contrast, I support the Standard Model’s view that no cognitive devices operate exclusively for religion; no ‘God’ modules exist. Throughout the chapter I draw attention to the possibility that the
domain specific device approach may be best seen as in heuristic terms rather than as a physical structure.

**Computational Assumptions**

Although the terminology does vary, most of the Standard Model literature employs the terms ‘modularity’ and ‘modules’ to describe the mind’s computational devices or mechanisms. Evolutionary psychologists such as Cosmides and Tooby (1992)—and most Standard Model advocates—claim that modules manage specific aspects of cognition, such as the ability to attribute agency, or the ability to generate innate moral judgements. While in general most cognitive scientists support a degree of modularity in specific domains, they do not agree on their manifestation, composition, or role in cognition. To make matters worse, cognitive neuroscientists exhibit less confidence about modularity, their structure-function investigations not revealing the physical architecture corresponding to modular specificity.

The evidence for and against modularity will be evaluated from an evolutionary viewpoint in chapter ten. However, by way of introduction, a revealing example can be found in the relatively advanced neuroscientific research into the visual system. Bechtel (2003, p. 221) argued that the brain comprises highly inter-connected processing units that perform operations at a micro organisational level. In fact, neuroscientific evidence appears consistent with a much smaller and more integrated modular form, revolving around micro information processing. Modularity of this fine-grained sort comes about as evolution modifies already existing complex entities rather than selecting new ones to be developed from scratch. A limitation, however, remains that a fine-grained version of modularity cannot yet be proven on the basis of the coarse data from neuroimaging studies.

The evidence from neuropsychology ambiguously includes cases that both support and undermine modularity. The brain may well contain numerous modular processing structures, but little is known about how they were formed (Friedenberg and Silverman 2006, Ch. 4). One tentative option might be that the brain contains compartmentalised functions as well as integrated and distributed ones. An exclusively domain-general cognitive structure must therefore be unlikely as well. However plausible cognitive modularity might be, the mind cannot be fully compartmentalised for the obvious
reason that behaviours and functions interconnect, bleeding into each other seamlessly (Peterson and Fiez 1993, p. 513). As a result, any functional module must be capable of feeding back into generalised intelligence (Rolston 2005, p.19). The putative presence of modules therefore leaves as many questions unanswered as resolved.

A second relevant computational assumption implicit in the Standard Model is a functionalist stance. For functionalists, cognition equals the sum of computations needed to process mental representations and their relations. The important factor here is that cognition (and perhaps even consciousness) accompanies a specific functional organisation. It is how the parts are put together that matter, rather than the nature of the parts themselves.

Throughout this work I express misgivings about the computational and functionalist assumptions so embedded in the Standard Model. My concerns stem from a suspicion that the computational-representational theory suffers intractable flaws, including its presumption that information arrives to the mind raw before undergoing a context-free transformation. On the computational model, cognition operates as an algorithm where certain inputs inevitably deliver predictable outputs. I do not think the algorithmic model reflects the intense interactivity and reflection that occurs during cognition. It also sidesteps the pivotal question of what actually occurs during cognition. To say that a domain-specific mechanism ‘computes’ representations into thoughts just shifts the problem. I do not go as far as Nathanial Barrett (who should not be confused with the Standard Model advocate Justin Barrett), but I agree with the spirit of his concern: “This is the fatal flaw of computational theory: it imputes to computers self-contained cognitive capabilities that in fact are dependent on a wider context of human implementation, and then imports these self-contained capabilities into the human brain or some other circumscribed set of operations (e.g., brain plus calculator” (Barrett 2010, pp. 596-597). As my analysis unfolds, I present evidence suggesting that cognition—religious or otherwise—incorporates contingency and convergence. The Standard Model overplays the latter. Consider, for example, Day’s (2004, p. 101) comment that the study of religious cognition returns to the evolutionary design of the mind: “ … we have our kinds of gods because we have our kind of mind.”
In contrast, connectionists maintain that cognition arises through the formation and patterning of connections between neural units, sometimes called neural nets. The symbolic representation of information is redundant. Despite Pyysiainen’s (2002, p. 2) claim for a growing acceptance of the connectionist agenda, it does not feature strongly in a Standard Model dominated by the functionalist paradigm, where computation means the manipulation of symbolic representations. In addition to the neurological and evolutionary plausibility of modules (tackled in chapters eight and ten respectively), the debate between functional and connectionist agendas infuses more uncertainty about the Standard Model position. Of course, the two issues deal with different aspects of the same problem. Both re-appear in this chapter and others, beginning here with the basic features of modularity.

**The Antecedents of Modularity**

A mental module is a domain or task-specific functional processor operating within the entire mental computational system comprising numerous (in fact an unknown quantity of) modules. A weak interpretation of modularity assumes that the mind possesses some modules, but is not necessarily composed exclusively of them. Conversely, a strong position assumes that the mind consists of a large quantity of modular components managing the majority of cognitive operations. On this continuum, weak modularity seems relatively uncontentious, as most cognitive scientists would accept that the mind contains functionally-dedicated components to some extent, as simple dysfunctions are evident—such as deafness—without impairment to other cognitive faculties. On the other hand, a strong modularity position—sometimes referred to as ‘massive’ modularity—where all cognitive faculties are modularised, would not find ready consensus. Debate also continues as to the kind/s of cognition that modules manage. Weak modularists suspect that modules operate only for perceptual and linguistic processes, while strong modularists include reasoning and specific problem-solving intelligence. As I shall shortly explain, the Standard Model falls toward strong modularity.

The modularity debate was inflamed by Fodor’s (1983) position outlined in *The Modularity of Mind*. Although Fodor’s nine properties have been employed as defining conditions, most cognitive scientists now consider much of the list inessential. In general, contemporary modularity debates revolve around scale. To frame the scale
issue, it helps to begin with the uncontroversial assumption that the mind can be functionally decomposed. That is, the mind consists of systems that can be differentiated by the functions they undertake. The properties of these systems take centre stage because they define the parameters and magnitude of functional decompositions. The debate therefore ignores whether the mind behaves as a network of interconnected systems and sub-systems, but about how these systems and sub-systems might be characterised. In this respect, strong modularity demands strong functional decomposition.

The Standard Model employs a strong version of modularity. When wielded by cognitive and evolutionary psychologists, modules have even been labelled ‘Darwinian Modules’ (Samuels 1998, pp. 567-580) to emphasise their evolutionary delivery. Modules as specified by the strong version, can be characterised by four common features. First, modules are domain-specific, where domain-specific computational mechanisms dominate the cognitive architecture. Second, modules are innate cognitive structures, delivered through natural selection and expressed via genetic characteristics. Third, modules are universal, common to all normally functioning human brains. Finally, modules operate using a computational mechanism, manipulating mental representations. These features appear prominently in the account provided by Cosmides and Tooby (1994), which begins with the general premise that minds contain clusters of cognitive structures that deal with specific cognitive problems. A module would likely exist for language and vision, for example, each separate and efficient. Strong modularists go much further. For every major problem domain, a corresponding module processes information to deliver an intuitive inference, ostensibly at least, solving the problem. Domain-specificity reflects an important first principle for the kind of strong modularity inherent in the Standard Model. It stands in contrast to domain-generality, which assumes a far more flexible cognitive structure that can be employed to manage a range of problems. But to the strong modularists developing the Standard Model, specific problems need specific solutions.

Cosmides and Tooby (1994b) argued for strong modularity with what has become known as the optimality argument. Optimality in this context refers to the importance of an adaptive problem which instigated the need for a module in the first place. An adaptive problem arrives with environmental pressures. Solutions deliver an improved
chance of reproductive success. Common examples include predator avoidance and the ability to locate a sexual partner. According to Cosmides and Tooby, modules evolve at the confluence of adaptive problems and the machinations of natural selection. In a later section of this chapter, the possibility that adaptive problems led to the evolution of a specific religious cognition module will be considered and rejected.

Adaptive problems require efficient solutions, and efficient solutions demand specificity. Thus, when it comes to solving adaptive problems, a ‘jack of all trades’ general solution is simply not good enough. Moreover, two specific solutions perform better than a single all-purpose one. Efficient solutions require efficient mechanisms where computation precisely targets certain kinds of representations. For Cosmides and Tooby, this axiom applies to all solutions posed by adaptive problems. As a rule, they claim, natural selection ensures that the best solution prevails, and the best solution arrives as a consequence of functional differentiation.

Weak modularists counter-claim that natural selection does not necessarily deliver the most optimal solution (Sober 1993, p. 120). The best solution may never have been an option. Moreover, modularity may not actually have been the optimal solution given the unique circumstances in which our ancestors evolved. Perhaps some adaptive problems are best solved with domain-general cognitive apparatus. In order to make this assessment it would be necessary to examine details concerning the evolutionary landscape, the features representing the site of selection, and the range of alternatives (phenotypes), that could have been selected. Obviously, these data are not available.

If it turns out that specific problems can be solved through general computational mechanisms, then strong modularity fails. In addition, the presence of a module that serves no conceivable evolutionary advantage would be difficult to explain and might be evidence of a different kind of cognitive mechanism.

There must have been a multitude of selection pressures, where any specific solution would have helped solve an important adaptive problem. However, it remains unclear just how many there were, and how specific a problem would have to be in order to provide a sufficient selection impetus. Would we expect a ‘bear avoidance’ module, or would it function as a generic ‘predator avoidance’ mechanism? Almost every aspect of
Palaeolithic life must have stimulated survival problems. Have they all generated modules, and why were some successful and others not?

As a final uncertainty, the functional differentiation essential to optimality suggests that the overlap between modular faculties must be complexly interwoven. For example, avoiding a predator demands numerous perfectly synchronised perceptual mechanisms including vision, audition, olfaction as well as language, reasoning, logic, and perhaps even moral or social instincts. We do not know how the computational outcomes of modules would be integrated without some kind of domain-general intelligence to act as a kind of filter and organiser.

The evolutionary psychology, cognitive psychology and Standard Model interpretation suggests that natural selection delivered a mind containing a universal set of domain-specific modules that operate computationally. The Standard Model calls upon a hardware metaphor to explain the operation of modules, emphasising functional specificity. Since the brain’s hardware comprises billions of neurons and neural networks, modules can be considered a functional arrangement of neurons; neural mini-computers each designed for a particular activity. Cosmides and Tooby (e.g. 1997) have been prominent in the development of the hardware view. At the same time, they propose that the cognitive specialisation inherent in modules also performs in a manner analogous to computer software. Thus, modules can be conceptualised as subroutines or algorithms run by neurons (Tooby and Cosmides 1992). Obviously, connectionists consider this computer metaphor outdated and simplistic. In addition, some Standard Model leaders, such as Pyysiainen (2002, p. 2) see modularity in more instrumental terms, as a way of conceptualising the mind’s computational outputs rather than as if it provides a literal description of brain structure. Nevertheless, optimality and the Standard Model would fall into trouble if there was another way in which the mind could manage domain-specific cognition without computation, thereby utilising the advantages of a specific solution without the ambiguities that accompany a proliferation of modules. The Standard Model’s presentation of computation in the form of domain-specific modularity is examined next.
Religious Representation Computation

On the Standard Model, the mind is not an all-purpose problem-solver, but rather operates as a collection of sub-systems or modules executing content-specific computations, some of which act upon religious representations. While the mind’s capacity to label objects and experience plays an important role in religion, the Standard Model places a special emphasis on how the mind attributes value to the cross-over between boundary categories, such as with counterintuitive concepts (Anttonen 2002, p. 26).

Computations act on representations of objects or categories such as ‘animal’ or ‘person’ to generate spontaneous inferences (Boyer 2000, pp. 277-278). The precise mechanisms behind this inferential computational process are uncertain. Nevertheless, Boyer presumes the presence of cognitive systems delivering fast, spontaneous identifications, categorisations and inferences about the world. Intuitive judgements about the world and its contents seem like an obvious survival requirement. After all, precious resources should not be wasted on biological irrelevancies such as meaning when survival might be at stake.

The mind evolved modular functionality as part of the process of acquiring adaptive fitness (Boyer 2001, Ch. 3). Of these modules, a hypertrophied social intelligence occupies a central role in the development, maintenance, and transmission of religious representations. Although innate social facilities underpin survival, they also cause trouble by encouraging the overzealous attribution of agency where it might not apply, or bestow volitional behaviour upon inanimate or imagined things. For good survival reasons minds possess a bias towards over-detection. To Boyer religion emerged as a side-effect of over-detection. It constitutes a false positive; a malfunction of already sensitive social agency apparatus leading to the supposition that agency operates where none in fact exists.

Boyer’s interpretation does not call for a differentiation between the computation of religious representations and non-religious representations. To those supporting the Standard Model, religious representations (counterintuitive or supernatural concepts) can be easily explained by the over-stimulation of normal modular activity. There is no need to invoke religion modules because social agency was selected, not religion.
However, if the computational processes managed by modules do not operate exclusively on religious representations, then no unique, defining characteristics of religious representations should be identifiable. The modules that process religion cannot tell the difference between religious and other representations, counterintuitive, supernatural, or not. If the very processing apparatus cannot identify a religious representation, then why would the Standard Model place such a great emphasis on specifying the features of religious representations?

A counterintuitive concept involves a representation that has undergone computation and has returned a domain violation. A representation was input, but rejected, because it could not be processed in the normal way. In fact, the Standard Model stakes a major claim around this modular failure. Domain violations and their counterintuitivity constitute explanations for the special memorability of religious concepts, and their consequent transmission advantages. In a strange way, the Standard Model holds that for religious representations, the computational process does not work properly.

The relationship between modular failure and evolutionary psychology’s optimality appears strained. For example, Standard Model advocates suggest that modules evolved to meet ancestral selection pressures and may no longer be as relevant as they once were. The strange noise in the garden at night might be a lion, but it is probably the neighbour’s cat. On the other hand, the pressures for social cohesion and the alleviation of existential anxiety were probably also strong. Why would over-detection necessarily lead to religious representations? Why would it not simply lead to a resetting of the detection apparatus? It was not a lion this time, but it could be next time. Could there have been some additional selection pressures which made the recognition of supernatural agency more advantageous than merely discarding the false-positive?

Despite some unresolved issues, the Standard Model’s version of modularity highlights the advantages of possessing rapid identification and inference processes. To take a further step, efficient computations need to be conducted by specific, purpose-driven apparatus designed to act within narrow bands of representational input. I therefore next explore how religious inferences derive from domain-specific modular computation.
Domain Specific Modularity

Numerous research streams have contributed to the domain specificity perspective, including Chomsky’s notions of universal grammar, studies of the visual system, the analysis of expert performance, and comparative studies of animal cognition (Atran 2005, Ch. 3; Chomsky 1984; Cosmides and Tooby 1994b; Fodor 1983; Hirschfeld and Gelman 2006; Pyysiainen 2002a). Advocates for domain specificity argue that the mechanisms for acquiring and structuring knowledge, as well as the process of reasoning, are unique in different domains (Pyysiainen 2003a, Ch. 7). Thus, for cognitive scientists committed to the Standard Model, interpretations of religious thought and activity revolve around how the mind behaves in different domains. Each module operates within unique parameters.

So far, Standard Model theorists have identified a handful of putative modules pivotal to processing religious representations. On the positive side, the accounts of religious cognition and behaviour these modules generate appear plausible, and reflect the most comprehensive and thorough explanation for religious cognition available. On the cautious side, the strong modularity employed by the Standard Model seems unlikely to be the final word on computation. Strong modularity may provide a useful heuristic to understand cognition. Rather than a physical description of the mind’s composition, modularity might be a metaphor, subsequently replaced by a more nuanced account of cognition. In other words, modularity might loosely describe the outputs of processing but not the mechanism of processing. However, since assessing the Standard Model’s position on computation demands an engagement with domain-specific modularity, I will continue with caution, emphasising its specific challenges in religious cognition, and its connection to evolutionary psychology.

Assuming cognition was shaped by evolutionary pressures, it must have emerged as a functionally distinct adaptation (Pyysiainen 2003a, Ch. 7). Under circumstances where two adaptive problems have different or incompatible solutions, “a single general solution will be inferior to two specialized solutions, and thus domain-specific solutions will be favoured” (Pyysiainen 2003a, p. 197). Pyysiainen, like most Standard Model advocates, believes it unlikely that the varied problems faced by human ancestors could have been solved using a generic cognitive system. As a result, he argues along with his Standard Model colleagues, that domain-general cognition must be inconsistent with
evolutionary pressures. If we accept this argument, and assume that a domain-specific computational system manipulates religious representations, the questions remain as to which domains employ specific modules, and what precise functions they each perform.

Numerous domains associated with religious cognition have been proposed. Boyer and Walker (2000, p. 152), for example, identified five. First, a supernatural domain, computing representations about the existence and specific powers of supernatural entities, agents, and items. Second, a moral domain, computing notions about correct thought and behaviour. Third, a group identity domain computing concepts associated with belonging. Fourth, an action domain, computing behaviour. Finally, an experience and associated emotional states domain, computing feelings.

I find the preceding list of computation domains troublesome for several reasons. Although some evidence from developmental studies and lab experiments reveal that individuals do represent religious concepts across some of the domains identified above (see for example, Barrett and Nyhof 2001; Boyer and Barrett 2005; Leslie 1994; Leslie and Frith 1988), no evidence indicates that the computations are governed by a correspondingly specific module. The limited available evidence suggests that computation operates in a way consistent with domain-specific predictions, but it does not demonstrate that domain-specific modules are actually doing the work. Predictions have been successfully realised, but it is easy to see how Musgrave’s version of novelty would prove decisive if another, new account of computation could anticipate something modularity fails to predict. In such a scenario, the new account would demand attention having successfully predicted a hitherto unanticipated observation.

In addition, the Standard Model cannot say what place religious representations occupy within specific domains. For example, does the presence of a supernatural domain suggest the operation of a supernatural module? The Standard Model says no. Rather, supernatural representations stimulate schemas within domains that manage natural concepts as well. Thus, supernatural concepts are computed by a module that also handles non-supernatural concepts. But, where are the boundaries of such a module? What happens when representations appear in tandem? Do numerous domain-specific modules engage concomitantly with seamless integration?
Standard Model accounts presume that numerous modules engage during religious thought and behaviour, blurring the distinctions between ontological domains (Pyysiainen 2002a, p. 1). Nevertheless, the relationship between computational processes for religious representations versus non-religious representations remains uncertain. If there is no difference, how does modularity help to explain religious cognition? And, once again, how do counterintuitive concepts help distinguish religious representations when they are computed in the same way and by the same modules as non-religious representations, unless modules dedicated to counterintuitivity exist?

The answers to these questions remain ambiguous within the Standard Model (and in cognitive science). However, the Standard Model does not accept religious cognition as a unique cognitive phenomenon. At one level, the Standard Model seeks to explain religious computation by demonstrating that it is really just ordinary computation working on certain kinds of representations. Or, more specifically, a computational error causes the misidentification of outputs and inferences associated with counterintuitive supernatural agency. Standard Model contributors have sidestepped the description of religious representation computation by instead identifying the key categories of modular functionality. Identifying categories of modularity shows how all cognition operates through a restricted number of modules which enforce constraints. While useful, the approach fails to explain the full diversity of religious thought.

A good example can be found in Barrett (2004, Ch. 3), who claimed that cognitive modules provide mental tools which may be divided into three domain-specific functions: categorisers, describers and facilitators, summarised in Table 6.1 below.

Table 6.1 Barrett’s (2004) Categories of Modular Functionality

<table>
<thead>
<tr>
<th>Categorisers</th>
<th>Describers</th>
<th>Facilitators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object Detection Device</td>
<td>Object Describers</td>
<td>Social Exchange</td>
</tr>
<tr>
<td>Agency Detection Device</td>
<td>Living-thing Describer</td>
<td>Regulator</td>
</tr>
<tr>
<td>Face Detector</td>
<td>Theory of Mind</td>
<td>Social Status Monitor</td>
</tr>
<tr>
<td>Animal Identifier</td>
<td></td>
<td>Intuitive Morality</td>
</tr>
</tbody>
</table>
As a central player in the construction of the Standard Model, Barrett sees no need to invoke religious domains. On the other hand, he believes the three domain-specific functions play an instrumental role in processing religious representations. In a similar vein to Barrett, Atran (1998, p. 548) proposed that an innate ‘folk biological’ module manages the universal human propensity to classify and taxonomise the world and its contents. While broadly consistent, where Barrett identified four modules fulfilling a categorisation role, Atran offered only a single ‘folk biological’ module performing the same duties. While there seems to be a consensus amongst the main proponents of the Standard Model that domain-specific modules exist, they do not articulate their specific function or composition. Nor do they agree on which ones should be identified.

Atran’s folk biological module provides computational outputs different from scientific classifications. For example, folk-biological computations do not lead to causal or integrative accounts. Instead, they work only at the general practical level and emphasise cooperative behaviour rather than the inherently competitive activities of science. Put another way, Atran thinks that an intuitive folk biology does not engage in theory-building. For example, the computation of religious representations is designed for fast inference and practical decision-making. From a religious cognition perspective, Atran’s position highlights the difference between ‘common-sense’ and scientific explanation. While the latter might be rigorous, the former is fast. Of course, intuitive inferences can also be wrong, which helps to explain how modular computation can be affected by cultural learning.

Sperber and Hirschfeld (2004, pp. 40-41) argued that cultural groups share a constant flow of information, some of which is highly relevant and therefore known by most members. Culture on this view refers to widely distributed information, its representation in group members’ minds, and its expression through their behaviours and social relationships. The challenge for the Standard Model lies with explaining the diversity of culture using a common cognitive platform.

Not only does diversity in culture demand explanation, but also the stability that can be found in culture. In fact, any given culture has little chance of propagation unless its content and practices remain stable enough to be defined and reproduced. A religious ritual, for example, cannot be established until it can be reproduced without alteration.
However, it has been well-established that the fidelity of content tends to degrade with transmission; distortion and decay accompany the imperfections of memory and imitation. Yet despite inherent limitations in imitation, communication and memory, almost endless examples of stable cultural content can be found, including religious practice. Cultural stability can be explained by Standard Model advocates through modularity. The mind acquires knowledge more easily when structured in domain-specific ways. In short, cultural universality may be an outcome of common domain-specific processing. Domain-specific modules do not just *process* religious representations, they *cause* them.

In order to recognise items that belong to its domain, a module uses selection conditions as a kind of identification procedure. As a result, cognitive computation might be considered probabilistic in nature. A false positive might result in recognising an image of the Virgin Mary on the surface of a toasted cheese sandwich, but most of the time, the face recognition module is stimulated in response to actual faces. The putative face recognition module may also figure prominently during religious rituals, as well as myths such as those exemplified in European renaissance art and Easter Island statues. The domain functions revealed through empirical testing are summarised in Table 6.2. I repeat that no consensus can be found amongst cognitive scientists regarding how many modules there might be.
<table>
<thead>
<tr>
<th>Modular Domains</th>
<th>Functional Description</th>
<th>Supporting Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of mind</td>
<td>Capacity to interpret behaviour in terms of mental states like belief and desire</td>
<td>(Frith and Frith 2001; Gallese 2001; Leslie 2000; Tomasello, Call, and Hare 2003; Wellman, Cross, and Watson 2001)</td>
</tr>
<tr>
<td>Folkbiology</td>
<td>Capacity to sort living things in terms of their morphology and reason about them in terms of biological principles like growth, inheritance, digestion, respiration, etc.</td>
<td>(Atran 2002; Atran et al. 2001; Gelman 2003; Inagaki and Hatano 2002; Ross et al. 2003; Sousa, Atran, and Medin 2002)</td>
</tr>
<tr>
<td>Number</td>
<td>Capacity to distinguish collections of objects according to the (small) number of elements in the collection.</td>
<td>(Dehaene 1997; Feigenson, Carey, and Spelke 2002; Wynn 2000)</td>
</tr>
<tr>
<td>Face recognition</td>
<td>Capacity to distinguish conspecific faces from other similar stimuli and to identify individuals by the specificity of their faces.</td>
<td>(Bonatti et al. 2002; de Haan, Pascalis, and Johnson 2002; Gauthier and Nelson 2001; Kanwisher, McDermott, and Chun 1997)</td>
</tr>
<tr>
<td>Naive mechanics</td>
<td>Capacity to form consistent predictions about the integrity and movements of inert objects.</td>
<td>(Baillargeon 2002; Hauser 2003; Povinelli 2003)</td>
</tr>
<tr>
<td>Folk sociology</td>
<td>Capacity to sort conspecifics into inductively rich categories, membership in which is based on (supposedly) shared intrinsic natures.</td>
<td>(Astuti 2001; Bloom and Veres 1999; Boyer 2003)</td>
</tr>
</tbody>
</table>

The Standard Model advocates that cognition constrains and directs the expression, content and transmission of religious content. Its defence of domain-specific modularity reflects a strong adaptationist position, which requires further examination.

**Computation and Cognitive Adaptationism**

Cognitive and evolutionary scientists make interpretations about cognitive design and functionality on the basis of assumptions about cognitive adaptation. For the strong
adaptationist, any functional cognitive design too complex to be the outcome of pure chance must be either an adaptation or the by-product of an adaptation. The presence of complex, interdependent, functional cognitive sub-components cannot be explained by anything other than natural selection-driven adaptations.

I should note at this point that using the term ‘adaptation’ can cause confusion. On my usage, adaptations arrive through natural selection in order to solve ecological problems organisms face for survival and propagation. Sometimes confusion can occur with the term ‘adaptive’, when mistakenly taken as synonymous with ‘adaptation’. An adaptive trait confers survival or reproductive benefits. But, an adaptive trait may or may not be an adaptation; adaptive traits are useful but not necessarily a result of evolution.

The distinction between adaptation and adaption demands clarification because Standard Model cognitive scientists argue that religion can be both an adaptive and non-adaptive trait, but not as an adaptation. In their language, religion represents an evolutionary ‘by-product’, sometimes offering productive social outcomes and other times incurring unnecessary, gratuitous social and personal costs. To make matters more confusing, cognitive scientists view cognition and its underpinning mechanisms as adaptations. Cognitive mechanisms were selected—an adaptation—for purposes unrelated to religion. As a result, cognitive scientists support the by-product view of religion (a weak adaptation position) at the same time as supporting the selection of cognitive mechanisms (a strong adaptation position). In chapter 10 I confront the by-product versus adaptationist argument regarding religion. Here, I focus on the adaptation of cognitive mechanisms.

Strong adaptationism relies on a method of inferring the selection pressures which originally stimulated adaptations. This is achieved by working backwards, or ‘reverse engineering’ the properties of a cognitive function in order to hypothesise about the selection force that could have created it. Using reverse engineering logic demands a problem and a cause. In our ancestral past, as the human population grew, the intense social competition favoured larger, cooperative groups. Since biologically-motivated kin cooperation diminishes as groups get bigger, any group possessing another bonding mechanism would have been advantaged (Atran 2005, pp. 48-55). Religion fitted that mandate.
The strong adaptationist position entrenched in the Standard Model explains the selection of enhanced social cognition, but it does not explain why religious cognition eventuated as well. At the same time, Standard Model stalwarts like Boyer argue that accounting for religion is unnecessary. Religion exists because it can. More specifically, religion was not selected, social cognition was. Religion arrived as an accidental side-effect of super-charged social modules and grew because it enhanced social cohesion, and perhaps, satisfied existential uncertainties and explained physical phenomena.

A counter-position may be sketched out for weak adaptationists, who argue that most complex cognitive capacities are side-effects from early evolutionary by-products that were not adaptations fulfilling specific functions or solving problems in the ancestral environment. Early evolutionary by-products have no function and have since been modified by cultural selection pressures. To the weak adaptationist, religion fits this description, far more influenced by cultural forces than evolutionary forces. Weak adaptationism implies that identifying an original selection pressure has little relevance to the complexity and composition of any given cognitive function. Just because a cognitive function displays complexity does not mean that it had to be the outcome of a specific selection pressure. Furthermore, reverse engineering complex cognitive functions will not necessarily reveal a causal evolutionary factor responsible for creating it. While religion may have been a positive by-product of adaptation in the environment in which it initially evolved, in other environments, including the current environment, it may be maladaptive (Sosis and Alcorta 2003, pp. 264-274).

Cognitive traits are considered adaptive because they reflect a particular set of selection pressures. Thus, cognitive traits must be studied within specific ecological contexts in order to assess whether a current trait delivers the greatest reproductive success or not. However, such a process cannot be undertaken without a detailed account of the ancestral environment. Nevertheless, from a reverse engineering viewpoint, the Standard Model has not yet accounted for religion’s commonality or robustness. Both imply that religion somehow responds to the selective pressures created by potentially diverse ecological contexts. It may be premature to assess the costly commitments associated with religion as accidental, or even as maladaptive, by-products. Costliness may be a cultural adaptation, a possibility taken up in the following chapter.
At the risk of oversimplification, strong cognitive adaptationism seeks complexity as an indicator of functional specialisation, from which original problems and selection pressures can be inferred. The Standard Model tends towards strong adaptationism, but without going the full distance in claiming the presence of an innate religious module. On the other hand, weak adaptationists consider complexity misleading, and often irrelevant to the precipitating biological problem or function. Cognitive complexity is not a signal to look for historical selection pressures.

I find the strong position overstated. In fact, it may obstruct theoretical progress when used to generate functional explanations on the basis of vague guesses about ancestral environments. When the strong position goes too far it generates a post hoc evolutionary story based on the presence of a cognitive function’s complexity and pervasiveness. From an empirical viewpoint, weak adaptationism pursues more demanding explanations. It requires unpredictable deductions rather than just consistency or a retro-fitting evolutionary imperative. Perhaps unsurprisingly, I argue here for the concomitant use of strong and weak strategies, initially keeping them distant until a combination yields a new interpretation.

The Standard Model has made little progress beyond presumptions of domain-specificity towards the number, type, extent, independence, interaction and composition of modules. It has, nevertheless made the definitive point that no modules exist that corresponds exclusively to religious domains.

**Religion as a Unique Computational Domain**

I have outlined the Standard Model’s commitment to domain-specific modularity. But does religion command a specific cognitive domain, and therefore a specific and dedicated computational module? One instructive approach begins by distinguishing between religious concepts and others involving counterintuitive representations. For Boyer (2001, Ch. 2) and Mithen (1996, pp. 167-170), the violation of intuitive ontologies features in religious concepts where domain-boundaries overlap. Religious practitioners interpret the resultant concepts literally due to strong emotional associations and cultural indoctrination. However, the counterintuitive concepts can also include a host of other non-religious representations including the scientific (like quantum physics).
Like Pyysiainen (2003a, pp. 18-22), I argued earlier that violations of intuitive ontologies are not sufficient to explain religious belief. Counterintuitivity might characterise religious concepts but it does not explain them. The Standard Model must also explain why practitioners believe religious beliefs to be true. In order to be convincing, the explanation has to avoid the trap of using computation as the point of differentiation between religious counterintuitive representations and non-religious counterintuitive representations. For example, characters violating intuitive domains appear regularly in works of fiction, but no one thinks them real. Thus, a computational process capable of discriminating between religious counterintuitive representations and non-religious counterintuitive representations would have to be remarkably sensitive.

Religious ideas may be the natural result of inevitable domain boundary-crossing. The problem remains that some counterintuitive concepts refer to scientifically-validated phenomena while others do not, and differentiation seems unlikely for even a precise computational process. My view is that religious doctrine plays an important role, sorting the wheat from the chaff. It serves as a kind of pre-computational classification system, accounting for the ambiguities and paradoxes in one sweeping set of concepts. The cognitive structuring religion performs allows the chaos of all possible counterintuitive ideas to be channelled into a handful, and for the ‘real’ ones to be differentiated from the fictitious. Theoretically then, religion does not constitute a cognitive domain, nor does it require a unique computational process. It instead works with the available intuitive cognitive domains, but slips across boundaries (Pyysiainen 2003a, p. 233). At the same time, culturally acquired doctrine provides religious practitioners with a system for reflectively evaluating concepts on the boundaries, which appear counterintuitive. Thus, when we see something move out of the corner of our eye in a cemetery at night that intuitively seems like an apparition, it will be reflectively confirmed or rejected later in line with cultural learning.

Like Pyysiainen, other Standard Model contributors have concluded that religion arrived as a side-effect of other cognitive adaptations selected for prosaic survival reasons. There is no specific religious domain and no exclusive religion computational module. Standard Model advocates like Atran (2002, pp. 67-71), as well as cognitive scientists like Pinker (1997, pp. 524-26, 554-60) and Kirkpatrick (1999), have argued that religious belief involves more than one domain-specific mechanism. Suspicions of
supernatural agency accompany the pattern-matching responses that arise with an agency detection module sharply on the lookout for hazards. Attributing agency to the supernatural is a side-effect of computational processes which evolved for social purposes. The cultural phenomenon we call religion reflects the product of ‘aggregated’, but ordinary, cognitive processes (Barrett 2000, pp. 29-34). Representations need not be anchored in a single modular domain. In fact, the more supernatural representations draw on multiple domains, the stronger their cultural stability (Sperber and Hirschfeld 2004, p. 45). For example, Birgegard and Granqvist’s (2004) experiments determined a correspondence between the cognitive computations associated with conceptions of parents, and those associated with God.

Somewhat ironically, the computational power of the Standard Model may be attributable to the way religious representations do not neatly align with the computational mechanisms that process them. There cannot be a religion module because religious representation computation delivers a domain-violation, which is memorable because the computation returned a violation. In a crude sense, religious modules do not exist because whatever modules that actually process religious representations fail. If there were a religious domain and a corresponding religious module, then religious representations would be returned as intuitive. If there were a religious module, we would all automatically be believers.

Conclusion
The computational power of the Standard Model relies on the accuracy of its functionalist and modularity assumptions. Religious cognition occurs when domain-specific, modular processors perform computations on religious mental representations. If functionalistic representation transformation loses credibility while the connectionist paradigm gains it, then the Standard Model will become more vulnerable. I address this possibility in more detail in chapter eight on neurological plausibility. Despite the Standard Model assumption that modular processes manage both perception and reasoning, the issue has not been resolved either, and remains a source of debate. An allegiance to domain-specificity across all cognitive faculties characterises the Standard Model’s position on computation. Other than to say that modules govern planning, decision-making and the development of inference and explanation about the world and its contents through the processing of domain-specific representations, the Standard
The Standard Model does, however, provide some general predictions about how religious computation works through a domain-specific modular process. I have noted that future work might expose an entirely different mechanism governing computation that integrates more easily with the prevailing neuroscientific evidence. Nevertheless, whatever the replacement for modules might be, it must be capable of making similarly useful, if general, predictions while resolving the anomalies I have highlighted in this chapter.

On the Standard Model, the computational mechanisms that manipulate religious representations function through domain-specific modules with dedicated functionality, and fast, efficient processing. However, Standard Model interpretations presume that numerous modules engage during religious thought and behaviour, blurring the distinctions between ontological domains (Pyysiainen 2002, p. 1). While specific, the computational processes managed by modules cannot be exclusive to religious representations. Since counterintuitivity infuses religious representations, the computational process must have produced a domain violation. If a religious domain and a corresponding religious module were engaged, then religious computation would produce intuitive inferences. On the other hand, the Standard Model claims that counterintuitive domain-violations explain the memorability of religious concepts, and therefore their transmission success. The learning and transmission of religious concepts are examined in more detail in the following chapter dealing with psychological plausibility.

The main challenge associated with domain-specific modularity lies with determining which cognitive mechanisms operate during religious cognition. To weak adaptationists, the challenge revolves around the plausibility of domain-specificity, but for the Standard Model the challenge is a matter of probability and extent. Although committed to multiple domain-specific computation, the Standard Model cannot specify modular degree, composition or role.
There have been several attempts to identify the computational modules relevant to religious cognition. Commonly, theory of mind, folkbiology, number, face recognition, naïve mechanics, and folk sociology, modules are identified. However, even a cursory inventory of cognitive functions would produce an immense list. Standard Model scholars have tended to ignore the potential scope of the list and focus particularly on those cognitive functions that could bolster supernatural agency if violated. My concern is that any computational process in any putative module could return a domain violation. I see no compelling reason why any violation should be interpreted as the work of a supernatural agent. I have suggested that religious doctrine helps by providing a pre-computational sorter classifying violations. If religion exerts a cultural force upon cognition then we can explain why only certain counterintuitive domain violations seem relevant. This kind of weak adaptationist view does not feature prominently in a Standard Model tending towards strong adaptationism. However, the Standard Model does flex somewhat in order to account for the prodigious anthropological data about religious practice. In so doing it has found a place for ritual as cognitive-behavioural mediator. It is also the site for a promising inter-field theory, a possibility I explore in testing the relevant of my claims for novel inter-level connections as exemplars of progress.
Chapter 7. Psychological Plausibility of the Standard Model

Introduction
In chapters five and six, I argued that the Standard Model relies on a counterintuitive characterisation of religious representations, processed through domain-specific cognitive modules. However, the Standard Model also takes the view that the modules responsible for processing religious representations do not operate exclusively for religious concepts. If the mind contains no innate religious function, then the Standard Model must also explain how minds acquire and transmit religious representations. In part, at least at a representational level, the answer has already been provided: the successful transmission of religious representations relies upon of a common cognitive receptivity, enhanced by memorable counterintuitive notions. However, the Standard Model account struggles to differentiate religious cognition from other culturally universal forms of cognition.

Psychological plausibility builds upon computational power, and the cognitive mechanisms operating upon religious representations, by explaining the idiosyncratic ways in which religious practitioners actually think. In this chapter I aim to build on the previous two by reviewing the Standard Model’s position on computation-representation in the context of religious concept acquisition and transmission. I conclude that the Standard Model’s computation-representation assumptions broadly accommodate religious concept transmission. I concur with the Standard Model’s claim that the practice and emotional response accompanying the performance of religious ritual delivers an optimal memory engagement conducive to the transmission of religious concepts. However, as with the previous chapters, I make my assertions tentatively and subject to a suite of conditions. I continue to harbour a fear for the legitimacy of the Standard Model as a high potential research program. To rehearse a serious concern that I raise later, assumptions within the Standard Model treated like a Lakatosian ‘hard core’ should actually be seen more like a protective belt. For this reason, I argue that a compromise ‘soft’ core, or Hardcastle-inspired principles, offers a better approach. Such flexibility, in my opinion, shows evidence of a useful, developing research ‘program in-the-making’. We see in this chapter what Stepin (2005) referred to as ‘paradigmatic grafting’, where cognitive science builds new explanations by cobbling together old ones from multiple disciplines. Grafting is noteworthy to my arguments.
about explanatory frameworks and their capacity to uncover previously unseen connections between levels (and disciplines). ‘New’ empirical knowledge illuminating the plausibility of theories, hypotheses and their predictions remains an obvious component in the progress of a research program. In addition, I argue that in multi- and inter-disciplinary research, programs should also create new knowledge by grafting existing knowledge together in novel ways.

Notwithstanding issues around modularity, in the previous chapter I argued that the Standard Model presents a ‘computationally plausible’ theory of religious cognition. The present chapter goes one step further. Here I consider whether the cognitive and anthropological evidence reinforces the computation-representation account in terms of “the particular ways that humans do it” (Thagard 2005, p. 18). Accordingly, I attempt to determine whether the theoretical predictions of computation-representation align with descriptions of religious practice. With the exception of neuroimaging studies investigating religious experiences—which are examined in chapter eight—empirical studies have focussed on the hidden psychological world of religious thought: the anthropological tradition of observing religious ritual and practice. Standard Model advocates believe that religious rituals help to expose religious cognition. Their position maintains that the successful transmission of religious representations occurs 1) during periods of common cognitive receptivity, 2) enhanced by counterintuitive notions, and 3) an optimal engagement with memory via the repetition and emotion inherent in religious rituals.

As described in the previous two chapters, the Standard Model claims that religious cognition builds upon the inferential capacities in ordinary cognition. Boyer (1998, p. 876) maintained that religious concepts are acquired through social interaction, but supported by the specific working of modules. He used counterintuitive religious representations as a vehicle for connecting cognitive receptiveness with cultural content. Similarly, Tremlin (2006, pp. 149-151) argued that religious ideas rely upon shared mental mechanisms (cognitive modules), transmitted through a population in the form of public representations, or commonly shared representations. This strongly cognitivist view assumes that the ‘public representations’, or concepts associated with religion, are contingent upon the mind’s processing apparatus and method. Since minds have to come into contact somehow, religious practice offers the ideal forum. As a result, the
Standard Model has appropriated some anthropological techniques and concepts, such as Whitehouse’s Modes of Religiosity theory. In addition, as Anttonen (2000, pp. 46-47) observed, counterintuitive concepts need to have a specific cognitive and normative status in order to become ritually engrained in culture so that specific values receive emphasis. For the Standard Model, this means that the composition and practice of rituals plays an instrumental role in the experience, acquisition, amplification, and propagation of religious concepts.

I organise this chapter into six further sections, each reflecting a different aspect of the cognitive interpretation of religious ritual and practice. In the first section, I explore ritual structure in order to frame the subsequent discussions on ritual practice. I propose that religious ritual is characterised by five features: 1) invariability and sequencing, 2) formality, 3) symbolism, 4) expectations, performance quality and goals, and 5) unusual environment and context. Later, I reinforce the importance of counterintuitive representations of supernatural agents as a distinguishing feature of religious rituals.

In the second section, I examine several prominent cognitive theories of religious ritual connected to the Standard Model. Each assumes that religious concepts are transmitted by normal cognitive mechanisms where certain cultural content falls into a narrow channel of cognitive receptivity. For example, Boyer and Lienard’s theory describes the relationship between the cultural and cognitive from the viewpoint of optimality. The key issue, as usual, remains counterintuitive content in representations. On this view, overzealous hazard detection inferences create anxiety subsequently assuaged by ritual performances containing counterintuitive representations of supernatural agents. Although the theory explains the cultural canalisation of religious concepts, I highlight several anomalies inherent in the position that weaken its psychological plausibility. Foremost, I cannot reconcile the practical connection between experiences of anxiety driven by modular inferences, with the practice of religious rituals.

In the third section, I examine Whitehouse’s Modes of Religiosity theory, which introduces the importance of memory and emotion. I use it to advance a more sophisticated position on cognitive optimality. The central premise of the Modes of Religiosity theory asserts that successful religious representations involve particular kinds of doctrinal repetition and emotional arousal. Notably, both tend to be present
during religious rituals. I note some contradictions associated with the Modes of Religiosity theory, but also suspect that it exposes a duality in the way rituals engage cognition. I propose that rituals provide both relief from overzealous modular activity, as well as amplification of anxiety by adding counterintuitive features to existing intuitive inferences. I argue that religious rituals should be thought of in terms of cognitive ‘capture’, where computation performs in a way innately programmed to seize upon, and bolster, particular representations.

In the fourth section, I assess how commitment or signalling theory corroborates the psychological plausibility of the Standard Model. Commitment theory helps to explain how religious practices increase group cooperation and trust through participation in costly actions. Religious rituals demand the performance of irrational actions based on unverifiable assumptions. However, group rituals signal commitment, and can be reinforced by the powerful emotional reactions periodically accompanying ritual performance. In addition, repetition substantiates the veracity and meaning of the performance. Rituals therefore help to reveal an important intersection of two pivotal theories: Modes of Religiosity theory and commitment theory. Given that I suggest programmatic progress needs to reveal novel inter-field connections, this offers an exemplar supporting the Standard Model’s potential.

In the fifth section, I address the significance of emotional stimulation in ritual. Rituals anchor religious content. I also claim that the inferences practitioners make about which beliefs to embrace and which behaviours to perform, are not derived exclusively from evidence or even doctrinal repetition. In fact, the emotional values indigenous to the religious representations in question influence the impact of religious rituals. Some representations may possess advantages in cultural transmission because they provoke stronger emotional responses. The emotional dimension of religious concept transmission is further analysed in the following chapter which considers religious and ‘mystical’ experiences. It will be at this point where I have enough pieces to start building the basic premises of an inter-field theory connecting religious cognition and experience.

In the final section of the chapter, I argue that rituals present an important connection between cognition and behaviour within the Standard Model’s framework. Furthermore,
the computation-representation theory underpinning the Standard Model is psychologically plausible, but subject to serious gaps and an absence of detail. On the one hand, this chapter helps to establish that the Standard Model’s propositions as plausible at worst, and legitimate at best. That is, the connections between disciplinary interpretations provide some helpful corroborating evidence. On the other hand, the propositions generate weak predictions. As I mentioned in the previous chapter, an alternative but unknown mechanism might be the cause. In addition, some components within the propositions can be falsified, as this chapter and the next two reveal in places.

Cognitive Interpretations of Ritual
According to the Standard Model, rituals deliver concepts ideally suited to cognitive receptivity. To a large extent, this explains why rituals have become a universal component of religious practice (Dennett 2006, p. 75). It has been well documented that religious traditions connect with significant life experiences such as birth, death, natural events, war and food. For cognitivists the conundrum pertains to persistence. Why do practitioners expect rituals to work in the absence of evidence, and what mechanisms govern the expectation of success? (Appiah 2009, p. 199).

Anthropological research has a rich tradition of examining ritual meaning, structure and function. In these treatments, rituals perform as communicative actions with multi-layered meanings relative to a foundation culture (Dulaney and Fiske 1994, p. 245). Rituals may be broadly described as intuitively recognisable, stereotyped, rigid, and repetitive behaviour characterised by a lack of causal and rational motivation, and found in cultural practices, both religious and secular (Boyer and Lienard 2006, pp. 597-599). Rituals may be a distinctive and universal mode of action, but there remains some lack of detail about which specific actions should be considered distinctive and universal. Nevertheless, as I will argue shortly, several features of ritual defines their performance and differentiates them from other cultural activities. I think this approach provides a profitable interpretation of rituals. In other words, ritual features are more useful than ritual contents. The former I claim as universal, while the latter are innumerable and defy taxonomisation. My view supports at least part of the Standard Model’s position on rituals as a carrier of cognitive content about religion.
In the following section, I have revised Rappaport’s three features of rituals (1999, pp. 32-50) and added two features to create a synthesis of the literature. I consider the careful explication of ritual features pivotal to demonstrating their connection with cognitive content.

1. Invariability and Sequencing
A religious ritual is invariable in that it follows a standardised and inflexible pattern of activity and adheres to common performance criteria, including a prescribed temporal order (Sosis and Alcorta 2003a). For example, serialization forms an essential component in ritualised communication. Regular timing must be strictly maintained, such as a weekly church service or a daily call to prayers.

2. Formality
Rituals are formal in that they adhere to established forms and conventions. Officially prescribed and recognized, rituals employ formality (Sosis and Alcorta 2003a). As Rappaport (1999) specified, formality means an ‘adherence to form’ where participants act consistently with prescribed expectations. For example, all major religions include formalized events and activities, such as baptisms. Religious rituals require the performance of formal activities possessing no intrinsic value. Instead they hold meaning through symbolic power.

3. Symbolism
Symbols help to convert simple routines into rituals (Sosis and Ruffle 2004). A symbol is an item embedded with meaning greater than its overt function or appearance. Rituals possess a symbiotic relationship with symbols; ritual performance reinforces symbols at the same time as symbols become imbued with significance as the result of ritual (Bliege and Smith 2005; Geertz 2000, Ch. 8). At least four manifestations of symbolism can be found in religious practice, including stories and myths, ceremonies and rituals, imagery and signs, and anecdotes and stories. Humans hold a unique capacity to invent and wield symbols (Geertz, 2000, Ch. 8; McCauley and Lawson 2002, Ch. 3; Mithen 1996, Ch. 3-4; Pinker 2002, Ch 4, 20). This capacity requires conceptual representations whereby objects and ideas not present or tangible can be imagined and understood. Anthropologists have established symbols as markers defining boundaries of cooperation and inclusion (Alvard 2003, pp. 129-135; Atran 2002a, pp. 86-87; Boyer
4. Expectations, Performance Quality and Goals

The expectations associated with rituals influence their performance (Boyer and Lienard 2006; Rappaport 1999, pp. 37-45). In some circumstances, expectations may be strongly connected with success, or super-normal goals, like performing meditation to induce ‘spiritual enlightenment’ or praying for rain. Expectations may also link with prosaic rituals such as lighting a candle or saying ‘grace’ prior to a meal. However, the performance of religious rituals tends to be associated with outcomes that defy rational, causal expectations.

5. Unusual Environment and Context

Rituals invoke orderly behaviour in environments quite different to those associated with everyday life (Boyer and Lienard 2006; Rappaport 1999, Ch. 2). In a religious context, rituals may hold greater transformative power including the potential for developing group solidarity, than in secular circumstances. One common explanation is that religious ritual environments tend to be purpose-specific. A church or temple introduces a unique environmental dimension difficult to reproduce in a community hall or a home.

To summarise, religious rituals enact specified behaviours which are standardized, rule-bound, predictable, repetitive, and directed towards super-normal goals. In addition, rituals require physical performance in a deliberate sequence, with little variation. Formality and embedded symbolism inflates ritual importance. In religious contexts, ritual performance is compulsory, despite an absence of information regarding its efficacy. Rituals are also undertaken in specific contexts or environments which facilitate their performance or amplify their significance.

In short, I define religious rituals as bounded, repetitive, serial activities that confer symbolic meaning when performed in specific, predetermined contexts with the ambition of achieving super-normal objectives. The limitation with this definition is that, with the exception of super-normal objectives, religious rituals seem similar to any other kind (Dulaney and Fiske 1994). I therefore will construct a more precise
formulation of super-normal objectives, which I consider pivotal to specifying religious ritual and the cognition it demands. For the Standard Model, the representations inherent in religious rituals are cognitively attractive as a by-product of their counterintuitive features. As a result they play a symbolic psychological function by providing a memorable anchor linking concept to practice.

Cognitive Ritual Theories
If cognitive processing features in an account of religious ritual, then the Standard Model must distinguish between cognition-heavy ritual, and ritualised actions or ‘mindless’ routine. Religious rituals occur when sequenced, formal actions combine with symbols representing counterintuitive concepts about supernatural agents (Boyer and Lienard 2006, pp. 595-600). But, ritualised actions should not be confused with routinisation. This distinction becomes clear once the notion of mindless repetition is discarded. To cognitivists, ritualised action demands high control, attentional focus, and an explicit emphasis on correct performance. In contrast, routinised action is automatic, involves low attentional demands, and a limited emphasis on performance.

Boyer and Lienard’s (2006) model of ritualised action proposes an explanation consistent with Standard Model modularity assumptions, in this case using an evolved precaution system developed to detect and react to inferred threats. Because the system causes anxiety, ritualised activity conveniently re-focuses attention on the motor control needed for simple gestures and movements. As a result, working memory becomes overloaded, leading to relief. Underpinning the model is an assumption about the connection between pathological obsession and security motivation, as well as a collection of assumptions derived from the character of specialised modular processing. Of the latter, for example, Boyer and Lienard assumed that the precaution system is an outcome of a module designed to provide a sensitive hazard inference response. The model of ritualised action implies that Boyer and Lienard consider the inclination to perform rituals to be a cognitive adaptation. They conceded that rituals contribute to coordinated social action, but also pointed out that social explanations fail to explain why rituals include redundant, goal-irrelevant and scripted actions.

The model of ritualised action suggests that rituals work because they over-tax working memory and allow practitioners to displace the anxiety accompanying an over-excited
precaution system. An obvious limitation with this account lies with the assumption that religious rituals are performed in response to some kind of hazard raised by a modular, inference-detecting precaution system. A ritual performer would have to infer the presence of some form of danger or problem in his or her environment leading to feelings of heightened awareness or anxiety. Perhaps general existential anxiety might be temporarily alleviated through the performance of a ritual that distracts one’s mind from a problem. However, I struggle to see how general existential anxiety would arise through any specific computational inference. Equally, a sharper anxiety experience stimulated by inference, such as the threat of personal danger, will not necessarily be followed by ritual performance. Nor would a ritual performance assuage any serious, life-threatening fear. I can see, however, where reflective thought might increase anxiety and be diminished through ritual performance. For example, a religious practitioner might be diagnosed with a serious illness leading him or her to attend mass to pray for healing.

Rituals under this scheme provide a structure in which anxiety is diminished through the repetition of activities which are cognitively demanding. With this focused attention, religious representations gain a foothold in practitioners’ minds, and become anchored as they are continually used to allay inferential anxieties. However, a final problem is that the model does not satisfactorily account for the fact that religious rituals can increase anxiety. In some cases, religious rituals can stimulate the precaution system to generate inferences leading to more agitation amongst practitioners rather than less. In fact, as I shall argue later, rituals which stimulate emotional arousal are amongst the most powerful in transmitting religious representations.

The model does help connect ritual performance to cognitive process. I consider this link important because it shows how religious representations can be packaged best for cognitive receptivity. Rituals under this scheme provide a structure in which anxiety diminishes through the repetition of cognitively demanding activities. With focused attention, religious concepts gain a foothold in practitioners’ minds. Religious concepts become anchored when continually used to allay inferential anxieties. However, I do see one final problem. The model does not satisfactorily account for the fact that religious rituals can also increase anxiety. In some cases, religious rituals can stimulate the precaution system to generate inferences leading to more agitation amongst practitioners.
rather than less. In fact, as I shall argue later, rituals which stimulate emotional arousal are amongst the most powerful in transmitting religious representations.

Where Boyer and Lienard’s model of ritualised actions emphasises reductions in precaution module activity, Sorensen’s (2002, pp. 180-184) version suggests that rituals may work the other way around as well, stimulating novel inferences, or connections between inferences. Not only do rituals provide relief to overzealous modular activity, they also amplify them by adding counterintuitive features to existing intuitive inferences. Although the causal aspects of the relationship do not fall within the ‘mainstream’ Standard Model, computation-representation remains at the hub. Two approaches with similar emphases were offered by Lawson and McCauley (2002), and Whitehouse (2004).

Lawson and McCauley’s (2002, pp. 155-156) cognitive approach to ritual form works on the premise that the cognitive mechanisms involved in ritual activity are the same as those computing generic forms of representation. They argue that rituals incorporate actions for which already well-developed systems operate. Of course, this is the position held by the Standard Model. Nevertheless, if generic computation manages ritual activity, we return to the question of what differentiates religious rituals from any other kind. Lawson and McCauley’s answer is that religious rituals require representations of agents possessing counterintuitive characteristics, the presence of which shapes the qualities of rituals. Specifically, three sub-aspects provide further clarity about the difference between religious rituals and other forms of ritualised action (Lawson and McCauley 2002, pp.169-174).

First, the specific acts conducted in religious rituals are unique to religious conceptual schemes. But, if content distinguishes a ritual, then the definition problem reverts to the unique properties of that content. However, Lawson and McCauley provide an answer in their second point. Enquiries about the causal or rational foundations of religious rituals end with the enabling role of a supernatural agent. Supernatural agents and their intervention answer all troublesome questions.

Finally, only in religious rituals do participants perform actions willing intervention by agents with counterintuitive characteristics. For example, a baptism will not work with
just any water. It has to be holy water, which has become holy as a consequence of the joint efforts of a sanctioned facilitator in the form of a blessing, and God, who channels His powers via the blessing.

Lawson and McCauley’s (pp. 157-158) formulation of religious rituals helps us to deal with the role of super-normal objectives. They claim that the key to characterising religious ritual lies with the location and number of superhuman agents invoked to act. From this vantage, all paths lead to understanding how the mind processes supernatural agents and counterintuitive representations during rituals. For the Standard Model, the answer always returns to the centrality of a computational-representational, modular conception of the mind.

To speculate for a moment, there may be a bandwidth in which supernatural agent concepts become cognitively optimal. Too much engagement will lead to overtaxed computation, whereas too little will be inadequate to stimulate memorable inferences. Boyer might predict that the most easily transmitted rituals employ a set of concepts in which only a minimal number are counterintuitive.

The cognitive connection between rituals and their counterintuitive content provides a central thread in my assessment of psychological plausibility. However, the question is not whether rituals are successful in transmitting religious concepts, but rather why they are successful. Perhaps unsurprisingly, the Standard Model maintains that the presence of counterintuitive representations about supernatural agents in ritual practice determines transmission effectiveness.

Two key questions remain to be answered. First, in what ways do emotion affect cognition during particularly intense ritual activity? Second, what effect does repetition have on the representation and computation of religious concepts? At the periphery of the Standard Model, Whitehouse offers some answers by introducing memory and emotion through his Modes of Religiosity theory.

**Modes of Religiosity**
A foundational position in the Standard Model is that the transmission of religious concepts requires a minimum level of ‘psychological fitness’. The mind’s ability to
receive religious concepts determines the success of content transmission. To that end, the most contagious religious concepts are ‘cognitively optimal’, in that they align with the fixed and universal propensities of human cognitive apparatus (McCauley 2005, p.xii). By this sweeping claim, McCauley meant that religious concepts rely on the inferences generated by modules. Moreover, those containing counterintuitive elements defy modular inferences and consequently become more memorable. Similarly, Whitehouse (2004, Ch. 2) emphasises cognitive computation in concept transmission. As a vehicle for transmission, he elevates rituals to a priority role. According to Whitehouse, ritual composition determines cognitive optimality. Religious practices involve the transmission of complex, culturally diverse ideas which stretch practitioners’ cognitive tools. For example, religious ideologies involve complicated interpretations of events and specific doctrinal behaviours that challenge the limitations of human memory. Whitehouse believes that memory has a significant influence upon religious cognition.

According to Whitehouse (2004, Ch. 4), successful religious concepts take advantage of two particular aspects of memory: repetition and arousal. Together they enhance concept recall and transmission. Repetition works through exposure, where more leads to better recall. It also delivers a generic and context non-specific ‘semantic’ memory. Arousal works through emotional stimulation where high levels associated with concepts or events leads to stronger recall. Arousal produces a highly specific and context-driven ‘episodic’ memory. Both forms of memory engage during the performance of religious rituals.

Ritual occurs in all religions. Cognitive anthropologists such as Whitehouse view rituals as a fundamental feature in the transmission of ideologies because it incorporates both semantic and episodic memory, although not necessarily together. For example, when rituals reinforce relatively unchanging codified knowledge, a ‘doctrinal mode of religiosity’ operates. In contrast to this top-down dissemination of religious concepts, when rituals stimulate arousal memory through distinctive, emotionally charged episodic activity, then an ‘imagistic mode of religiosity’ transpires. To Whitehouse, the way that these two modes of religious expression engage memory makes them effective platforms for the successful transmission of religious concepts.
As an extension, Tremlin (2005, pp. 171-184) introduced a ‘dual-process’ model, contrasting explicit with implicit cognitive processing. Explicit processing involves conscious, serial, and slow cognitive operations, creating explicit, abstract, and unemotional representations. Implicit processing deals with automatic, parallel and fast operations, creating unconscious, practical, and emotional representations. The key to Tremlin’s contribution lies with its connection to a psychological experience of cognition. His theory predicts that implicit processing will trump explicit processing because it has greater utility, emotional engagement, and relevance. Tremlin claims that implicit processing is therefore the more ‘natural’ mode of religious cognition. For example, implicit processing demands psychological priority, explaining why doctrinal religious leaders cannot prevent practitioners from modifying religious formulae. Ultimately, religious systems are compelled to gravitate toward a balance of explicit and implicit forms of religious practice. This ‘optimum’ composition is underpinned by computational utility (modular inferences) and psychological relevance (emotional power).

Modes and dual-process theories have been criticised for being descriptive rather than explanatory (Hinde 2005, p. 33; Pyysiainen 2005, p. 163). Moreover, modes of religiosity theory begins with the premise that the doctrinal and imagistic modes somehow combine to make optimal use of episodic and semantic memory. But as Day (2005, p. 86) observed, there is nothing in the theory to justify its preliminary assumption. Nothing in the Standard Model accommodates the assumption either, although I will offer some suppositions.

I think that the Standard Model’s most convincing explanation for ritual success emphasises their requirement for attentional focus in order to deflate hyper-active hazard detection or other inferential modular activation. However, as I argued earlier, the Standard Model version of the cognitive role in rituals remains severely limited. For example, although rituals might demand attentional focus, religious practice involves a multiplicity of more mindless routines as well. I suspect, along with Tremlin’s thinking, that routinisation also encourages receptivity though concepts imposed by sheer repetition. Although cautious of modes theory, Boyer (2005, p. 24) conceded that “the standard model … can be supplemented with a series of causal hypotheses derived from independent evidence concerning transmission processes and social dynamics.” For
Boyer, Modes theory generates some interesting propositions that remain to be satisfactorily tested empirically.

Whitehouse predicted that high-arousal rituals instigate deep and spontaneous exegetical reflection from which practitioners gain insights into ritual meaning. At the same time, the emotional power reinforces ritual’s transformative power. Religious gatekeepers therefore preserve and protect rituals as knowledge-rich vehicles for learning and acceptance. Richert, Whitehouse and Stewart (2005, pp. 140-143) tested Whitehouse’s prediction through two physiological-response experiments designed to assess participants’ reflections upon rituals. Data revealed that participants with stronger emotional reactions to rituals also experienced stronger, deeper and longer levels of meaning reflection. These results imply that a cognitive account of religious concept transmission via rituals must go beyond immediate modular inferences.

The relationship between the Standard Model’s conception of computation-representation, and the roles of both memory and emotional religious experience, need to be clarified before a psychologically defensible theory of religious cognition can be established. I venture further with both elements, the former in a forthcoming section of this chapter, and the latter in the next chapter.

Another cognitive-anthropological connection that helps bolster the Standard Model’s psychological plausibility is commitment or signalling theory, which assumes that religion increases group cooperation by providing costly signals to group members engendering trust and mutual belief (Dow 2006, pp. 70-72). It represents another potential inter-connection between cognition and context that satisfies both psychological and anthropological evidence.

Commitment and Signalling
The acceptance of supernatural agents, Alcorta and Sosis (2005, pp. 325-328) noted, contradicts natural ontological categories, the logical classifications made about the nature of being. Dead ancestors with present wishes, talking totemic animals, and omniscient gods are unnatural assumptions. However unnatural religious beliefs might be, Alcorta and Sosis observed that they elicit deep devotion. Of course, Boyer’s articulation of counterintuitive concepts has already offered an explanation, but Sosis
and Alcorta (2003) proposed that in part counterintuitive concepts act as an overt register of belonging, thereby connecting their computation-representation to behaviour and transmission. Religious behaviours require sacrifice, representing credible signals of commitment.

Commitment or signalling theory maintains that religion comprises a system of costly signals that diminishes deception and enhances social cohesion (Dow 2006, p. 70). The challenge lies with establishing why humans engage in religious behaviours that cost them in time, energy, and materials, as well as in physical and emotional trauma (Sosis 2003, p. 92). However, this very conundrum may also be the key to unlocking the universality of religious traditions. For example, Irons (2001) showed that costly religious behaviours are hard-to-fake signs of commitment to a group, which discourage insincere members from joining. An outsider would have to endure unacceptably high costs in order to gain the rewards of membership to a religious group. Only genuine belief makes the costs worthwhile. And, belief is learned and maintained through the performance of ritual (Sosis 2003, p. 116).

Anthropologists embrace commitment theory enthusiastically because it integrates interactive theories of symbolic communication with more materialist theories of individual rational and strategic action (Bird and Smith 2005, pp. 221-222). Signalling allows individuals to powerfully demonstrate commitment to irrational, unverifiable and counterintuitive ‘truths’, leading to enhanced bonds of trust and fellowship (Dow 2006, p. 71; Iannaccone 1992, p. 274). For example, Sosis and Bressler (2003) showed that communes imposing costlier requirements enjoyed greater longevity. In another experiment, Sosis and Ruffle (2004) demonstrated that males in an Israeli Kibbutz who attended synagogue daily were the most cooperative as measured by their preparedness to share a potential financial windfall in a simulation. Brumann (2001) found that religious communes distinguishing between sacred rituals and prosaic activities were more successful than those without such clear demarcations. Yet another study demonstrated that the presence of God concepts increased prosocial behaviour, even in anonymous situations involving strangers (Shariff and Norenzayan 2007), although Chen and Lind’s (2004, p. 2) study revealed that religious groups possessing greater within-group giving are less inclined towards welfare and encourage social conservatism. There may also be a relationship between strictness and commitment; an
observation that has been used to explain the shrinking congregations commanded by the more moderate and inclusive major denominations, such as the Catholic Church (Finke and Rodney 1992, Ch.7; Iannaccone 1994, pp. 1180-1181).

While religious rituals enhance solidarity effects, secular rituals can as well. Although some secular rituals are powerful, they tend not to hold the same connective and transformative influence as those associated with religion. The difference may have something to do with the sanctification of unfalsifiable beliefs inherent in religious rituals (Sosis and Alcorta 2003, p. 268). For example, performing a ritual that cannot be logically justified or objectively verified seems to evoke a substantive emotional reaction reinforced by repetitive practice. Rituals serve as emotional anchors for social solidarity and belief. Indeed, when activated, they reveal the honest condition of adherents’ faith through difficult to fabricate physiological responses, thereby enhancing trust in the group (Adolphs, Tranel and Damasio 1998, pp. 470-474; Morris, Ohman, and Dolan 1998, pp. 467-470).

Several important connections with the Standard Model need to be highlighted. First, counterintuitivity relies on context and the composition of a belief set. In addition, what seems to be intuitive or counterintuitive is determined by modular computation. For the Standard Model, counterintuitive concepts hold relevance because they are cognitively optimal. To anthropologists, however, counterintuitive concepts are socially optimal as well.

Second, commitment theory adds further weight to the relationship between emotional response and religious cognition. Demonstrating commitment through physical displays stimulates an emotional response that further anchors ritual content.

Third, agency inferences of the kind identified by the Standard Model may support signalling. For example, social agency includes the intuitive search for trustworthiness in a social group.

Finally, rituals provide an accessible intersection between cognition and behaviour, where the latter may instantiate the former. If this is the case then participation in ritual may precede belief. To employ Sosis and Ruffle’s (2004) conclusion: “The greatest
cooperation can be achieved when frequent and emotionally evocative rituals are employed to bolster postulates that are highly unfalsifiable” (p. 112). A connection with signalling can also be introduced through emotionally salient commitments to superhuman agents capable of motivating moral exchange (Bulbulia 2009, p. 73). Signalling links religious cognition, moral cognition, and emotion.

To speculate, commitment signals become most powerful when they include counterintuitive concepts embedded in ritual. Absorbing beliefs through repeated participation in rituals drives concept internalisation, augmented by their physical, public, formal, and repetitive features. Ritual performance amplifies belief for the simple reason that to avoid cognitive dissonance non-believers will either change their beliefs or stop engaging in the ritual. Accordingly, the cultivation of belief is less a factor of ‘brainwashing’ as popularly imagined, and more a factor of continued ritual performance, particularly when the beliefs embedded in the practices overlap with those already held by the practitioner. I also think Bulbulia (2009, p. 74) is on the right track in proposing that cognitive firewalls stand between religious information and practical action. Rituals help this process by insulating emotionally salient beliefs and actions from practical and functional behaviour. Moreover, consider McClenon’s (2002, p. 4) cross-cultural examination of rituals associated with healing, which suggested that the placebo effect was a powerful influence in the belief that rituals work. Although beliefs and their supporting symbols vary substantially, the framework of religious ritual actualises these symbols in order to define the sacred (Rappaport 1999, Ch. 4). Symbols would seem to act as cognitive triggers stimulating ritualised behaviour. Perhaps the need for, and expression of, symbolic metaphors is innate, even if the content relies on context. As Boyer (2001, pp. 19-23) proposed, symbols become sacred through the shared creation and evocation of their emotional valence, rather than their intrinsic properties. For this reason, I turn next to emotion, with the additional intention of introducing the pivotal connection between transformative religious cognition and neurological activity in the following chapter.

**Emotion as a Psychological Mediator of Religious Cognition**

The strength and robustness of religious belief belies the mundane character of its cognitive deployment. The Standard Model makes it plain that religious thought is prosaic, parasitic upon ordinary cognitive mechanisms. But cognitive functions,
Pyysiainen (2003a, pp. 97-109) argued, encourage the creation of counterintuitive concepts, which elicit significant emotional reactions serving as cognitive anchors. In fact, conceptual knowledge may be strongly connected to physical responses. Studies have demonstrated (e.g. Barsalou, Barbey, Simmons and Santos 2005, p. 18) that visual, tactile, auditory and kinaesthetic senses all produce responses to conceptual representations, like the mere thought of a large, hairy spider on your arm. The addition of sensory modalities to cognition helps to explain how emotion might assume a larger role in a more robust version of the Standard Model. Religious art provides an example in that it provides imagery of disembodied, supernatural agents in a form that can be imagined by religious practitioners, thereby encouraging cognitive simulation and repetition. This process can be enhanced through the practice of rituals as well. Specific body positions may offer anchors that stimulate certain conceptual knowledge as well as conditioned emotional responses. Symbols may even provide stimuli connecting cognition with sensory and emotional response. I speculate next about the mechanisms through which this connection might be maintained.

Emotional responses to religious rituals may connect with cognition through the explicit or symbolic content of rituals. Since religious statements transgress material verification, adherents cannot appeal to logic in order to affirm the symbology inherent in a ritual. An adherent’s only recourse for demonstrating solidarity with the practicing group is to attest through experience. Accordingly, religious rituals tend to stand apart from secular rituals in that they demand a high level of intra-group cooperation and commitment in order to sustain a common absence of scepticism. The process demands the utilisation of meaningful symbols, both overt and tacit. Symbols in turn serve as anchors linking their conceptual representation to sensory memory. In this way, the mere thought of a symbol used in a ritual elicits a physiological outcome and a corresponding emotional experience.

The lack of a substantive account of the relationship between cognition and emotion in the Standard Model represents a gap in its explanatory framework. The problem can be traced to a simplistic conceptualisation where cognition is treated as independent from emotion and behaviour. Cognition and emotion cannot be separated, according to Thagard (2005b, pp. 60-63). Cognitive expressions of emotional states stimulate the emotions they signify. Moreover, religious commitment relies upon the emotional
benefits they deliver. Religious concepts must be infused with emotion. This position has received growing acceptance with the acknowledgement from neuro-psychologists such as Damasio (1999, pp. 40-42, 1994) and Fazio (2001), that all decision-making contains an emotional dimension, as in fact does every form of thinking. From this now uncontroversial premise, Thagard proposed that consistency between thought and action diminishes logical tensions between beliefs, and constructs a system of intellectual commitments leading to emotional coherence. For example, when people apply reasoning to determine the best explanation for the existence and design of the world, they make judgements that produce both positive and negative outcomes. The evaluation of positive and negative outcomes cannot be a detached cognitive calculation. Instead, strong emotional attitudes influence decisions. Thus, emotional coherence reminds us that decisions about what beliefs to embrace and which behaviours to enact are not exclusively based on hypotheses and evidence, but also on the emotional values connected to the concepts in question (Thagard 2005b, p. 72). Taking the argument a step further, cultural anthropologists like Dulin (2011, p. 224) propose that cross-cultural “regularities” in religious belief and practice can be explained in part by “basic universals in the human emotional repertoire”. This view is consistent with my earlier argument concerning rituals where religious concepts become associated with existentially-relevant emotional themes.

Conclusion

The evidence I introduced in this chapter concentrates on accessing and explaining the role of cognition in religious ritual. The Standard Model advocates that the cognitive analysis of religious ritual provides a window to understanding the practice of religious computation-representation. Specifically, it holds that computational inclinations for social exchange reinforce costly commitments to supernatural agents and the ritualised performances that expose them. I went further, suggesting that the successful transmission of religious concepts might be described in terms of a common cognitive receptivity, enhanced by counterintuitive notions of superhuman agents, and an optimal engagement with memory via the repetition and emotion exercised by religious rituals. Notwithstanding debates about the nature and stimulus for social exchange inclinations (matters which need to be addressed concerning modularity and neurological activity), substantial support for the behavioural outcomes they predict can be found. As a result, rituals appear to offer a useful connection between cognition and behaviour in a manner
supportive of the principles articulated in the Standard Model. It also reveals how the Standard Model can play a role in revealing potential sites for inter-field theory development.

Cognitivists assume that religious representations are transmitted through normal cognitive mechanisms driven by a modular capacity for inference. In this respect, inference becomes sovereign over imitation. The Standard Model claims that certain cultural content falls upon fertile soil, canalised by the powerful inferential properties of the mind. Boyer’s influential theory describes this process in terms of cognitive optimality. Religious representations contain counterintuitive features more readily memorable because they optimally align cultural content with cognitive receptivity. Taking cognitive optimality a step further, Whitehouse’s Modes of Religiosity recognises that culturally diverse concepts stretch recipient’s cognitive tools, particularly the boundaries of memory.

For Standard Model advocates, rituals present an important confluence of exposure, repetition, emotion, and transmission, which collectively culminate in a transmission effect. I suspect that rituals might also provide both relief from overzealous modular activity, as well as amplify it by adding counterintuitive features to existing intuitive inferences. From the perspective of the Standard Model, cultural rituals should be viewed in terms of cognitive capture. Religious content becomes attractive because rituals engage innate cognitive systems.

Commitment theory represents another cognitive-anthropological connection that bolsters the psychological plausibility of the Standard Model. It assumes that religious practices increase group cooperation through the display of costly actions which prompt trust. In addition, the performance of a ritual that cannot be rationally verified can stimulate a powerful emotional reaction that becomes anchored with subsequent performances.

To summarise: First, rituals provide a transparent site for the examination of how religious cognition operates in practice. Second, religious rituals contain counterintuitive representations of supernatural agents. Third, ritual performance is cognitively attractive because it reduces anxieties stimulated by overzealous modular
inferences. Fourth, the invoked enabling role of supernatural agents enhances the
cognitive optimality of rituals. Fifth, doctrinal or repetitive rituals encourage semantic
memory, while imagistic or arousing rituals instantiate episodic memory. Repetition
leads to routine, which in turn decreases active cognition, allowing external concepts to
be more easily overlaid. Conversely, arousal leads to reflective thought, which bolsters
religious thinking. Sixth, rituals that involve costly signalling stimulate social inferences
while demonstrating solidarity and trust. Seventh, signalling rituals utilise symbols to
amplify their expressive power because symbols anchor and evoke emotional responses,
reinforcing the cycle of concept transmission.

The evidence and theories discussed in this chapter help in understanding how religious
computation-representation works. Based on the evidence and theories presented, I have
adopted several suppositions which I consider promising. These include the importance
of counterintuitive supernatural representations, social inferences supporting group
cohesion, and a combination of memory triggers generating emotional arousal, with
reflection and repetition engraining doctrine. However, these suppositions also reveal a
sizable gap between the Standard Model explanatory framework and the way religious
activity tends to work in practice.

The main problem comes with the leap from computation to behaviour. For example, if
domain-specific modules are at work, it remains unclear which ones activate during
each ritual mode. Their interface with memory also needs clarification. Another
complication appears to be that at least some religious practitioners participate in rituals
without believing in their efficacy, which implies that rituals are not a sure-fire method
of transmitting religious concepts. I tackle this issue directly in chapter nine on the
practical applicability of the Standard Model. A third problem is that although it seems
likely that some rituals approach a kind of cognitive optimality, the precise composition
has yet to be resolved. In fact, the vast range of religious rituals and their content may
make this problem unassailable. The current approach to finding optimality assumes
that ritual content is far less important than the manner in which the content is presented
to practitioners. Some steps toward resolving this problem arise from my analysis of the
integrative power of the Standard Model in chapter eleven. Finally, the relevance of
emotional arousal continues to appear with little explanation for its role in mediating
cognition, although some further clues are examined in the next chapter.
Chapter 8. Neurological Plausibility of the Standard Model

Introduction
Neurological plausibility refers to the Standard Model’s ability to describe and explain the neural correlates of religious cognition. However, the neural correlates of general cognition have not yet been established, and the prospect of isolating religious cognition remains a distant objective. Religious cognition involves a vast range of different forms of ‘ordinary’ cognition. I have already laboured the Standard Model point that religious cognition is ‘parasitic’ upon ordinary cognition. As a result, the neural correlates of religious cognition cannot be specified until every (at least) major kind of cognition is mapped. And yet, the neural underpinnings of religious cognition form a key element in the Standard Model’s future performance because its propositions and predictions need to correspond with neural architecture and activity. The evaluation of neurological plausibility therefore seems problematic.

The Standard Model relies on a wide variety of cognitive computations, most of which command interest in cognitive or experimental psychology, but have only just begun to be studied in cognitive neuroscience. To make matters worse, even if voluminous data were available identifying the neurological correlates of various kinds of cognition, they would not necessarily tell us much directly about religious cognition. It would be easier if there were some unique or defining characteristic of religious cognition that could be distinguished from other forms of cognition.

As I argued in chapter five, although counterintuitive concepts present a practical mechanism for distinguishing religious concepts from others, they are not exclusive to religious thought. Nevertheless, mapping brain activity during counterintuitive thought would be helpful. For example, it might reveal that thoughts about God activate the same neural centres in a religious practitioner as thoughts about Superman in an atheist. Alternatively, an agency study specifying the neural correlates of inferences about God’s thoughts could be compared to inferences made about the thoughts of humans. Unfortunately, such data are not yet available. However, I will highlight some useful results from other neuro-imagining studies, which expose the brain structures involved in inference and agency. These studies show, albeit crudely, the brain structures
connected to important cognitive activities. On the other hand, they fail to tell us anything specific about religious cognition.

While limited data make establishing the neurological plausibility of the Standard Model problematic, scrutinising the available neuroscientific evidence remains important. For example, one area connected to religious cognition has received an unusual amount of neuroscientific interest. The neurology of religious experience has been studied seriously for several decades and has been the subject of conjecture since William James’ *Varieties of Religious Experience* was first published in 1902. James distinguished between the physiological responses that accompany belief, and religious doctrine. James’ *The Varieties of Religious Experience* (1902) proposed two kinds of hardwired impulses in humans. Low-level instincts manifest as desires, while deeper urges lead to voluntary sacrifice and challenge. According to James, the arbitration between these two types of instincts defines the nature of religious experience. Similarly, Pahnke (1966; 1970) drew heavily on Stace’s (1960) ‘universal mystical experiences’ theory, but reached conclusions consistent with those of James.

The relationship between religious cognition and religious experience highlights how the Standard Model’s framework can be employed to stimulate an inter-field theory. I continue to argue in this chapter that a progressive program or explanatory framework should be able to map inter-field and inter-level connections. In fact, I experiment in this chapter with an inter-level theory of religious experience as a method of testing the Standard Model’s explanatory framework.

Research concerning the neural basis for religious experience has been undertaken with little if any regard for cognitive accounts of religion. I explore the relationships between the two bodies of work and try to determine whether the Standard Model and religious experience hypotheses intersect. Two central issues arise. First, how ordinary religious cognition is affected by religious experiences, and second, how religious experience is influenced by pre-existing religious belief. Although advocates of the Standard Model touch on the relationship only tangentially, the commentaries offered by Atran and Boyer present a firm connection between religious experience and cognition. I sketch a general account of how religious experience might work, leading to speculation about its role in religious cognition through the Standard Model. To foreshadow my position, I
argue that an explanatory framework for religious cognition must accommodate connections between religious thought and religious experience. Since the Standard Model fails to explore this relationship satisfactorily, I fill in the gap speculatively, and suggest that the intersection reveals some important issues including an under-developed conception of the role of emotion in religious cognition. From a progress viewpoint, on behalf of the Standard Model, I fulfil some of the promises Darden and Maull, de Jong, Wylie, and Bechtel have suggested might accompany progressive research programs dealing with different analytical strata.

In the second part of this chapter I introduce the limited neuroscientific data relevant to religious cognition. I comment on the brain structures likely to be involved in several common forms of cognition relevant to religion, including agency-detection. One exciting study I describe reports on the neural correlates of belief, while another reveals that thoughts about religion activate the same brain structures in both believers and atheists.

The third major section of the chapter presents the key hypotheses emerging from work on religious experience. I employ the term ‘religious experience’ in an inclusive way representing all forms of religious, spiritual, mystical, peak and flow experiences and episodes.

As an extension to the second section, I highlight the neural systems relevant to religious cognition, which are also likely to be activated through religious experiences: the Temporal Lobe Hypothesis, the Neurotheological Hypothesis, and the God Centre Hypothesis. The first two have in common the assumption that neurological dysfunction causes religious experiences, the first blaming systemic pathology and the second temporary impairment. Both of these hypotheses offer plausible accounts of the neural precipitants and correlates of religious experiences. Religious experiences may be generated from multiple neurological circumstances, all of which cause a destabilisation in the same structures leading to a predictable pattern of changes in temporal perception and physiological response. In contrast, I find implausible the God Centre Hypothesis, which contends that a specific neural structure has exclusive responsibility for religious experiences and perhaps for religiosity as well. While some structures, such as those connected to the limbic system, certainly operate during all religious experiences, no
evidence can be located for a God Centre which evolved specifically for the purpose of instantiating religious experience.

I conclude that religious experiences are defined and interpreted according to an individual’s prevailing belief systems and cultural norms. Evidence from psychological and neurophysiological research also shows that unusual experiences with similar characteristics need not be attributed a religious or spiritual meaning. Work on psychological flow states as well as mirror neuron activation during observation of physical activity suggests that the conscious awareness of time, space and personal boundaries can be disengaged.

The hypotheses explaining religious experience are important because they point to connections between religious practice and religious cognition. The anthropological research on rituals demonstrates that religious activity shapes belief, but I think it misses out considerable detail about the possible influence of religious experiences. Even for the practitioner who undergoes a brief and weak episode where they become ‘lost’ in the performance of a ritual, their subsequent interpretation of its importance may prove crucial in shaping personal belief. I attempt to explore the relationship between religious practice, personal experience, and cognition. I argue that the three are intricately associated. In particular, religious experience can substantively affect religious belief and thought. At the end of the chapter I propose a general model of religious experience which shows where the Standard Model provides useful connections. All of these observations will ultimately play a role in my argument that the Standard Model offers a useful explanatory framework for research around religious cognition, but that its central propositions reflect a ‘soft core’ of heuristics or general guidelines rather than a Lakatosian ‘hard core’.

Neural Correspondence and Religious Cognition

Cognitive scientists studying religion have not specified at what level of brain structure or function explanations of religious thought should focus (Pyysiainen 2003a, pp. 6-7). The problem also extends beyond religious cognition, as Dennett (2006, p. 316) observed: “Until we develop better general theories of cognitive architecture for the representation of content in the brain, using neuro-imaging to study religious beliefs is almost as hapless as using a voltmeter to study a chess-playing computer.”
Of course, certain cognitive mechanisms engaged in religious thinking may be linked to specific brain structures. For example, some compelling although underdeveloped evidence connects personal agent representation with the prefrontal cortex. Higher order cognitive functions such as planning may also be associated with the prefrontal cortex, playing a role in inhibiting impulsive action and encouraging analysis (Gallagher and Frith 2003, pp. 77-78). The obstacle remains, however, that specifying the neural correlates of religious cognition demands identifying the neural correlates of general cognition. Quite obviously this is an immense task, and one that will need more than current neuro-imaging techniques to resolve (Kandel and Squire 2001, p. 130).

One profitable area of research concerns brain activity during the cognitive states of belief, disbelief and uncertainty. Harris et al. (2008) reported that each of these cognitive states differentially activates distinct regions of the prefrontal and parietal cortices, as well as the basal ganglia. Results from Harris et al. showed that brain areas associated with higher cognition activate during truth-value assessments of linguistic propositions. But, of key significance, final acceptance or rejection relies upon brain areas connected to primitive, hedonic processing. “Truth may be beauty, and beauty truth, in more than a metaphorical sense” (Harris et al. 2008, p. 141) as the brain literally reacts to disbelief in the same way as it does to disgust. In a follow-up study, Harris et al. (2009) used functional magnetic resonance imaging (fMRI) to identify the neural correlates of religious belief by comparing the brain responses of Christians and non-believers. Results for both groups indicated that religious cognition activates brain regions governing emotion, self-representation, and cognitive conflict, while ordinary facts draw more heavily upon memory retrieval. Greater signals emerged when subjects believed the statements proposed, irrespective or whether they were religious or non-religious in nature. Thus, while religious and non-religious cognition engage different regions of the brain, the difference between belief and disbelief appear to be content independent. Atran’s claim that religious cognition is parasitic upon ordinary cognition holds. As Harris et al. (2009) concluded, these data “further our understanding of how the brain accepts statements of all kinds to be valid descriptions of the world” (p. 1). Further support can be found in Kapogiannis et al. (2009, p. 4879) who sought to locate the cognitive and neural foundations of religious belief. Their neuro-imaging study determined that religious belief engages well-known brain networks. Amongst the prominent tasks stimulated by religious belief were abstract semantic processing,
imagery, and intent-related and emotional theory of mind. In addition, the results revealed that adopting religious beliefs relies on a series of cognitive-emotional interactions. For Kapogiannis et al. (2009, p. 4879), religiosity is undeniably integrated into cognitive processes and the brain networks employed in social cognition. With similar certainty, the authors proposed that these brain networks evolved due to their primary roles in social cognition, language and logical reasoning: “Religious cognition likely emerged as a unique combination of these several evolutionarily important cognitive processes” (Kapogiannis et al. 2009, p. 4878).

Instead of wrestling with all the varieties of religious cognition, another option would be to select a distinguishing or representative kind against which to establish a neural correspondence. One candidate would be the neural correlates of counterintuitive thought, while another would be the neural correlates of agency-detection. While the former has never been the subject of a neuro-imaging study, the process of studying the latter has begun.

Blakemore et al. (2003) used fMRI to determine that brains distinguish between mechanical (object-related cause and effect) cognition and intentional-social (human agency) cognition. In short, brains respond differently to objects than they do to other brains. This study did not reveal an easily identifiable theory of mind structural system in the brain. However, neuro-psychological experiments indicate that theory of mind capacity can be impaired in individuals with autism, while unimpaired in individuals with Williams syndrome (Leslie and Frith 1988). Contrary to the results from Blakemore et al., what appears to be a conscious theory of mind capacity might instead be an automatic and unconscious response to the observed behaviour of another person. Agency-detection could be associated with a specific neural structure that can be compromised due to injury or pathology.

It is noteworthy that abnormal patterns of activity in the temporal lobes—particularly the amygdala and hippocampus—have been associated with an inability to recognise objects or even to mistake inanimate objects for humans (Brodal 2004, p. 455). Neuro-imaging studies reveal the brain activities associated with visual object recognition and what occurs when it goes wrong (Aquirre and Farah 1998, p. 322). For example,
McCarthy, Puce, Gore and Allison (1997) showed that the fusiform gyrus of the ventral (underneath) temporal lobe seems to be involved in facial recognition.

To summarise, the temporal lobes moderate a range of recognition activities including auditory processing, while the hippocampus and the amygdala activate during emotional experiences. A complex set of patterns involving autonomic activity, hormonal, and cortical responses are integrated through the amygdala leading to emotional stimulation. Relevant also are the direct and indirect connections to the amygdala through the thalamus and neocortex respectively (Fuster 2003, pp. 47-48). In addition, the left amygdala is preferentially involved in processing conscious emotional information while the right largely deals with unconscious information (Pizzagalli, Shackman, and Davidson 2003, pp. 511-520). Different structures of the brain also play roles in the expression of certain emotions. For example, the amygdale guide the expression of fear, and the anterior cingulate cortex of the limbic system engages during anger (Carlson 2001, Ch. 11). I will argue that both connect to religious cognition as a consequence of the emotional engagement stimulated during religious practice. As a further example, in separate studies, Delgado (2007) and Schjoedt et al. (2008) confirmed that prayer stimulates the dopaminergic (reward) system, delivering pleasant and no doubt motivating after-effects.

Damasio (2001, pp. 103-104) determined that emotion in the limbic system corresponds to activity in the cingulate cortex (or the anterior cingulate cortex), the amygdaloid nuclei or amygdala (known collectively as the amygdale), and the hypothalamus (although it is not always included in the limbic system). In more practical terms, Damasio’s research has shown that emotions produce two kinds of outcomes. First are behaviours producing an emotional expression. Second are the cognitive representations of emotional states or feelings, which influence the ongoing thinking of the subject. Damasio proposed that the limbic system operates as the hub of these emotional processes. Similarly, as I will shortly introduce, a substantial body of research reports that the limbic system stimulates religious experiences and influences memory (e.g. D'Aquili and Newberg 1998, pp. 80-85; Persinger 2001; 2003).

In the next part of this chapter I analyse the competing hypotheses concerning the neural correlates of religious experiences. The hypotheses are relevant to my ongoing
assessment of progress in the Standard Model because they each use data to invoke specific assumptions and predictions about the connections between cognitive activity, the onset of religious experience, and the corresponding neural mechanisms engaged.

**The Temporal Lobe Hypothesis**

In a series of experiments conducted in the 1980s, Persinger (1983; 1984a; 1984b; 1984c) hypothesised that religious and spiritual experiences originate from unusual activity in the temporal lobe. He later concluded that religious experiences are the consequence of microseizures, or temporal lobe ‘transients’, stimulated by brief electrophysiological changes such as corticosteroid elevation from crisis situations, extreme fatigue, or lack of oxygen or blood sugar (Persinger 1983; 1987). In a more recent study, Persinger claimed to be able to evoke sensed presences—the sensation of being with invisible company—which he linked with weak magnetic fields applied over the brain’s right hemisphere (Booth, Koren and Persinger 2003). Persinger (1984) also recorded temporal lobe transients using EEG, concluding that delta frequency spikes correspond to subjects’ reports of mystical experiences. In similar work, Puri, Lekh, Nijran, Bagary, and Richardson (2001) studied schizophrenic patients who regularly experienced religious delusions. PET scans highlighted an increase in left frontal blood flow at the time of the delusions accompanied by an increase in left anterior temporal flow. Puri et al., like Persinger, argued that temporal lobe dysfunction precedes religious experiences, including those known to be caused by temporal lobe epilepsy.

Persinger (1987, Ch. 1, 2) claimed that the transient temporal lobe stimulation during temporal lobe epilepsy—specifically within the amygdalo-hippocampal complex—leads to what he called a ‘God experience’. He stipulated that the characteristics and intensity of religious experiences can be correlated against temporal lobe stability. In particular, the amygdale and hippocampi help to construct a sense of self within time and space. Interruptions to normal amygdale and hippocampi functionality can be interpreted as a merging with the universe or God. Thus, spiritual experience is precipitated by anomalous but specific electrical, vascular and cellular activity in the temporal lobe (Persinger 1992, p. 568; 1997, p. 129; 2001, p. 520). I later argue that Persinger’s position is relevant but oversimplified.
Substantial clinical evidence suggests that religious experiences can be caused by dysfunction or pathology in certain structures in the brain. Wuerfel et al. (2004, pp. 640-642) examined neural activity in epilepsy patients demonstrating heightened religiosity. Patients with high ratings on the religiosity sub-scale of the Neurobehavioral Inventory had significantly smaller right hippocampi. In fact, Wuerfel et al. found a statistically significant negative correlation between religiosity and hippocampal volume. In a parallel line of research, Borg, Andree, Sonderstrom and Farde (2003, p. 1965) reported a negative correlation between the density of a certain class of serotonin receptors (5-HT1A) located in both the Raphe nuclei of the brain stem and the hippocampus, and the experience of mystical episodes. This is an interesting result in light of the already well-accepted role the hippocampus plays in seizure events that have been associated with heightened religiosity.

Further pointers to the neural structures related to religious experience can be found in studies of neural pathology including temporal lobe epilepsy, near-death experiences and drug-induced hallucinations. The brain states associated with these conditions are linked to feelings of depersonalisation, timelessness and spirituality. Religious and mystical experiences are probably limbic in nature. The dysfunction of the temporal lobe represents an indicative marker of religiosity producing symptoms ranging from out-of-body experiences to hallucinations (Saver and Rabin (1997, p. 498). However, temporal lobe dysfunction might be relatively common.

The occurrence of auditory hallucinations in normal populations is surprisingly high. One study reported that a third of the general population has experienced a religious auditory hallucination (Morrison, Wells and Nothard 2000, pp. 68-69). Prince’s (1992, pp. 281-285) cross cultural analysis concluded that Western cultures tend to perceive hallucinations as negative and malevolent, whereas non-Western cultures view them as special. Indeed, extreme mystical states are associated with pathology in secular societies, but taken as sacred where religion is institutionalised (Wahass and Kent 1997, pp. 175-180).

One possibility suggests that psychotic and mystical hallucinations share a common neurological agency (Jackson 1997, pp. 137-138). The point of difference seems to be in the interpretation and the resulting emotional and behavioural response. Psychotic
hallucinations induce negative emotional and behavioural episodes while mystical hallucinations lead to positive and adaptive outcomes. Peters, Day, McKenna and Orbach (1999, pp. 90-92) discovered that adherents to spiritual movements experienced more religious hallucinations than non-religious control groups. But unlike psychotic in-patients, religious adherents showed significantly lower levels of post-experience distress. Similarly, Davies, Griffin and Vice (2001) compared the experiences of auditory hallucinations in psychotic, evangelical and control groups. The psychotic group showed the highest, and controls the lowest, levels of hallucinations. A strong religious or spiritual conviction may be a pivotal factor in determining the content and interpretation of hallucinations. If such conviction results from contextual pressures, then socio-cultural forces play a determining variable in amplifying and directing brain activity. Religious cognition in the form of pre-existing belief could transform ambiguous sensory experiences or hallucinations into religious meaning (Davies et al. 2001, pp. 365-368). I further this line of argument later in the chapter.

The Neurotheological Hypothesis

In contrast to Persinger, D’Aquili and Newberg (1993) focused on religious experiences precipitated by meditative and altered states of consciousness. D’Aquili and Newberg (1993; 1998; 1999) proposed that four structures in the brain combine to create mystical experiences: the inferior temporal lobe, the inferior parietal lobule, the posterior superior parietal lobule, and the prefrontal cortex. Religious or mystical experiences involve a specific sequence of activity in these four brain structures culminating in simultaneous sympathetic and parasympathetic nervous system activity (Newberg and d’Aquili 2002, pp. 259-263). The sympathetic system engages the body’s fight-or-flight response and directs the body’s metabolic energy expenditure. In contrast, the parasympathetic system conserves body energy through quiescence and relaxation.

In an attempt to draw religious experience and cognition closer together, Atran (2002a, pp. 182-186) emphasised the role of ritual and ceremony in creating simultaneous sympathetic and parasympathetic nervous system activity. Initially, ritualised ceremonies focus attention on specific sources of sensory stimulation that induce altered states of consciousness. Examples include hyper-ventilation, deep-breathing meditations, contemplative mountain walks, and chanting. Each of these sensory channels arouses emotional responses in the limbic system (the hippocampus, amygdala
and hypothalamus). Atran hypothesised that an overly-stimulated amygdala becomes hyperactive but undirected, generating feelings of intense but nebulous emotional gravity. In a cascade effect, the hypothalamus receives a flood of raw information that cannot be adequately processed through the autonomous nervous system. In turn, the information cascades through the sympathetic and parasympathetic branches of the nervous system. Since the former prepares the body for action and the latter prepares the body for rest, a system collision occurs. As a result, the body simultaneously experiences a heightened respiratory and heart rate, muscle tone, and hormonal output related to fight or flight, as well as the physiological conditions encouraging relaxation and quiescence. Following the collision, one system or the other ends up dominant. For example, in meditative states, the parasympathetic system tends to win, with the augmented sympathetic system adding a raised perceptual sensitivity. In this way, an individual remains alert, focused and cognitively intense without compromising a relaxed state. In contrast, what Atran described as more frenzied mystical states like those associated with chanting and trance-possession, reflect sympathetic system dominance. Here, prolonged and heightened arousal is followed by a sensual pleasure, in a similar way to a sexual release.

With the over-stimulation of the amygdala comes an overload of the hippocampus, which introduces a new dimension since it mediates emotional expression and adds a conceptual label and significance. D’Aquili and Newberg (2000, pp. 39-41) specified that the neuropsychological characteristics of a mystical experience reflect the strength of an individual’s affective response, and their subsequent inclination to attribute it significance. In addition, Newberg et al. (2001, pp. 118-120) found that during mystical experiences, information flow increases to the frontal lobes but diminishes to the posterior superior parietal lobe. The precise mechanisms remain uncertain, but since the frontal and parietal lobes provide temporal and spatial orientation respectively, we have an explanation for the blurred experience of time, along with perceptions of diffused personal boundaries that merge with a seemingly fluid universe. Consistent with Atran’s view, Newberg, d’Aquili and Rause (2001, Ch. 6) proposed that ‘unitary’, ‘cosmic’ or ‘God’ consciousness—where time and space boundaries become ambiguous—occur when sympathetic and parasympathetic systems fire simultaneously at maximal levels before one becomes dominant. Although uncertain, this nervous system condition likely stimulates a complementary neuro-chemical process. For example, Austin (1998, pp.
287-290) reported that meditation on a singular focus leads to an over-stimulated cerebral cortex, which in turn excites the reticular nucleus of the thalamus. The chain of causality leads the reticular nucleus to block sensory impulses until they can no longer be transmitted. This inhibition shuts down the cortex and releases a complex flood of neuro-chemicals.

Similar reports have been made concerning the brain effects of meditative states (Azari et al. 2001, pp. 1649-1650; Carter et al. 2004, pp. R412-R413; Cysarz and Bussing 2005, p. 85; Davidson et al. 2003; Dietrich 2003, pp. 242-244; Golocheikine 2001; Lehmann et al. 2001; Lumer, Friston, and Rees 1998, p. 1930; Lutz et al. 2004, p. 16373). These studies expose two common features of meditative states. First, sensory input diminishes. The resultant state produces the physiological reactions associated with relaxation. Second, meditation involves a sustained concentration and awareness by focusing on a particular target. Less dramatic than Atran or Newberg et al’s ‘collision’, Winkelman (2002, p. 1876) found that the two features of meditation create synchronized brain activity. As a side-effect, meditators perceive images and conceive metaphors consistent with pre-existing beliefs. At the same time, the brain experiences high-voltage, slow-frequency wave activity controlled by the limbic system, and brain stem connections subsequently allocate synchronizing patterns into the frontal cortex: “This integrates activities of different levels of the brain with coherent brain wave impulses from lower brain structures through the frontal cortex, producing a synthesis of behavior, emotion, and thought” (Winkelman 2002, p. 1879), perhaps accounting for the unusual form of attention.

Attention is well-accepted as a prefrontal brain function, but may also be accompanied by transient hypofrontal activity (Dietrich 2003, p. 244). Although apparently a contradictory state, the unique conditions give rise to a conscious alertness and awareness combined with a lack of cognitive content. When meditators focus exclusively on a single target, they amplify its importance until it becomes the exclusive content of working memory. The exclusive occupation of memory disengages all other cognitive capacities of the prefrontal cortex, potentially causing the alpha wave activity. This phenomenon explains experiences consistent with diminished prefrontal activity, such as feelings of timelessness, a blurred sense of self, curtailed abstract thinking and emotional content, and a sensation of unity with something vast but intangible. The
conditions appear compatible with those predicted by both Newberg’s and Atran’s theories.

The neurotheological hypothesis predicts that religious and mystical experiences can be intentionally generated by experienced practitioners. In my view, this possibility introduces a rich vein of research around psychological flow states and the neurology of vicarious experience.

**Flow States and Vicarious Experience**

Csikszentmihalyi (1990, pp. 72-74) gave the term ‘flow states’ to experiences so intense that perceptions about time evaporate. From a psychological viewpoint, flow states occur when the skill of the participant and the challenge they undertake is matched; peak performance and peak experience align (McInnman and Grove 1991, pp. 333-334). Wise (2002, pp. 11-12) showed that during infrequent but intense moments of high performance, all her subjects exhibited a distinct brain wave pattern from beta to delta. Some evidence shows that like in meditative states, the cerebral cortex and amygdala in the limbic system simultaneously activate (Ashby et al. 1999). According to Wise, information during flow states is integrated between conscious and unconscious levels of brain functioning in an unusually smooth and coordinated manner. In addition, the neuro-chemicals facilitating flow states bolster cognitive efficiency and creativity. Donahoe and Palmer (1993, p. 55) specified that dopamine regulates the pleasant feelings that can accompany flow states, facilitates rapid focusing of the mind, and acts to help exclude interfering stimuli. Dopamine levels may even represent a proxy for the presence of flow states (Horvitz, Stewart, and Jacobs 1997; Koepp et al. 1998).

I think enough research converges at the following speculative conclusions about what occurs in the brain during flow experiences. First, symmetrical brain wave activity occurs, suggesting the paradoxical presence of a partly passive and partly alert mind. Second, elevated activity in the limbic system supports the cerebral cortex where higher reasoning occurs. Third, the release of the neurotransmitter dopamine enhances cognitive performance. These three factors represent immediate hypotheses to be tested during periods of concentrated engagement and euphoric moments of enthrallment. If confirmed, it would reinforce the Standard Model position that peak experiences have a neurological cause and are not connected with religion beyond the dogmatic, cultural...
values overlaid later during interpretation and rationalisation. Furthermore, repetitive religious rituals may stimulate flow states through the ritualistic use of mantra or movement. Repetitive activities of this nature can create the brain conditions ripe for religious experiences (Newberg and Lee 2005, pp. 478-479). According to Sosis (2004, pp. 167-170), religious experiences transpire during the most sacred rituals. Perhaps more accurately, rituals create a flow or peak state culminating in a powerful experience interpreted as religious in nature. Religious experience and religious cognition intersect.

Peak experiences may also be activated by repetitive ceremonies involving music or sound, colour, odour and light (Roll et al. 2002; Austin 1998, p. 503; Sosis and Alcorta 2003, pp. 270-271; Burzik 2004, p. 1). For example, joyful and melancholic music each elicit different electrocortical activity patterns in the frontal brain (Schmidt and Trainor 2001, p. 487). In addition, a coordinated exposure to music and lights can stimulate emotional (limbic) reactions, and flow states may emerge during periods of intense concentration. The primary visual cortex in the brain’s occipital lobe contains chapters of cells responsible for responding to direction, movement, texture and colour of visual stimuli (Gazzaniga, Ivry, and Mangun 2002, Ch. 4). Abstract colours (unrelated to a known object like orange grass) activate the colour areas of the visual cortex, but iconic (representational colours like green grass) also activate the hippocampus, thereby drawing in the limbic system to add an emotional legacy (Carlson 2001, Ch. 6). Equally, we might speculate that colours possess powerful emotional associations connected to intractable representational meanings. For example, red resin dripping from aging timber carvings of the Virgin Mary might be linked with blood.

Most perceptual stimuli are processed unconsciously, but processing can be affected by cognition through selective attention (Fuster 2003, Ch. 6). The use of colour in iconography is one way of acquiring attention. Other forms of perceptual stimuli are common in religion as well. For example, Howell’s (1997) study on the use of ritual to induce altered states of consciousness in a fringe religious movement illustrated the importance of attention-directing music. Altered states of consciousness occur at the confluence of hyperbolising belief, spiritual ‘exercises’ and facilitating perceptual stimuli.
One further strand of research evidence linked with vicarious experience suggests that the brain can undergo significant change simply through observation. Decety (1996) investigated the neural correlates of motor imagery by charting cerebral blood flow, finding that the timing of mentally simulated actions closely mimic timings of actual performance. In addition, the same parts of the brain operate during imagery as those used during the actual performance of a motor task. This means that when a member of a church congregation mentally rehearses the motor skills of a ritual, their brains activate as if they were actually performing the activity. Imagined and real actions share to a large extent the same brain mechanisms. Similarly, Decety and Chaminade (2003) showed that observation of an action involves neural regions similar to those engaged during an actual performance. In later research, Oüllier, Jantzen, Steinberg and Kelso (2005) found that imagined movements generated significant activity in the premotor cortex, supplementary motor area, basal ganglia and lateral cerebellum. By implication, strongly engaged congregation members may remain seated and still, but their brains can work overtime in sympathy with an animated evangelist or during a placid ceremony.

Sympathy may extend beyond motor actions to emotions as well (Adolphs 2002). The perception of emotion in a target can lead to the activation of affective neural mechanisms in the observer. Thus, the observer is prompted to duplicate the emotional actions of their target. For example, a congregation member can react directly to the emotional conditions of the leaders, or other members, which in turn can engage the limbic system and focus attention on a singular target (Wegner, Sparrow and Winerman 2004, p. 846). This brain state probably occurs during prayer and meditation as well. The brain’s ability to engage in activity corresponding to the actual performance of an observed activity may be hardwired though ‘mirror’ neurons (di Pellegrino et al. 1992; Ramachandran 1995; Szalzone 2005). It is possible that mirror neurons facilitate understanding, cooperation, learning, and overarching ‘theory of other minds’. Perhaps certain complex cognitive abilities even require dedicated neurons?

**The God Centre Hypothesis**

Neurobiologist Hamer (2004, Ch. 5) suggested that he had located a gene linked to belief and he was not afraid of claiming it as the ‘engine of faith’. Hamer statistically examined a DNA sample from subjects against their results in a survey on spiritual
propensity. He discovered a weak but consistent correlation. Specifically, Hamer pointed to the VMAT$_2$ gene, which is polymorphic, or subject to different mutations in different people. Hamer speculated that it might be the God gene, or more accurately, a God gene. He also speculated about how the gene might affect self-transcendence.

The VMAT$_2$ gene helps manufacture proteins involved in the transmission of neuromodulators and neurotransmitters. It is probably reasonable to suggest that it has a role to play in mood, amongst other aspects of behaviour. Hamer, however, imagined that the gene changes neurotransmitters in ways that lead to higher feelings of self-transcendence. Moreover, along with other yet to be identified genes, the VMAT$_2$ bolsters faith, encouraging the recipient to feel more optimistic about the future. In this way, Hamer argued that the gene had conferred sufficient advantage to be selected. But, there is no evidence that the gene could be considered more than tangentially relevant to religious belief.

**Implications of the Hypotheses**

The temporal lobe model is strongly reductionistic, even eliminativist, in that it removes the need to explain religious thought beyond the brain’s innate capacity to stimulate religious experiences. The advantage of temporal lobe reductions lies with their specificity and even the possibility for experimentally-induced mystical experiences. However, in my view, there are two reasons why the temporal lobe reductionist approach cannot yet provide an alternative to cognitive accounts of religion.

First, the changes to the brain described by the temporal lobe model do not causally lead to religious experiences. Similarly, seizure disorders only periodically precipitate religious experiences or greater religiosity. While some compelling evidence indicates that temporal lobe malfunction can lead to religious experiences, it is too early to conclude that it represents the definitive cause either, particularly in healthy brains.

Second, although the majority of people have not undergone a religious experience, the majority of people do actually believe in supernatural agents. Thus, belief does not require a personal transcendent experience. In fact, religious experiences are neither necessary nor sufficient to stimulate belief. According to Livingstone (2005, p. 79), the
current neuroscientific evidence presents an obvious refutation of William James’ (1902) once definitive position on the centrality of religious experience in belief.

Temporal lobe models also seem incomplete from an evolutionary perspective. Why would natural selection deliver the capacity for religious experiences? Since executive cognitive functions managed by the frontal lobe allow humans to envision the future, including their own demise, Persinger answered that temporal lobe experiences provide relief against the existential anxieties that accompany corporeal life. The temporal lobes have an inbuilt mechanism for destabilising perceptions of time, space and self. There may even be a link with near death experiences. However, Persinger’s existential relief theory remains unpopular with cognitive scientists and anthropologists, all of whom claim that religion does not necessarily alleviate existential anxiety. In fact, as I have noted in earlier chapters, religion often increases existential anxiety through threats of eternal punishment. We should also accept that religious experiences from temporal lobe anomalies may have nothing to do with an evolutionary adaptation. I think it is too early to claim temporal lobe destabilisation as the exclusive cause of religious experience.

The neurotheological hypothesis offers a plausible argument connecting the temporal region of the brain with spiritual experience. However, some neuropsychological evidence implies a distributed rather than localised mechanism behind religious experiences (Atran 2002a, pp. 174, 196). For example, Newberg et al. (2001) found distributed cerebral blood flow during meditation. In another study led by Newberg (2005), brain imaging data showed increased electrical activity and blood flow to the inferior (bottom) frontal and dorsolateral (upper side) prefrontal cortical regions of the brain during meditation and prayer. Hugdahl (1996, pp. 252-255) noted that these areas inhibit stress-related responses from the amygdala-hippocampal complex and the hypothalamus. In fact, Worthington et al. (1996, pp. 457-458) concluded that prayer bolsters self-esteem and reduces stress, indicating systemic rather than localised brain activity. Temporal lobe instability might be the trigger for a religious experience, but the cause of instability probably comes from the right combination of systemic conditions.
Neuroscientific perspectives do not yet have much to say about the antecedents of religious belief. Given that the majority of religious practitioners do not have intense experiences, the neurotheological hypothesis does not explain everyday worship. Atran (2002a, p. 196) pointed out that we know little about the neurobiology of prosaic faith.

Finally, although a clear connection between the brain (in particular temporal lobe pathology) and religious experience has been shown, the neurotheological hypothesis may have less relevance for non-pathological populations. Furthermore, identifying Persinger’s ‘God spot’ or Alper’s (2001) ‘God part of the brain’ has proven unsuccessful. On the other hand, discernable patterns of brain activity can be associated with reported religious experiences, particularly as they arise from ritualized behaviour.

**Rituals, Religious Experience and Cognition**

It remains unclear how culturally significant rituals induce religious or peak experiences, although I have outlined some possibilities in both the previous section and the previous chapter. I now wish to see whether these possibilities can be placed in a more useful context by mapping some connections between the hypotheses and the Standard Model. It also furthers my attempts to place religious experience within the Standard Model’s explanatory framework.

Religious techniques like meditation and prayer, neurological conditions, and pre-existing religious beliefs all connect with religious cognition. Three connections have been investigated (e.g. Boyer 2003; James 1902; Newberg and D’Aquili 1998): 1) specific religious experiences are associated with specific brain events; 2) specific religious experiences encourage belief in specific religious concepts; and 3) the specific concepts articulated by those who have undergone religious experiences—like mystics—influence a group’s religious traditions. Progress has been made with points one and two above, but the third remains troublesome. However, we can be confident that culturally transmitted concepts provide a host for religious content (Boyer 2003, p. 121). To take another step, ritualised activities may provide a kind of syntax or grammar in which non-verbal religious symbols become embedded and transmitted. In fact, inventing and projecting symbols represents a pivotal aspect of religious rituals (Donald 1991, Ch. 8). But, not only do religious rituals provide vehicles for transferring cultural content, they might also affect neurological conditions.
Persinger and Healey (2002) stimulated a sensed presence by passing a complex combination of pulsating magnetic fields across subjects’ temporo-parietal lobes. In fact, Persinger and Healey managed to induce fear and even peculiar smells. These results suggest that non-clinical populations can be affected by rhythmic stimuli in the same way that seizures can be caused in epileptics. Also, since the amygdala hosts connections to the olfactory tract, stimulating the appropriate part can spontaneously create specific smells. Conversely, religious rituals can employ fragrances which arouse the amygdala leading to focused attention or visual hallucinations.

Directions for intentional action from the prefrontal cortex are processed in the hippocampus and amygdala, which link intentions to emotional markers. Atran (2002a, pp. 155, 165, 168) pointed out that religious rituals like chants and prayers can influence limbic processing and therefore emotional outcomes. For example, unlike the uncontrolled vestibular disruption that accompanies a trip in a boat on a rocky sea, a controlled disruption via repetitive rocking, swaying or other ritualised movements can induce pleasant sensations like floating or feelings of being out of synch with the body. In a clinical example of the phenomenon, Makarec and Persinger (1985) reported that brain activity can be influenced by a range of external stimuli including flashing lights and rhythmic sounds.

Livingstone (2005, pp. 84-87) suggested that the most powerful religious experiences come from ritualised activity governed by a belief system. Livingstone’s model presupposes that prior knowledge and acceptance of religious doctrine will determine an individual’s response to a religious experience. Practitioners interpret their experiences through a prevailing belief system, which circuitously encourages further ritual practice. Conversely, doctrinal religious instruction often prescribes ritual participation, which in turn offers an opportunity to undergo religious experiences. This perspective intersects with Whitehouse’s (2000) Modes of Religiosity theory, which distinguishes between the doctrinal and imagistic, as well as McCauley and Lawson’s (2002, Ch. 2) Ritual Form hypothesis.

Religious cognition is not just influenced by emotion, but is interwoven with emotion. For example, Azari and Birnbacher (2004, p. 902, 906-907) showed that emotion is not ‘pure’ feeling, but rather incorporates a cognitive dimension; emotion can neither be
reduced to pure feeling nor pure thought (Azari and Birnbacher 2004, pp. 914-915). As a result, an account of religious experience must also acknowledge cognitive content. Religious experience cannot be confined to any exclusive conceptualisation of thought or feeling. On the other hand, a more nuanced view of emotion can pinpoint the distinctive content and quality of religious experience. Similarly, Watts (1997, p. 250) revealed that emotions can sometimes occur prior to conscious reflection, but not without “at least some tacit cognitive construction of the situation that elicited the emotion. This also appears true of religion”. Of course, emotions tend to be transient where religious cognition tends to be stable. Watts speculated that religious cognition may be partly described as a mood. At the least, emotions must be mediated by cognition; the specific attribution of an emotion requires some kind of evaluation, appraisal or judgement about the experience. Emotion gives religious experience its unique quality and content. Through emotionally-influenced cognition we can better understand the effect of religious rituals.

Rituals form an artificial reality where behavioural guidelines and counterintuitive representations acquire an appearance of factuality. A commitment to the truth and importance of religious beliefs comes with repetition (Whitehouse’s doctrinal mode) and through emotional stimulation (Whitehouse’s imagistic mode). Repetition reinforces the reproductive fidelity of religious concepts, and encourages practitioners to accept them. An emotional response may occur during doctrinal rituals but they tend to be interpreted within a doctrinal schema, which tends to diminish its personal, emotive impact.

Emotional commitment to schematised religious representations may be considered ‘religious belief” (Pyysiainen 2003a, Ch. 5), as explained through Damasio’s (see 1999, pp. 40-42) somatic marker hypothesis. Emotions characterising both belief and experience correspond to physiological states that denote religious representations. Associations, or somatic markers, form between religious representations and physiological reactions. In the next section, I will attempt to map all of the connections I have noted so far in this chapter to form a speculative inter-field theory of religious experience. I aim to determine whether the propositions contained in the Standard Model help to locate connections with other fields that have shed light on neural aspects of religious cognition.
Bringing the Hypotheses Together: An Inter-field Theory of Religious Experience

In this section I outline an inter-field theory of religious experience. I claim that it shows where the Standard Model can provide a useful investigative framework for religious cognition. Although speculative, I have presented a range of evidence in this chapter to suggest that the following processes occur during religious experiences:

1. All religious experiences occur within the boundaries of pre-existing beliefs, serving as a form of contextualisation. As an interpretive mechanism, beliefs are influenced by cultural conditions as well as inductive, personal evidence.

2. Careful focus upon an activity engages the frontal lobe and pre-frontal cortex. Although the mind is alert and lost in a task, the body remains relaxed due to the influence of the parasympathetic nervous system, which maintains a calm homeostasis. During intense focus, neuronal activity may become patterned in the form of neural firing synchronisation.

3. In the event that the focal activity reaches a threshold of intensity, the sympathetic nervous system engages, flooding the brain with chemicals designed to stimulate the body into action. Reaching this threshold can be facilitated by ritualised activities because they tend to stimulate the limbic system and create an emotional reaction.

4. Now the forces for arousal and quietude are simultaneously engaged and the volume of information through certain parts of the brain cannot be adequately processed. The spill-over forces an over-stimulation of the limbic system and temporary dysfunctions in the temporal lobe, amygdala and hippocampus. In addition, less activity is directed to the parietal lobe. The combination results in the temporary collapse of temporal, personal and spatial orientation.

5. Meanwhile, the frontal lobe remains highly active on a singular task, thus discouraging attendance to other sensory information that might help de-escalate the effect. However, as the effect dissipates, a dopamine spike delivers a temporary but powerful feeling of pleasure.

6. In the ongoing cycle of meaning-making and interpretation, the experience adds to any previous ones and inductively influences existing beliefs. The experience

---

is unlikely to be interpreted as religious in nature without strong pre-existing religious beliefs to canalise the interpretation in line with doctrine.

In summary, I suggest a central role of the frontal and parietal lobes, as well as the limbic system (Lazar et al. 2000; Lou et al. 1999; Newberg et al. 2001; Newberg et al. 2003). Put in simple terms, brain imaging studies show that intense meditation, prayer or ritual performance increases activity in the front part of the brain and decreases activity in the area of the brain that orients bodies in space, blurring the normal sense of self. This brain activity can stimulate feelings of mystical unity, ‘oneness’, peace and even the sensed presence of God or other invisible entities. Meaning relies on reflective thought, strongly defined by previous beliefs and cultural exposure. A reciprocal relationship exists between religious experience and religious cognition where reflective thought and belief influences the interpretation of religious experiences, while religious experiences can also significantly amplify belief. Figure 8.1 illustrates the relationships.
Figure 8.1. An Inter-field Representation of Religious Experience
Conclusion

Standard Model advocates have little to say about the neural correlates of religious cognition, particularly since they assume that religious cognition cannot be distinguished from ordinary cognition. In fact, the Standard Model seems to be on solid ground in this respect considering the early evidence from neuroscientists such as Harris, which shows that atheists and believers use similar parts of their brains to conceptualise religion.

Either all cognitive operations need to be mapped against neural correlates, or a specific, characterising and representative form of religious cognition needs identification. For example, it may be illuminating to map the neural correlates of counterintuitive thoughts, but it would be unreasonable to conclude that the result would be a neural account of religious cognition. A more useful program undertaken by cognitive neuroscientists such as Damasio seeks to locate the inter-connections between emotion and cognition. For example, Damasio’s (1999, pp. 40-42) somatic marker hypothesis indicates that emotion is embedded within cognitive processes such as decision-making. If this theory proves accurate, basic assumptions like the independence of cognition and emotion will need to be reviewed. The Standard Model acknowledges the importance of emotion in religious cognition, but it must not be treated as an outside variable instead of one inseparable from cognition itself. A successful theory of religious cognition will integrate the cognitive, affective and behavioural aspects of religious practice.

In this chapter I have shown that the neurological correlates of religious experience can bolster the Standard Model. Several major research streams have yielded relevant data and hypotheses. The temporal lobe hypothesis, driven by Persinger and other neuropsychologists, emphasises pathology or temporary dysfunction. When structures in the temporal lobe fail in certain ways, they destabilise the brain’s hold on time, space and self. The neurotheological hypothesis, exemplified by the work of Newberg and d’Aquili, focuses on the concomitant activation of the sympathetic and parasympathetic nervous systems. A collision between the two leads to the same kinds of structural destabilisations that Persinger noted. Similarly, correspondence between the brain state stimulated by meditation and that accompanying any kind of intense, singular focus
seems likely. I find it unlikely, however, that a ‘God’ part of the brain may be responsible for religious experiences.

This chapter, like the previous, reinforces the importance of rituals and their capacity to elicit an emotional response. The Standard Model does not go far enough, however, as rituals also influence neurological activity in a way that encourages and facilitates religious experiences. At the least, rituals offer an intense focal point that activates the frontal lobe, stimulates a physiological response, offers a target for vicarious experience and the potential activation of mirror neurons, and confers meaning to religious experiences.

In the final section of the chapter I presented an inter-field theory of religious experience. In so doing, I crudely showed where belief and experience intersect. My model claims that the relationship between neurology and cognition is not just a matter of intersection, but one of reciprocal action. Although a religious experience might be powerful at the time, the process of cogitation that occurs afterwards has greater influence in determining how a religious practitioner makes sense of the experience. The evidence also strongly points to pre-formed beliefs as central in the process of interpretation, as well as the influence of prevailing cultural forces. In fact, religious cognition might operate most powerfully in the space between a self-authenticating religious experience and ritualised activities (Rottschaefer 1985). Without dismissing the impact of religious experiences, I can identify neither a uniquely religious mode of experience nor a unique religious neurological footprint. I concur with Schjoedt et al’s (2009, p. 334) position that, although less exciting, investigating how specific cultural traditions modulate normal cognitive process represents the most productive avenue for future neuroscientific research.

Religious cognition provides meaning while religious experience provides leverage. In between the two, religious practice, whether in the form of rituals, meditation or prayer, help to connect cognition and experience by simultaneously reinforcing doctrinal concepts and creating ripe neurological conditions. Cognition and emotion intertwine, augmenting the impact of religious experience. With the right doctrinal exposure, religious experiences will seem supernormal in nature and will strengthen existing beliefs.
The neurological plausibility of the Standard Model cannot be determined with the available neuroscientific data. However, I have shown that in line with Whewell’s (1967) condition, the Standard Model has the potential to help explain evidence from a phenomenon for which it was not developed to explain. In my view, this outcome bolsters a claim for progress under my reasoning that exposing inter-level connections accompanies a developing explanatory framework. However, trying to anticipate the future of the Standard Model remains frustrated by the fact that some people never accept any form of religious concepts, while others discard those previously held. My next task, therefore, is to determine whether the Standard Model can explain the practical purpose and utility of religion, including the choice of atheism.
Chapter 9. Practical Applicability of the Standard Model

Introduction

By ‘practical applicability’, Thagard (2005a, pp. 17-18) meant a cognitive theory’s capacity to explain real world behaviour and experience. Since I am employing Thagard’s criteria as organising principles, I aim to extend the spirit of his practical applicability test. After all, accounts of religious cognition try to explain why religion exists and how its concepts propagate and persist. In this chapter I use Thagard’s final evaluative criterion to pose the question: Can the Standard Model provide a plausible explanation for religious belief?

This chapter reinforces my broader contention that the Standard Model operates as if its assumptions deserve ‘hard’ core status. A more accurate position would view the assumptions and propositions driving the Standard Model as a collective of what Hardcastle would consider ‘principles’, pliant guidelines rather than inviolable axioms. When treated from the softer ‘principles’ perspective, it becomes easier to see how the Standard Model provides an explanatory framework capable of generating useful empirical outcomes as well as connecting existing theories from different analytical levels. At the same time, an explanatory framework contains weaknesses, as this chapter further exposes.

I begin by outlining the Standard Model’s response to the question of why people hold religious beliefs. In recapitulating the Standard Model’s defence of computational-representational, modular cognitive specialisation, I draw out key assumptions about the mind used to explain religion’s putative universality. I consider how the Standard Model explains the absence of religious belief, the diminishment of religious belief, and the conversion process from one set or level of religious beliefs to another set or level of religious beliefs. Because the Standard Model makes the core assumption that all minds share a cognitive susceptibility to religious concepts, it struggles to explain why some minds reject religion altogether. My analysis therefore leads me to the conclusion that the Standard Model explains the presence of religious belief better than it explains the lack of religious belief. My conclusion recognises that the Standard Model offers some plausible, but incomplete, explanations for atheism.
In the forthcoming analysis, I argue that atheism does not represent the opposite of religious belief, and therefore does not necessarily undermine the Standard Model. I try to avoid a mistake in assuming that atheism exemplifies the rejection of counterintuitive concepts; atheism merely rejects religious counterintuitive concepts. I present some experimental evidence concerning decision-making showing that all humans hold both faulty beliefs and suffer to some extent from flawed reasoning, including holding beliefs containing counterintuitive concepts, both with and without supernatural agents. I argue that the Standard Model might be good at explaining all forms of extreme beliefs. But, I suggest that the Standard Model’s core principles need supplementation in order to explain conversion, non-belief, belief-degradation and belief loss.

**Why Would Anyone Believe?**

The Standard Model remains silent on the matter of religious and spiritual meaning. In fact, Pyysiainen (2002a, p. 5) argued that cognitive science does not aim to provide a contribution. Instead, Pyysiainen emphasised the importance of natural cognitive processes because: 1) empathetic understanding demands inferences and therefore a cognitive dimension; 2) the need for metaphysical explanations is not a universal feature of religion thereby making it a poor driver of cognitive activity; and 3) even if supernatural agents do exist, they will still make their presence known through mundane systems of cognition. Thus, the mind and its machinations should remain the unit of analysis. Belief comes about when normal cognition latches on to religious beliefs because computational inferences amplify counterintuitive representations.

As I observed in chapters five and six, the Standard Model’s reliance on counterintuitive concepts and inferential mechanisms does not fully account for religion’s presence or success. Rather, it accounts for the success of counterintuitive concepts. In my view, the fact that counterintuitive representations are not exclusive to religion suggests that a significant piece of the puzzle remains missing. One solution suggested by Atran (2002, p. 264) supposes that religious representations are the only counterintuitive concepts that elicit a powerful emotional commitment. Similarly, Boyer (2001, p. 90) averred that religious beliefs contain the only counterintuitive concepts that really matter. As Pyysiainen put it, religious belief cannot be explained in terms of “cognitive negligence” (2003a, p. 110). Rather, religious belief operates actively and requires a substantial cognitive and emotional commitment.
I do not deny the power and emotional intensity that religious counterintuitive concepts command. In fact, I have reinforced this argument in the last two chapters. On the other hand, I am not convinced that religious counterintuitive concepts are the only ones that matter. Counterintuitive concepts feature in powerful secular beliefs as well. For example, counterintuitive concepts appear prominently in beliefs connected with war, nationalism, political ideology, sport, and human relationships. To claim that religious counterintuitive concepts are the only ones of importance implies that non-religious individuals either do not hold any counterintuitive concepts in mind, or hold none of consequence to them. The first possibility undermines the Standard Model’s assumptions about the ubiquity of mental mechanisms, and religious cognition’s reliance on ordinary cognition. The second possibility seems obviously untrue. For example, counterintuitive concepts can be found in influential scientific (quantum physics), distorted (love at first sight), ideological (from sport to politics) and fictional (Harry Potter) concepts (Pyysiainen 2002b, p. 115). A second, related problem is a lack of explanation for dramatic but successful counterintuitive concepts, like those embedded within religious cults and extreme fundamentalism.

In order to explain the creation of fiction—counterintuitive representations that do not involve supernatural agents or transform into religious beliefs—Pyysiainen (2002b, pp. 114-116) melded Sperber’s (1996, pp. 69-71) view of reflective representations with Cosmides and Tooby’s (2000, pp. 65-69) evolutionary conception of human cognition. According to Cosmides and Tooby (2000), creating and holding fiction in the human mind is an adaptive function. It provides the ability to run mental simulations of reality on the basis of hypothetical representations. Of course this capacity proves advantageous because it allows us to empathise with others, to imagine the contents of their thoughts, and to anticipate their behaviour. Ironically, the capacity to conceptualise fiction helps us better understand social reality. Pyysiainen (2002b, pp. 114-116) hypothesised that religious belief exploits the cognitive mechanisms that facilitate fiction. However, he also proposed that religious beliefs rely on the way cognition interacts with emotion. Despite the evolutionary function of emotions as regulators of ‘adaptive avoidant behaviour’, Pyysiainen maintained that religion need not serve any adaptive end. Instead religion invokes cognition, emotion and behaviour that work with evolved functions in an epenthetic, parasitic relationship. Religious belief should therefore be viewed within the context of cognition and culture, the outcome of three
factors: a fluid mix of cognitive functions able to transfer features of representations across domains; the reproduction of beliefs in validating contexts; and the ability to create emotional markers against religious concepts and beliefs.

Religious counterintuitive concepts are probably amongst the most powerful. However, they cannot be the only form of influential counterintuitive concepts. If religious cognition is parasitic upon ordinary cognition, then religious counterintuitive concepts must also be parasitic upon ordinary counterintuitive concepts. If the mind holds a predisposition towards counterintuitivity, then whether a counterintuitive concept is religious or not is irrelevant. Conversely, assigning importance to the counterintuitive concepts embedded in a personal belief system is important. I think a better position would claim that counterintuitive concepts appear in any belief system that matters to its host. I will provide some further evidence for this supposition later in this chapter.

Variability in Religious Cognition

The Standard Model assumes that the same cognitive mechanisms govern both religious cognition and “garden variety cognition” (Lawson 1999, p. 721). At the same time, it claims that religious cognition can be distinguished by the representation of counterintuitive supernatural agents. However, this does not mean that all religious practitioners believe the same things. In fact, the evidence suggests that individual religious practitioners hold unique belief sets, even compared with those who belong to the same religious denomination or group. For example, Atran (2002, pp. 13-15) argued that since most cognitive processes are consciously inaccessible, individuals may behave in ways that contradict their declared belief systems. In addition, the cognitive strategies used to manipulate cognitive content appear to be culturally influenced (Norenzayan, Choi and Peng 2007).

Cultures exert a ‘differential expertise’, or a particular set of knowledge about a domain, upon certain cognitive strategies (Norenzayan and Heine 2005, pp. 772-773). Specific cognitive processes might be equally available in principle, but differentially accessible depending upon culture. For example, Asian culture employs high levels of situational thinking, where individual behaviour will more likely be attributed to external factors (Choi, Nisbett, and Norenzayan 1999; Norenzayan, Choi, and Nisbett 2002). Assuming the presence of common existential universals does not therefore mean that a common
Barrett (2004, pp. 2-17) used a division between reflective beliefs and nonreflective beliefs to help explain belief modification. Reflective beliefs demand a conscious and deliberate process, whereas nonreflective beliefs work unconsciously and require little or no attention. According to Barrett, nonreflective beliefs influence reflective beliefs. Because nonreflective beliefs deliver rapid and essential information about the world, their production offers a convenient, non-taxing platform from which to generate assumptions.

Religious beliefs may be seen as reflective beliefs supported and shaped by nonreflective beliefs. I am leading to the suggestion, consistent with Barrett’s position as well as Tversky and Kahneman (1983, p. 294), that the Standard Model explains nonreflective beliefs better than reflective beliefs. Although as the Standard Model claims, the capacity to believe is hardwired, the content of belief—whether religious or otherwise—is more infused than prescribed. Perhaps to some extent the Standard Model confuses the innate structure of belief with the indoctrinated content of belief.

The Mechanisms of Belief
To Barrett (2004, Ch. 6), understanding religious belief means first explaining why anyone believes in anything. Barrett’s perspective assists my argument that religious belief represents one prominent manifestation of a universal capacity to form and change beliefs. I think that the Standard Model tells us more about this universal belief capacity than it tells us about religious beliefs specifically. According to Barrett (2004, pp. 2-17), supernatural agent detection appeals to a natural and inherent desire to anthropomorphise the cosmos. However, if religion constitutes a natural phenomenon leading to unreflective intuitive beliefs, the Standard Model explains belief but not its absence (Pyysiainen 2003a, pp. 110-115). In other words, the Standard Model suggests that compared to theism, atheism is unnatural. Another example can be found in McCauley’s (2011) argument that religion is natural while science is not. Religion depends upon what McCauley refers to as ‘natural cognition’, or automatic, intuitive, largely unconscious computations. Religious thinking goes on behind the scenes,
leaving it difficult to access reflectively to be interrogated by rational processes. At the same time, science demands slow, deliberative and unnatural computations, laboured through precise and semantic language. According to McCauley (2011), science often delivers counterintuitive propositions, an observation we might consider ironic given the centrality counterintuitivity plays in the Standard Model.

However, I suspect that McCauley and the Standard Model exaggerates the naturalness of religious concepts as consequences of modular inferences. Alternatively, the conventional sociological evidence showing that socio-demographic and geographic factors (e.g. Bainbridge 2005) affect religiosity could be re-interpreted in light of cognitive factors. Perhaps, speculated Barrett (2011, p. 235), certain combinations of social structures undercut natural cognitive dynamics. After all, sociological literature is booming with claims that the Internet age has destroyed the foundations of interpersonal relations (see for example, Fernback 2007).

While some atheists may indeed be comfortable living without a metaphysical safety net, I suspect that many also find it discomforting. Rejecting supernatural agents does not make an atheist more or less comfortable with existential uncertainty. All it means is that they do not find religious explanations either plausible or useful. Atheists reject religious concepts that do not make sense in light of the available evidence, or do not seem relevant or helpful to life. Just because the mind has a tendency to convert a rustling bush into a concealed predator does not make nonreflective thought sovereign over reflective thought. When the rustling bush turns out to be just a rustling bush, the correction is handled reflectively; a process that in no way contradicts the natural inclinations of the mind. I cannot find any evidence suggesting that atheists are better at reflective thought or even hold fewer unreflective thoughts as true. My views here correspond with two of Bering’s (2009) observations. He claimed that atheism is “cognitively effortful” (p. 168) and that it does not necessarily align with the natural reasoning that occurs “in their heads” (p. 168). For example, the ‘natural’ psychological inclination facilitates agency. Bering’s “naked intuition” (p. 168) demands atheists to continually correct their predilection to see the world and its contents through an agency lens.
Nor is there evidence that theists find moral reasoning more troublesome, and need to supplement a limited capacity with external heuristics. In fact, the evidence I reviewed in chapter six presented moral intuition as a well-tested modular inference. If the mind produces an intuitive schema for morality then it does not need religious belief for morality at all. It may be true that religious belief amplifies certain moral convictions, but it achieves this through doctrine and reflective processes rather than intuitive and nonreflective cognition. The morality argument would only work if moral reasoning were demonstrably absent without religion, or if religious belief causally led to greater moral reasoning. Neither is true. For Standard Model proponents like Barrett (2004, p. 118) though, resisting religious belief demands a fight against the mind itself: “If religion is the opiate of the masses, atheism is a luxury of the elite”.

The Standard Model misses the mark on atheism because it assumes that religious beliefs are the unreflective beliefs of choice for the mind. Rather, I suggest that religious beliefs neither constitute a single set of beliefs, nor are the only ones that will naturally emerge. Religious beliefs are persistent, powerful and pervasive, but they can diminish, change or vanish. From a practical viewpoint, therefore, the Standard Model excels at explaining the acquisition, maintenance and transmission of religious beliefs, but fails at explaining the rejection and modification of religious beliefs, as well as simple disinterest. Finally, we should also remain vigilant in distinguishing between questions about whether ‘religion is adaptive’ and whether ‘religion is an adaptation’. I have argued that belief systems represent an adaptation while religion is an adaptive trait.

**Religious Conversion**

The term conversion has been used to refer to numerous phenomena including the inward, psychological experience of individuals, their spiritual disposition, and even their public religious affiliation. A useful distinction separates types of conversion into singular events and an ongoing process. For example, Pyysiainen (2005, pp. 150-154) described three stages on a conversion continuum, the first a sudden event driven by an emotional response, the second also sudden but structured by doctrinal content, and the third a gradual cognitive process. Irrespective of the form of conversion and the salience of affective responses, psychologists studying conversion consider it the personal adoption of, or investment of faith in, a particular group of rituals, relationships, roles and rhetoric which collectively serve as an individual’s system of cognitive meaning.
My interest in conversion revolves around whether the Standard Model can account for belief change.

Although most people maintain the religious beliefs of their upbringing, around 10 per cent convert to another faith (Lamb and Bryant 1999, Ch. 1). Of this number is it unclear how many may legitimately be considered converted, having embraced wholesale an alternative doctrine. In general, however, conversion is an uncommon phenomenon, concealed within the minds of a small number of individuals, each unlikely to recognise their path or predict its effects (Rambo 1993, pp. 1-4; Rambo 1999, pp. 259-261; Rambo and Farhadian 1999, pp. 23-30).

The Standard Model leaves us with several gaps in explaining religious conversion. First, it assumes that an atheist would convert to religion because he or she has finally relinquished the fight against an internal mental schema naturally inclined towards religious concepts. In short, they have given in to the current of their cognitive processes, perhaps as Rambo (1993, Ch. 10) suggested, facilitated by a confluence of personal and environmental factors such as discontent and opportunity. Religion-as-adaptation proponents such as Bering et al. (2005, p. 361) would take an even stronger stand on atheism as a mode of cognition against the current. Belief according to adaptationists was selected for the pro-social, cooperative fitness advantages it created. Bering does acknowledge that belief could have arisen as a co-opted spandrel, independently subjected to selection. However, he views God as a way of thinking engrained into permanency by natural selection and difficult to shake for even the most strident atheist.

I return to earlier points I have made about the mind’s capacity to learn and accommodate to circumstance. I do not think that atheism requires so much cognitive vigilance at the same time as I think that cognitive negligence leads to the slippery slope of inexorable belief. As Deacon (1997) argued, human cognition displays an impressive systemic and symbolic capacity. A. Geertz (2010, p. 159) claimed that symbolic-systemic relations “enables us to learn, navigate and maintain systems of ideas, making us the purveyors and peddlers of ideologies, morals, norms, philosophies, science, fiction, sense and nonsense.” Given the vast variety of belief systems on show, from sport to UFOs, I suspect that symbolic-systemic cognitive abilities allow humans to
draw a variety of conclusions from the same basic experiences. While I can accept that cognitive mechanisms assert a probabilistic pressure upon the type of thoughts we have, the need to ‘silence’ God seems like an overstatement of the case.

I think it reasonable to claim that the mind is inclined toward religious belief. However, a better position would claim that the mind more readily accepts beliefs where some of the most persistent contain a counterintuitive element. So, while I accept that some atheists might turn towards religious concepts because they have an urge to do so, it is misleading to think they would replace non-belief with belief. On the basis of Rambo’s (1999; Davis and Rambo 2005) research data, atheists who convert substitute their existing belief set for a more comprehensive one that tends to be doctrinal in structure. I, like Rambo, suggest that the conversion of strong atheists remains rare. Perhaps when it does occur, such conversions must be catalysed through intense peak experiences that cannot be interpreted through existing belief systems. In any case, strong atheism comprises a belief set rather than the absence of a belief set. My point is that holding a belief system should be viewed as the natural inclination, albeit potentially enhanced by an occasional counterintuitive concept, and strongly influenced by intuitive mental processes.

I do not think that my computer crashed because God willed it, but I do sometimes suspect that it is out to get me. Reflective thinking corrects my natural inclination to attribute agency to my computer, just as it does when I see something moving out of the corner of my eye late at night, alone in the house. It is not a ghost, I tell myself, but I can see how someone could draw such a conclusion. For this reason I am sympathetic to the Standard Model’s ‘naturalness of religion’ platform when interpreted as a probability (Geertz and Markusson 2010, p. 156), but its propositions do not adequately explain why atheists naturally employ reasoned, reflective thought to correct their more racy intuitive presumptions. An explanation might be found in the mind’s structure; evolution has delivered a jerry-rigged rather than an economically engineered tool. Reflective thought evolved more recently than nonreflective thought, adding on the necessary corrective mechanism in a brain capable of imagining vast and complex options. I consider how the two work in concert to produce variable beliefs sets in the next chapter on the evolutionary plausibility of the Standard Model.
A second problem for the Standard Model lies in accounting for conversion from religion to agnosticism, from religion to atheism or ambivalence, or from a mainstream religion to a belief system with less doctrine and formality, like new age philosophies emphasising spiritual elements rather than obedience. In cases of backwards conversion, previously held beliefs are discarded or replaced. Each case must be unique in cause and situation, and pinpointing any common cognitive mechanisms driving less belief seems impossible. For example, conversion could be driven by discontent or an escalation of reflective thought. No putative cognitive modules explain how one person can abandon religion while another maintains their beliefs. Individual, social and environmental forces may therefore provide the sovereign factors at play in backwards conversion. Yet if the Standard Model has practical relevance, and it explains conversion toward religion with innate cognitive mechanisms, why should it be any more difficult to explain the reverse?

I can foresee several answers. First, the influence of individual, social and environmental forces are more pronounced than the Standard Model assumes. Second, innate cognitive mechanisms do impel religious belief, but the discontinuation of religious belief can come about through even more powerful individual, social or environmental pressures. Third, some other less well understood cognitive mechanisms (beyond simple reflective thinking) encourage backwards conversion. A final answer I favour suggests that the well-described cognitive mechanisms wielded by the Standard Model work in ways that facilitate belief in general, rather than religious belief in particular. Beliefs become modified, exchanged or supplemented. Even when dismantled, the removal of a belief set does not leave a belief vacuum. This explanation also attributes a significant role to cultural forces. The notion of religious conversion may be misleading because our real interest should be about how any beliefs undergo modification, and how decisions get made.

All humans sometimes make decisions based upon reflectively unsupportable beliefs, irrespective of religious content. For example, in a non-religious context, Strange and Katz (2002) demonstrated that individuals’ beliefs can shift dramatically following the exposure to a fictional narrative. To me, if a good story is sufficient to shift an individual’s beliefs, then cognitive interpretations of religion must be at least partly correct. On the plus side, the result implies that humans are primed to believe dramatic
fiction, while on the negative, it suggests that supernatural and therefore religious content is unnecessary. In the following section, I briefly venture further into the nature of decision-making and reasoning biases.

**Decision-Making and Reasoning**

According to research by Hsee and Hastie (2005, p. 31), people fail to choose optimally because they either do not accurately predict the consequences of their choices, or they ignore their own predictions when they actually make a decision. Some evidence suggests that individuals possess a hardwired set of cognitive decision-making strategies or heuristics, including an emphasis upon emotional responses as well as the results of previous, similar experiences. Experimental psychologists believe that these intuitive heuristics produce systematic biases in decision-making and reasoning.

Impact biases provide a good starting point. They describe an intuitive tendency to overestimate the impact of an emotional event, leading to a preoccupation with the event itself and overlooking the contextual circumstance that play a role (Wilson and Gilbert 2005, pp. 131-133; Wilson et al. 2000, pp. 821-825). A classic example involves predictions of happiness associated with winning a lottery. In fact, happiness is much shorter-lived than people predict, although unhappiness also diminishes faster than anticipated following a negative event.

Despite the evident emotional power of rituals, their impact may be limited, perhaps overestimated by religious participants. Equally, God’s failure to intervene in some important life event despite vigorous prayer and a vigilant lifestyle can be quickly rationalised away in the cognitive process psychologists call immune neglect (Gilbert et al. 1998, p. 619). Like a psychological immune system dealing with incompatible idea viruses, religious practitioners can intuitively rationalise God’s disinterest by imagining all the reasons why they might not be worthy. Emotions can introduce a further variable via skewed arousal states (Van Boven and Loewenstein 2003, pp. 1165-1167). Current states tend to be projected into future imagined states, which might help account for lifestyle promises made to God during traumatic moments, and assumptions that others can be ‘converted’ when regaled with dramatic religious stories (Van Boven, Loewenstein, and Dunning 2005, pp. 130-132).
How past decisions worked out can also affect the accuracy of future predictions. Memory introduces systematic biases disproportionally connected with past, heightened emotional states (Karney and Coombs 2000, p. 959). For example, Kahneman et al. (1993, p. 401) showed that high levels of pain seem more favourable in retrospect when they have a less unpleasant ending. Memory plays a key role in decision biases due to assumptions about choice itself. For example, more choices tend to be considered more attractive than fewer. However, experimental evidence shows that more options lead to worse experiences (Iyengar and Lepper 2000, p. 995), a subtle psychological axiom that strengthens the impact of religious doctrine in helping practitioners to navigate the complex world of choice and moral decision-making.

Decision-making problems do not merely come with poor predictions, but also with failures to act in accordance with accurate predictions. According to Hsee and Hastie’s study (2005, p. 33), rather than choosing what they predict will lead to greater happiness, people tend to select the option with the greatest immediate appeal, or that complies with social norms or religious doctrine. Some rule-based decisions prevent individuals from making choices based on predictions about the best experiential option. For instance, experimental data show that when faced with a choice between two free products, consumers will tend to choose the more expensive item even if they predict that it will give them less satisfaction than the cheaper item (Arkes and Blumer 1985). Moreover, the ‘psychology of sunk costs’ (Arkes and Blumer 1985, p. 124) encourages people to perceive more expensive investments as higher in quality than lesser investments, irrespective of actual quality. In a tangential way, sunk cost thinking might help explain why some religious practitioners do not discard their lifetime’s weekly worship ritual even though their faith has wavered. Perhaps like Pascal and his wager, it is better to stick it out to the end just in case.

Of all the variables causing predictions to be ignored, the most obvious psychologists call ‘medium-maximisation’. Here, individuals make decisions to maximise a medium or proxy rather than the objective. For example, people work harder and longer to maximise their status and wealth without yielding any tangible improvements to their happiness (Layard 2005, Ch. 1). Similarly, religious practitioners may worship with greater frequency, dedication and intensity without receiving any commensurate improvement in psychological or practical benefit.
Compelling evidence demonstrates a systematic tendency for people to make sub-optimal decisions. However, do these cognitive predictive errors help to explain a propensity for religious cognition? Or, more specifically, does the propensity for sub-optimal decisions encourage the acquisition, maintenance or propagation of counterintuitive representations about supernatural agents? I suspect that decision-making heuristics work in concert with the same cognitive mechanisms that the Standard Model holds at its core. Beliefs in general and religious systems in particular, provide useful heuristics guiding life decisions and understandable answers to logically immutable questions.

Decision-making biases may encourage the acquisition of religious concepts. For example, some religious practitioners have made poor predictions about the positive influence of belief on their lives, or may even have ignored the predictions they envisioned earlier. Some may adhere to religious doctrine in order to avoid punitive reprisals from supernatural agents. Sociologists and anthropologists assert that supernatural sanctions work as tools for coercion and to defer defection (Durkheim 1961[1915, pp. 303-326]; Johnson and Kruger 2004; Johnson, Stopka, and Knights 2003, pp. 911-912). Of course, the decision to adopt a religion and its practices may not be as tidy as the previous characterisation would imply. Many religious adherents become inculcated early in life and make few reflective decisions about their religious practices unencumbered by social pressures. It is also worth keeping in mind that recent research has demonstrated a correlation between religious practice and attentional bias. For example, Colzato et al. (2010, p. 93) argued that the expectations of meeting the expectations of one’s religious community demands behaviour that reflects the religion’s rules. As a result, biases towards “cognitive-control parameters” (p. 93) encourage the expected behaviour. Religious practitioners preferentially attend to stimuli consistent with the behaviour they seek to emulate, which of course varies depending on the religion and denomination. Adopting behaviours consistent with a specific religious faith leads practitioners to use correspondingly unique cognitive control styles and biases. These biases affect the way practitioners think about information, including the style and efficiency of their decision-making (Hommel et al. 2011, p. 184).
Some evolutionary theorists have devised an alternative interpretation of decision-making biases, especially where they involve social inferences. Predicting others’ behaviours can be obscured by numerous variables from limited information to deception. Assuming that social judgements will inevitably be vulnerable to error, evolutionary theorists ask how a suitable cognitive system should be designed to deal with them. Their answer comes in the form of Error Management Theory (EMT). It proposes that psychological mechanisms contain predictable biases for survival and social reasons (Funder 1987; Haselton and Buss 2000). In fact, EMT proposes that some biases are not errors but are functional and productive intuitions. For example, males tend to overestimate their attractiveness to females, risking rebuke but enhancing procreation opportunities. In addition, the over-inference of risk and danger, misplaced or exaggerated feelings of distrust or suspicion, food preferences and disgust, and snake or spider fears, have all been explained through EMT.

In application to religion EMT proposes a deceptively simple but compelling argument in the form of an evolutionary version of Pascal’s Wager. Humans receive a fitness advantage by assuming that their thoughts and behaviours are observed by supernatural agents who will judge, reward or punish (Johnson 2009, p. 169-170). On the surface, fearing retribution seems like a negative constraint on behavioural freedom. But according to EMT, it is this very constraint that discourages more serious and practical errors where extremely selfish conduct victimises other group members at the same time as risking real-world detection and punishment. Supernatural beliefs operate as a “mindguard” (Johnson 2009, p. 169) against risky, costly and selfish behaviour. Errors like believing in God can also be adaptive. As Johnson (2009, p. 178) observed, “A fear of the fires of hell may be a very effective smoke alarm against getting burnt for real in this world.”

Johnson and Kruger (2004) and Johnson and Bering (2006) venture much further than the Standard Model accommodates through their arguments about supernatural punishment theory. For example, Johnson and Kruger (2004) claimed that ancestral cooperation received support because compliance failures were deterred through threats of supernatural punishment. Johnson and Bering (2006) went a step further arguing that natural selection favoured thoughts about supernatural punishment because they discouraged costly and selfish social transgressions. They wrote: “As long as the net
costs of selfish actions from real-world punishment by group members exceeded the net costs of lost opportunities from self-imposed norm abiding, then god-fearing individuals would outcompete non-believers (Johnson and Bering 2006, p. 219). As a result, Johnson, Kruger, and Bering speculated that supernatural punishment thoughts represent an adaptation instrumental to the evolution of cooperation. This conclusion stands counterpoint to the Standard Model position that religion is a by-product of other proximate cognitive mechanisms that can be both adaptive and non-adaptive. Of course, even if the threat of supernatural punishment did contribute to the evolution of cooperation, it could not have been an exclusive pressure given the emergence of cooperation amongst non-religious groups.

For the Standard Model, several important implications arise from EMT. First, it separates accuracy from utility. Evolution has no preference for cognitive mechanisms that follow logic, ‘truth’ or content-general rules (Cosmides and Tooby 1994a; Symons 1992). Rather, evolution produces mechanisms that minimise costs and maximise benefits as measured in evolutionary fitness. Second, biases might not be cognitive heuristics, guidelines or short cuts after all. EMT conversely suggests that biases deliver a net benefit and should be regarded as characteristics of effective design rather than cognitive flaws. EMT implies that the cognitive biases present in religious choices reflect adaptive, pro-social decisions whereas the Standard Model presents religion as in more ambiguous light, mostly non-adaptive but sometimes adaptive. Being part of a religious group delivers net benefits from a survival and social perspective. EMT also underscores the importance of analysing the Standard Model from an evolutionary viewpoint, a task I pursue in the next chapter.

Conclusion
In this chapter I noted substantial gaps in the practical explanation for atheism; the Standard Model explains belief better than it does religion. While some people do not adhere to a religious system, no human ever abandons all paradigmatic assumptions and models about how the world and its occupants interact. Religion should therefore be seen as one form of belief rather than the only form of belief. The absence of religious belief is not the absence of belief systems. Furthermore, religion does not comprise a single or consistent kind of belief all of its own. Numerous religious systems, denominations, sects and interpretations have evolved, and as Barrett has
experimentally shown, each individual belief set is unique as well. I have suggested that the Standard Model’s reliance on innate cognitive mechanisms may be more useful in explaining the structure of all kinds of belief than in explaining religious beliefs. While the evidence remains limited, I think that the Standard Model overestimates the universality and ‘naturalness’ of religious belief. A number of key questions also remain unresolved. For example, the Standard Model does not explain which features of religion encourage pro-social outcomes.

Part of my reasoning relies on experimental evidence showing that cognitive decision-making processes incorporate systemic flaws and biases undermining accurate predictions about the future. This position does not contradict the Standard Model’s first principles about cognitive design. However, I emphasise that decision-making biases encourage the use of cognitive heuristics, of which religious thought provides one manifestation amongst many. The Standard Model claims that since religious cognition is ordinary, then religion is natural. I agree, but that does not mean that a lack of religious belief is unnatural. Rather, I think that all it means is that humans have a natural proclivity to devise belief systems to help them muddle through life’s clutter, complexity and uncertainty.² Research also finds that emotional decisions hold sovereign over the logical, thereby bolstering certain kinds of emotion-infusing beliefs. Such beliefs are hardly restricted to religion. In addition, the recurring importance of decision-making and emotional mediation further reinforces my position that an explanatory framework must be capable of boundary-breaking connections between and within analytical levels.

Another problem returns to counterintuitive representations. Some are true while others are not, and deciding between them might be somewhat arbitrary. However, I think that religion sorts the wheat from the chaff, serving as a kind of ontological sorter and accounting for the ambiguities and paradoxes in one sweeping set of concepts. Religion works as a useful decision-making heuristic. We must not, however, take this to mean that religion represents the only decision-making heuristic. In my view, the Standard Model tends towards this trap as evidenced by its disinterest in explaining atheism and

² For example, I have shown empirically that Boyer’s cognitive optimality of minimally counterintuitive belief structures can apply to extreme beliefs in sport. See Smith, A. (2009). An Exploration of Counter-intuitive Conceptual Structures in Organizational Stories, Journal of Sport Management, 23(4): 483-510.
backwards conversions. We must keep in mind that the Standard Model also has difficulty in explaining the acceptance of high proportions of counterintuitive content as found in cult and non-mainstream religious sects such as scientology.

Can the Standard Model provide a plausible explanation for religious belief? While I believe it has offered a progressive explanatory framework, I have observed in this chapter some reasons for caution. The Standard Model struggles with the practicality test. However, two further pieces of the puzzle need to be addressed, the first of which concerns the evolutionary plausibility of the Standard Model. The Standard Model rests upon a range of assumptions that remain contentious in the broader scientific arena. To review these controversial assumptions I must return to some of the most basic notions of cognitive science, including evolution and natural selection, adaptation, domain specificity, cognitive canalisation, and structure-function relations in the brain.
Chapter 10. Evolutionary Plausibility of the Standard Model

Introduction
Each of the previous chapters has acknowledged the relevance of evolutionary theory to the Standard Model. I now address the connection more directly through a new evaluative criterion that I have invented for the purposes of this analysis, labelled ‘evolutionary plausibility’. Evolutionary plausibility refers to the Standard Model’s consistency with evolution by natural selection. The key question concerns whether evolutionary theory supports the Standard Model’s contention that religion appeared as a by-product of cognitive functions adapted for non-religious purposes. Given the weight of evidence supporting evolution by natural selection, a Standard Model satisfying evolutionary plausibility possesses a more promising future. My reasoning fits with numerous prominent philosophy of science concepts including Popper’s corroboration, Hempel’s probability with the weight of diversity of evidence, Hintikka’s informativeness by eliminating uncertainty, Losee’s multiple-level ‘goodness’, Olsen’s coherence, and Swanson’s complementarity. To achieve my goal it will be necessary to consider several evolutionary mechanisms that have been proposed to explain the acquisition and transmission of religious concepts.

This chapter acknowledges two modes of evolutionary explanation. Mayr (1961; 1993) observed in two landmark papers that first, a proximate explanation is concerned with functional causes, including the elements and processes that comprise human social behaviour. Proximate explanations deal with ‘how’ questions. Second, an ultimate explanation is concerned with evolutionary causes, or those which shaped the development of the brain and human behaviour. Of course, the dominant force for evolution has been natural selection. Ultimate or evolutionary accounts provide explanations for the presence of a cognitive trait, or ‘why’ questions. Avoiding confusion between ultimate and proximate causes helps to unravel the evolutionary plausibility of the Standard Model. In general, the Standard Model claims that ultimately, religion is an adaptation which promotes group cohesion. But, proximately, religion exists because the cognitive mechanisms underpinning group cohesion encourage religious belief and practice.
In assessing the evolutionary basis of the Standard Model, I introduce evolutionary psychology. I outline the assumptions about evolution wielded in evolutionary psychology, but express some reservations about its approach to ‘reverse engineering’ the mind and its capabilities. Beginning with the capacity to perform religious cognition successfully, and working backwards to imagine the selection pressures that helped form the capacity, has the potential to confuse a selection input with an output. By this I mean that it could be an error to conclude from evolutionary reverse engineering that religion was selected, when it may really be a side-effect of some generic cognitive functions. Equally, I suggest that the Standard Model must account for how generic cognitive functions came into being. Unfortunately, evolutionary reverse engineering remains guesswork without significantly more information about the environment in which humans evolved.

I regard the Standard Model as an ‘explanatory framework in development’ that holds a strong degree of evolutionary plausibility. The Standard Model does not correspond well with strong theories of cultural transmission, which include group selection and the reproduction of cultural or memetic information, the latter I dismiss as lacking scientific veracity. For the most part, the by-product approach dominates scientific commentary about religion, although more recently direct adaptation has gained in supporters. I note views which manage to find a place to each as well.

In the following section I briefly outline evolution by natural selection and its potential connections with religion. I use this foundation to examine the Standard Model’s evolutionary ‘landscape’ argument in the chapter’s third section. In the fourth and fifth sections I review the key concepts associated with evolutionary psychology, followed by its criticisms. Finally, I discuss whether the Standard Model accommodates the more controversial thinking behind group and cultural selection.

**Evolution and Ultimate Causes of Religion**

Evolution has been broadly defined as the genetic churn within populations over successive generations (Charlesworth and Charlesworth 2003, Ch. 3; Mayr 2002, p. 9). Darwin’s evolution through natural selection indicates that the best adapted individuals within a population have the greatest probability of survival and reproduction. Given that many attributes are predetermined or influenced by genes, those inheriting
advantages slowly make an over-representative contribution to a population’s genetic pool. Evolution works through natural selection, which encourages variations to genotypes through environmental forces. When environments change, organisms experience selection pressures as well. Certain genotypes provide advantages in the new environment, allowing them to survive and procreate more successfully than others. Environmental selection pressures therefore mould genotypes, forcing them to either adapt or be extinguished, where adaptation is measured in terms of reproductive fitness.

Cognitive theorists and most evolutionary biologists believe that religious concepts arrived as evolutionary by-products. Religion does not constitute an ultimate adaptation. Rather, environmental selection pressures favoured ultimate adaptations such as survival instincts and social agency. Religious cognition comes about through the expression of these ultimate adaptations in the form of cognitive mechanisms—proximate adaptations—or indirect mental by-products which happen to be adept at facilitating religious thought. This view derives from Gould and Lewontin’s (1979) influential contention that some features of organisms arrived as side-effects of the specific configurations of other adaptations. Using their now infamous architectural analogy of spandrels—the eye-pleasing spaces between arches that serve no functional purpose—Gould and Lewontin recommended that the search for any functional properties of by-products should be carefully considered. For cognitive scientists, religious cognition constitutes a spandrel. Efforts are better directed towards uncovering the causes and nature of the functional cognitive mechanisms underpinning it, especially given the challenges in identifying the boundaries of religious thought accompanied by the absence of cognitive mechanisms exclusively dedicated to religion.

A minority of scholars consider the universality of religious concepts, their cognitive ‘stickiness’ and transferability, as well as their social implications, to be indicative of a direct, ultimate adaptation. For example, Alcorta and Sosis (2005, 2006) described religion as an adaptive complex of traits deriving from pre-human rituals and selected for in early hominid populations because they offered survival and reproductive benefits. In short, the practice of religion bolstered individual fitness. In contrast to the cognitivist position, Sosis (2009, p. 323) does not consider religious beliefs and behaviours to be spandrels produced by selected cognitive mechanisms. Rather, religion should be tackled as an irreducible unit of analysis; a system that produces functional
effects. I do agree with Sosis (2009, p. 323) that even if the cognitivist position is accurate and any particular feature of religious practice or cognition should rightfully be considered a by-product, we should remain silent about whether the broader religious system is an adaptation or not.

The evolution problem therefore revolves around whether religious concepts and beliefs are a direct or indirect response to selection pressures, the nature of these pressures, how they came to be applied, and their unit of transmission: individual minds or social groups. I will explore the direct social adaptation argument in order to answer these questions, after I have outlined the strong evolutionary position and the more moderate cognitive agenda.

A strong evolutionary position regards religion as an adaptive trait and an adaptation. Accordingly, the evolutionary position seeks to evaluate whether religiosity enhances or detracts fitness. If religion enhances fitness the inclination to be religious is adaptive and somehow genetically coded (Richerson and Newson 2009, p. 102). Cooperation and unselfish behaviours constitute an evolutionary conundrum. Why would an individual make costly sacrifices for the benefit of another genetically unrelated? One answer, according to Alper (2001) and others like Persinger, is that religion’s pervasiveness can be explained by a genetically inherited trait. Like with all genetic characteristics, the instinct to believe transfers from one generation to the next.

Alper (2001, p. 78) departs from Standard Model cognitive scientists in conceiving spirituality as a genetically defined and inherited trait. Moreover, damage or alteration to an individual’s spiritual neural circuits through drugs, surgery, pathology or injury, lead to changes in religious cognition, perception, sensation and behaviour. Persinger’s work adds weight to Alper’s suppositions, particularly where specific locations in the brain and their dysfunction can be connected with spiritual experience. The vast suite of research Persinger conducted over two decades led him to conclude that temporal lobe ‘transients’, or misfirings, evolved concomitant with the temporal lobes, hippocampus and amygdala. However, I argued that temporal lobe anomalies do not provide direct evidence that spiritual inclinations have a genetic basis. Alper’s theory assumes that atheists were either born without an essential spiritual gene, or that their lack of faith occurs against genetic programming, a little like a vow of celibacy. It also anticipates
family trees of atheists and other genetic pockets of strong or weak belief. I can find no corroborating evidence to indicate that atheists sublimate their natural proclivity for belief or are part of long familial lines of non-believers.

If religion and spirituality represent genetically inherited impulses, there must have been selection pressures to stimulate its evolution. For example, religion could have evolved to help manage fear, pain and anxiety within a framework of social obligation and morality management. As a genetic predisposition, atheism can only be explained by a particularly weak expression in a large population of individuals. Persinger simply posited that religion represents an essential survival trait to offset the startling existential burden of consciousness and the awareness of inevitable death. However, no evidence supports the claim that temporal lobe transients evolved in response to existential selection pressures. On the other hand, numerous examples of exaptations can be found where evolutionary by-products arrived with unrelated pressures.

Standard Model advocates dismiss the possibility that religion constitutes an ultimate adaptation. The religions we know today were founded and expanded well after humans had abandoned the physical environments and social contexts in which evolution occurred. Another supporting argument based on recent evidence from moral psychology claimed that religion arose as a cognitive by-product of pre-existing capacities selected for non-religious functions. For example, “… despite differences in religious background, individuals show no difference in the pattern of their moral judgments for unfamiliar moral scenarios” (Pyysiainen and Hauser 2009, p. 104).

Like Johnson (2008), I do not think that studying religious practice will reveal much about the adaptive role of religious beliefs as responses to selection pressures. However, Johnson and Bering (2006) took a further step more difficult to support. They turn causation on its head by claiming religious belief as the origin of moralizing and sanctioning behaviours. Based on the presence of a proximate cognitive mechanism they think responsible for bolstering the expectation and fear of supernatural punishment, Johnson and Bering argued that cooperation emerged with the assistance of pressures from religion.
My inclination remains that certain cognitive mechanisms evolved to underpin social cognition, including cooperation and moral assessments. Religion does not need to enter the picture at all, unless an argument for group selection is involved. For example, as Pyysiainen and Hauser (2009, p. 104) suggested, religion emerged as a by-product of other evolved cognitive mechanisms, but could then have been subjected to selection, becoming an adaptive cultural system for bolstering cooperation.

Cognitive scientists argue that human cognition has evolved to preference certain kinds of mental representations. As a result, cultural material is channelled making some concepts stable and recurrent despite differing cultural contexts. Cognitive scientists of religion do not assume that concepts travel fluidly and intact from one mind to another. Instead, they believe that concept communication requires inferential processes. Individuals become mindful of the cues offered by others’ behaviours, infer their communicative intentions, and build representations and concepts (Sperber 1996, pp. 41-43). Rather than the simple duplication of concepts, cultural transmission requires individuals to constantly infer others’ representations. Concepts both common and stable in a group reflect a preferential selection in the transmission process.

 Preferential selection features heavily in the cognitive view of cultural concept transmission. The key lies with universal selection factors rather than those associated with local circumstances. This means that the important selection factors relate to the specific ways in which minds acquire and store information, creating a substantially narrowed field of potentially successful concepts. The Standard Model assumes that specific selection pressures occurred for each major aspect of the mind’s functionality.

One assumed selection pressure stimulated the mind’s intuitive repertoire of ontological expectations about the contents of the world. As I have noted in previous chapters, Standard Model theorists argue that the counterintuitive expectations in religion affect concept memorability. Another form of selection delivered the ability to resolve strategic social problems. The Standard Model assumes that the mind possesses specialised mechanisms or modules which help manage particular social circumstances. They also play a role in religious cognition because they connect religious concepts with other common social representations such as identity, group behaviour and morality. However, religious cognition does not represent an adaptation, but rather a by-
product, arriving with the presence of mental systems which evolved for survival and success in a hostile but social environment. The major works of Standard Model stalwarts, Atran (2002a) and Boyer (2001), exemplify the evolutionary by-product perspective. Religious concepts are analogous to music or art in that they developed as a side-effect of evolved cognitive capacities that must have proven useful in ancestral environments, such as the ability to create maps, imagine scenes, create coalitions for survival, and moralise about behaviour.

Although not conclusive, my analysis will offer support to the by-product approach. Humans wield cognitive systems that evolved to deal with a dangerous social world. Religion is not the adaptation. It is a side-effect, or what Gould and Lewontin (1979) described as a ‘spandrel’. Like Bloom (2009, p. 124), I see evidence for an early-emerging cognitive bias stimulating agency-detection, the attribution of design to the random, and body-soul dualism. My position has a direct bearing on the conclusions I reach about progress for the Standard Model. Suppose for a moment that van Fraasen (1989) is right in that what distinguishes a given scientific activity from another is its criterion of success. Without venturing into the realism debate, I think that one of the constituting features of a research program is its explicit articulation of the program’s goals. On my assessment, the Standard Model is successfully transforming from an explanatory framework to a research program on the back of its confidence in explaining the influence of proximate cognitive mechanisms on religious thought.

Outside the Standard Model, contention surrounds religion’s evolutionary landscape, the relationship between evolved cognitive functions and religious cognition, and the unit through which religious concepts are transmitted. The following sections take up the arguments and position them within my own claims about the Standard Model.

**The Standard Model’s ‘Evolutionary Landscape’**

The complications of different roles, cultural interpretations, religious institutions, ecological variables and manifesting phenomenon such as myth, ritual, taboo, symbols and altered states of consciousness, make generalisations about religion’s antecedents difficult. However, to some extent the Standard Model sweeps away all of these variables. Instead, it relegates the myriad of religious variations to outcomes of a common cognitive structure, cobbled together by selection, and adapted for purposes
that also support religious concepts. Atran (2002, p. 266) wrote: “The evolutionary canalization of emotions, cognitions, and social commitments into a natural basin of possibilities, from which interacting individuals select their cultural paths, favors the emergence of religion for the life of our species.”

Standard Model theorists claim that religion manifests as complex cultural behaviour supported by numerous cognitive-behavioural mechanisms selected for survival and social reasons. Any fitness advantages that accompany religious behaviour reside with cognitive functions, not religious practice or content. According to the Standard Model, we do not simply learn what appears in the environment, but rather, what we have been prepared to learn (Boyer 2001, Ch. 1). Although not indigenous to the brain, religion contains concepts that the brain finds favourable. Boyer likened religion to a melody. Music is not genetically programmed, but humans do create, remember and reproduce tunes. Thus, evolution has created fertile minds for the growth of religious seeds. The Standard Model therefore focuses on explaining how the mind’s evolved capacities make religion possible (Anttonen, 2002, pp. 14-19; Kamppinen 2002, p. 269).

To summarise, religion comprises a by-product of numerous cognitive and emotional mechanisms that evolved to undertake mundane but essential adaptive tasks (Atran and Norenzayan 2004, pp. 748-749). Religion is not a direct evolutionary adaptation. It merely exploits evolved cognitive functions. Natural selection narrowed the expression of religious beliefs into the structures commonly found throughout history and culture (Dawkins 2006, p. 164). Religious beliefs and practices have appropriated adaptations and by-products as vehicles for their manifestation. Atran’s (2002, pp. 10-15) metaphor described religion (culture) as a mountain valley formed by mountain ridges shaped through natural selection. Religion constitutes specific sets of affective, social and cognitive features, or mountain ridges, each with a unique contour with peaks analogous to evolutionary time. Prime amongst all of these cognitive features is the human capacity to formulate abstract powers linked to agents. Only humans can conceptualise multiple representations of other minds and worlds, foremost amongst which are those related to the supernatural. Atran (2002, pp. 265-266) concluded: “ Cultures and religions do not exist apart from the individual minds that constitute them …” For example, imagining supernatural agents relies on cognitive mechanisms ‘trip-wired’ to
detect animate agents. Agency detection mechanisms also work by attributing intentions, beliefs, and desires to other minds, including supernatural agents.

Culture has an important influence on cognitive functions like agency detection. Groups acting together can affect a cognitive system’s presentation, emphasising certain culturally relevant characteristics or cues. Soul, spirit and ghost concepts provide good examples because they receive support from intuitive expectations about hidden agents. Since the success of agent detection demands a response from the slightest arousal, such as jumping at a shadow, humans readily infer the presence of agents. From a survival perspective, it is better to be skittish than be a meal. Of course, since we possess little firm data about the selection pressures from environments in the distant past, we can only surmise that the mind’s adaptations were organised around peculiar human survival needs. To that end, one approach attempts to infer which selection pressures existed based on the cognitive functions that presently exist. I now examine this controversial approach from evolutionary psychology and the role it plays in the Standard Model.

**Evolutionary Psychology and Religion**

Perhaps for as much as 99.5% of our history, humans have lived as hunter-gatherers (Stevens 1993, Ch. 1). Evolutionary psychologists assume that this context played the central role in evolutionary pressures for genetic adaptation. The corollary is a mind designed for survival, including instincts for social engagement and cooperation. Evolutionary psychologists also take the by-product view where religion exists as an artefact rather than an adaptation: “It is the present contention that our spirituality is a product of the very processes of human evolution which make the social construction of human culture, human meaning, and individual psychology possible, and even necessary” (Teske 1997, p. 163).

Since the publication of E.O. Wilson’s (1975; 2000) book, Sociobiology: The New Synthesis, Darwinian interpretations of human behaviour have accelerated, most recently under the banner of evolutionary psychology (EP). Evolutionary psychologists contend that the mind’s cognitive architecture provides a foundation for religious cognition, a position strongly embraced by the Standard Model. Evolution hardwired our brains with a cognitive structure that can never be wiped clean with the right
education or cultural pressures. Despite some controversy, I see a consensus that evolutionary thinking has merit. However, little agreement can be found concerning the importance and role of evolutionary explanations.

Although a broad research stream, EP has come to be associated with the interpretations of Tooby and Cosmides (1992) and the popular writings of Pinker (1997; 2002). Both emphasised how psychological functions, or ‘modules’, evolved on the basis of environmental selection pressures. Like all evolutionary sciences, EP uses a ‘fit among facts’ approach, using natural selection to explain behavioural predispositions (Caporael 2001, pp. 607-608). As Nicholson (p. 135) wryly observed, “You can take the person out of the Stone Age … but you can’t take the Stone Age out of the person.” EP claims that observed psychological mechanisms operate as devices selected to solve adaptive problems in our evolutionary past (Smith, Mulder and Hill 2000, F21-F25).

Few evolutionary psychologists insist that evolution imposes an exclusive, or even predominant, explanation for behaviour. However, most do insist that socio-cultural variables do not operate independently from inherited psychological functions (Pinker 2002; Tooby and Cosmides 1992). For example, human cultural universals like religion indicate that hardwiring encourages certain modes of behaviour, irrespective of how they might be idiosyncratically expressed in varying cultural circumstances (Freese 2002, pp. 44-46). However, a cautionary review of EP’s limitations and criticisms are also warranted, particularly since the approach has significantly influenced the Standard Model’s core propositions.

**Criticisms of Evolutionary Psychology**

One serious limitation of the EP argument lies with identifying the environmental conditions leading to selection pressures. Critics of EP assert that it overemphasizes the degree to which cultural behaviour can be attributable to genetics. For example, anthropologists Ehrlich and Feldman (2003, p. 89) argued that evolutionary stories can be too easily invented to explain observable behaviours, like the fear of snakes or spiders (Caporael 2001, pp. 609-610). The authors also assumed that the relatively small number of human genes compared to other more simple organisms reflects a hereditary system incapable of supporting hardwired behaviours. Ehrlich and Feldman noted that humans possess only three times the number of genes as fruit flies, while the majority of
human genes exist as dormant evolutionary baggage (see for example, Ridley 2003, pp. 2-3).

Accusations of genetic determinism also seem exaggerated. For example, Rose and Rose (2000, p. 149) wrote that “evolutionary psychologists believe that biology is destiny”. However, even the most strident evolutionary psychologists reject genetic determinism outright: “… every feature of every phenotype is fully and equally codetermined by the interaction of the organism’s genes … and its ontogenetic environments …” (Tooby and Cosmides 1992, p. 82). A more accurate portrayal of EP thinking was delivered by Ridley (2003, p. 34): “The genome is not a blueprint for constructing a body; it is a recipe for baking a body.” EP helps to shed light on universal and persistent behaviours, which in practical terms means that some familiar patterns of behaviour can be re-interpreted in light of innate tendencies; a possibility held important in the Standard Model.

Evolutionary psychologists look for evidence of design from which they infer adaptations (Hagen 2003, pp. 96). Adaptations manifest as the functional fit between a problem and an aspect of structure. This adaptation-response does not need a set environment. In addition, EP does not assume that learned and hardwired behaviours will be mutually exclusive, and in fact might be co-dependent. For example, the fear of snakes may be easily learned due to innate tendencies. Research by Ohman and Mineka (2001) revealed that lab-raised monkeys can be easily taught to fear rubber snakes, but not fake rabbits. Evolutionary psychologists argue that every aspect of human behaviour depends upon culture and learning, but these forces do not act in a vacuum; they act upon the innate machinery designed to do the learning. In this respect, EP lends support to the Standard Model’s case. Religion appeared as a cultural invention, impelled by evolved cognitive mechanisms shaped by selection pressures favouring social engagement.

There can be little doubt that a portion of human behaviour must be programmed into the brain and its neurochemistry through environmental factors, ranging from internal foetal temperature to cultural conditioning. Thus, as Blasi and Bjorklund (2003, p. 259) counselled, evolutionary psychologists must collect data from multiple sources and design “evolutionary experiments” to aid in clarifying the role of behaviour. However,
we need to be vigilant about distinguishing the “Palaeolithic puffery” (Freese 2002: p. 49) from the evidence. Thagard considered the former to outweigh the latter.

Thagard (2005b, pp. 59-65, 69-70) lamented the “fashionable” application of biological evolution to explain aspects of culture including religion. He argued that explaining emotion requires more than simply creating stories about how humans with joys and fears might have experienced survival and reproductive advantages. For example, research shows that all animal brains possess a centre dedicated to emotional processing. It connects with cognitive functions, and when impaired, seriously inhibits functional abilities. On the other hand, no known brain area explains religion. Furthermore, deficiency in religion does not presently seem to impede survival and reproduction. Nor does any evidence indicate that religiosity can be inherited, or that it provided an evolutionary superiority to humans who practiced it. However, Thagard’s position ignores some compelling anthropological evidence suggesting that religious groups tend to be more cohesive and cooperative (Sosis and Ruffle 2003) and enjoy survival and longevity advantages (Sosis and Bressler 2003). In addition, Koenig et al. (2001), in a comprehensive meta-study, concluded that religious belief reduces stress, anxiety and disease.

Perhaps then, Thagard (2005b, p. 71) conjectured, religion might be an exaptation or a by-product of some other emotional cognition. Because humans naturally avoid the emotionally unpleasant and are attracted to the emotionally positive, religion might arise along with the natural selection of emotions; evolution leads to emotional cognition, which delivers religion. Thagard remained dubious, arguing that the second causal sequence is weaker than the first. In addition, there must be many universal (or nearly universal) activities in which humans engage that depend upon evolved psychological capacities, but cannot be reasonably considered an evolutionary by-product. In the United States, more people watch television than engage in religious practice.

Perhaps emotional cognition merely encourages religion? Not so, according to Thagard, who argued that the connection displays no greater strength than between emotional cognition and other aspects of human culture such as art, music or sport. Thagard did concede that biological evolution has some relevance to understanding cultural phenomena including religion, as they all employ emotional cognition and the
representations it produces. On the other hand, so little is known about the early biological and social evolution of humans that it is unreasonable to even draw speculative assertions about the prevalence and nature of religion: “the explanatory connection between evolution and religion is very weak” (p. 71). In the end, Thagard took the position that human beings are susceptible to religion, along with every other culturally prolific activity.

Although Thagard is pessimistic about EP as an explanatory mechanism for religiosity, the Standard Model presents some well-accepted propositions about cognitive architecture. I suspect Thagard would agree with most of these views, including those concerning the computational-representational view of the mind and the modular specialisation in cognition. Since I am uncertain about the role putative modules play in religious cognition in particular, and any form of cognition in general, I will not replay my reservations. However, like Thagard I see little evidence to causally connect religion and evolution. Like most cognitive scientists, I am disinclined to see religion as a direct adaptation. On the other hand, I think that the Standard Model takes firm ground when assuming that religion finds favour in minds’ natural schema.

I also think Thagard helpfully reminds us that humans are obviously susceptible to a great many cultural activities, and religion is only one. Such caution fits my previous assertions that: 1) the Standard Model is overly preoccupied with counterintuitivity, which should not be narrowly associated with religion; 2) that religious concepts and belief are not an exclusive consequence of the cognitive apparatus that host them, 3) that the absence of religious belief is not the absence of belief systems, 4) that religion is not one consistent kind of belief all of its own, and 4) that the Standard Model overestimates the universality and ‘naturalness’ of religious belief.

EP supports the Standard Model contention that religion constitutes a by-product of natural selection. I agree, to the extent that all common human activities can be viewed as by-products of natural selection. I do not agree that religion was an inevitable or automatic by-product of natural selection. Humans have the capacity to perform an enormous variety of activities and hold vast sets of beliefs because evolution produced a mind with cognitive capacities geared to manage social and cultural information. Religion constitutes one package in which social and cultural information is transmitted.
Although he goes too far, I think Jensen’s (2010) observation that what he considers the ‘standard cognitive science of religion model’, overemphasises the ‘inside-out’ program: the influence of the brain-mind on behaviour and culture. The reverse process also needs to be addressed.

If religion, as the Standard Model proposes, exemplifies a special by-product of evolution, I cannot see how it will be conclusively determined. It would be equally troublesome to pursue Thagard’s tongue in cheek suggestion that religion is a social universal in the same way as watching television. Despite my scepticism about some EP claims which have deeply influenced the Standard Model, such as domain-specific modular computation, the Standard Model satisfies evolutionary ‘plausibility’. A final possibility I examine next concerns the impact of group or cultural selection, which does not align well with the Standard Model.

**Group and Cultural Selection**

A small contingent of biologists and anthropologists led by David Sloan Wilson argue for group (social) rather than individual (gene-level) selection. Non-controversially, Wilson (2002, pp. 9-10) claimed that religious concepts and beliefs provide sufficiently powerful group cohesion and solidarity to transcend the rational inclinations of opportunistic selfishness. Wilson invoked three assumptions. First, group selection can and does occur. Second, religious ideologies deliver intra-group solidarity, and third, some groups can be sufficiently isolated to achieve group genetic selection. Wilson’s theory remains Darwinian, even though he believes that selection occurs at multiple levels, including the group level. Accordingly, competition between rival groups determines selection. Multi-level theories view religious groups as organisms in their own right which compete with other groups. Selection can therefore transpire at both the individual and group levels because cultural evolution can transform a group through the dissemination of pivotal concepts. Religious concepts can deliver co-opted functionality.

Although group selection theory has not been well accepted for human social groups, as Dennett (2006, p. 184) highlighted, it presents nothing contrary to Darwinian logic. For Wilson, religion is a social phenomenon driven by evolution to improve cooperation within groups. Participation in religion, including its carefully orchestrated rituals,
creates bonding and trust within groups, allowing them to function more effectively. With these basics in mind, group selection appears worthy of further consideration.

Group selection helps to explain what appear to be unselfish behaviours in humans, such as altruism. After all, from an evolutionary perspective, altruistic behaviour should curtail an individual’s relative fitness. However, given certain conditions, groups can out-compete others thereby ensuring that their genes pass on to future generations. Reciprocal altruism operates within groups where little cheating transpires by individuals trying to get something for nothing. Group selection theory holds that the unit of selection is the group itself rather than individual genes. Furthermore, groups might be produced as a consequence of selection ([D.S.] Wilson and Sober 1994). Group selection requires no inter-group migration, which seems implausible. Another less popular explanation claims that kin groups make sacrifices for each other, thereby indirectly benefiting at least some of the same genes ([R.A.] Wilson 2005).

It is difficult to pinpoint where the social effects of a group’s commitment to religion intersect with genetically determined capacities. Establishing a link is troublesome because religious cognition might be the output of cognitive mechanisms. In other words, can cultural practices like religion be both inputs and outputs; cultural adaptations and cognitive mechanisms (Pyysiäinen 2006, pp. 209-215)? For the cognitivist, the mind is predisposed to support religious concepts, making them relatively easy to learn. However, group selection theorists view religion as an adaptive trait acquired through cultural selection rather than through direct genetic adaptations. Religion can be successful when the cultural environment encourages specific, genetically endowed traits at the expense of others. Sometimes referred to as the Baldwin Effect, cultural learning influences natural selection by encouraging group members to modify environmental selection pressures, subsequently affecting their offspring. In short, cultural learning has genetic consequences. A biological trait becomes innate through evolution as a result of being first learned. That is, religion evolved because it sent control signals to a group informing them about their interaction with the natural environment A Baldwin Effect might be seen when religious beliefs confer advantages to individuals with inherent predispositions toward its practice. According to group selection theorists, religion is neither an adaptation nor a set of
cultural concepts parasitic upon ordinary cognitive mechanisms (Dennett 1991, pp. 184-187).

Group selection incorporates several assumptions contradictory to the Standard Model. First, religion can provide a strong influence on group behaviour. Second, the composition of religion responds to changes in the group’s relationship to the natural environment, and third, groups form the unit of natural selection through which religion evolves. In further support of their approach, group selection theorists refer to the power of rituals as signals to a group. From such a vantage, religion works as an adaptive mechanism affected by culture (see for example, Rappaport 1999). Groups practicing religion would cultivate social advantages elevating their reproductive success and reinforcing beliefs through culturally embedded behaviour. Religion may be viewed as an overt site of gene-culture co-evolution (see for example, Dow 2006). Proposed by Lumsden and Wilson (1981, Ch. 4, 5), gene-culture co-evolution predicts a parallel cultural track operating in addition to the genetic evolutionary pathway. Culture forms when groups of people living in close proximity come to see the world through the same, or at least, similar eyes. Such collective worldviews are already pre-programmed to an extent, encouraging predispositions toward certain values and behaviours.

Group selection can be distinguished from largely discredited memetic theories. Units of cultural information, or as Dawkins (1976, Ch. 11) named them, memes, are passed along through the familiar process of selection, bestowing adaptations upon cultures. Memes spread from mind to mind in the form of stories, concepts and ideas, sometimes mutating in the process of establishing a ‘better fit’ with their recipient cultures. Certain meme pools eventually overwhelm and inculcate a population. Ideas evolve and the best adapted reproduce more easily (Dawkins 1976, Ch. 11; Dennett 2006, p. 184). Memes are usually defined as cultural artefacts (the prototypical example is an idea) that infest minds and reproduce in a manner roughly analogous to genetic replication. Most memes come to nothing, but some are remembered and shared, like genetic units mutating and propagating. Taking a strong stance on cultural memes, like Dawkins or Dennett, involves seeing them as units of cultural information transmitted in a pseudo-Darwinian fashion. Strong meme theorists argue that memetic fidelity operates almost perfectly. Most cultural theorists sympathetic to memes take a more moderate position, advocating that memes offer a useful metaphor for understanding the transmission of cultural
information, but they do not deliver near-perfect reproduction. Dennett’s (2006, p. 184) proposition, the Mild Meme Alternative, involves replacing group-level replication for memetic replication. Memes that foster human group solidarity in circumstances where group solidarity is essential for survival will be selected for cultural propagation. When these “meme-infested” (p. 184) groups survive, they broadcast the memes encouraging out-group curiosity and potential transmission.

It is difficult to define memes, which of course has made their empirical study troublesome. The difficulty lies in the breadth in which memes can be interpreted, including a single word or an idea, belief, thought, ideology or even philosophy. Comparative to genes, memes are ambiguous in meaning and application. Indeed, in genetic reproduction, information is reliably transmitted to an incredible degree of fidelity given the volume. On the other hand, in the cultural transmission of information, success of any kind is atypical. When transmission does occur it is often with a low fidelity, and in terms of religious concepts there is substantive evidence suggesting that the transmission is more inferential than imitative.

Memetic theories do not enjoy favour amongst cognitive scientists of religion or amongst mainstream evolutionary theorists for the simple reason that they add nothing to explanations about cultural transmission. Benitez-Bribiesca (2001, p.29), for example, described it as “pseudoscientific dogma.” Memes, or in simple terms, ideas, do not reproduce in ways that are anything like the biological processes with which they are compared. It is erroneous to conclude that a deeper understanding of cultural transmission occurs when a concept receives consideration as a meme. With no evidence of an evolutionary, selection process underpinning it (Aunger 2002), labelling a concept as a meme only positions it as an idea that could be manipulated, enhanced, modified or ignored as it circulates. As a result, I conclude, along with a consensus of evolutionary biologists that using the term ‘meme’ remains unhelpful from an explanatory perspective. Although Standard Model theorist see no theoretical place for memetics, the slightly more optimistic interpretation was offered by Atran (1998), who suggested that the concept can deliver a valuable framework for conceptualising cultural information. He did note, however, the absence of evidence for treating cultural units of information as replicators.
Atran also argued that modular mental systems stabilise and channel cultural information towards a general convergence. Accordingly, the transmission of cultural information occurs through inference rather than replication or imitation like in meme theories. In the case of religious information, inference can vary enormously. For example, Atran’s (2001, pp. 365-366) classroom experiments asked students to write down the meanings of three of the Ten Commandments. Even though the students expected a consensus, interpretations varied substantially. In short, cultural information is not reproduced in minds in the same way that genes reproduce in DNA. Nor do they generally disseminate through imitation. Atran concluded that biologically structured and culturally enhanced minds transform often fragmentary inputs into recurrent and convergent ideas.

On the Standard Model, religious beliefs succeed because mental modules canalise and support their invention and distribution. Religious notions do not replicate as memes imitated in host minds. Rather, they are recreated across minds through inferences driven by modular capacities. In addition, group selection theories presenting religious cultures as super-organisms ignore minds as causes of religion. There remains a significant distance between group selection theory, memetic theories and the Standard Model. Evolutionary mapping between the cultural and cognitive perspectives appears severely restricted at present.

Conclusion
A strong evolutionary perspective views religion as a direct, ultimate adaptation. I despatched with this possibility in the absence of evidence supporting a genetic programming for religion, or even a hardwired proclivity to practice religion. I also concluded that ‘God’ brain centre theories fail to present compelling evidence. However, I concede that the brain possesses structures, which under certain conditions, deliver experiences that can be interpreted as religious or spiritual in nature. But, the same brain structures serve other emotionally-charged events. In any case, without pre-existing, indoctrinated beliefs, peak experiences will not be interpreted as religious.

A more moderate evolutionary view underpins the Standard Model. On this perspective, religion was not selected. Rather, certain cognitive capacities were selected offering social and survival advantages. Consistent with evolutionary psychology, the Standard
Model claims that religion relies on numerous social engagement cognitive modules. Notwithstanding the actual cognitive mechanism responsible—modular or otherwise—I have reviewed numerous research streams indicating that the mind stabilises and channels cultural information towards a general convergence. However, in my view, the Standard Model overstates the degree to which cultural information is transmitted through cognitive inference rather than replication or imitation. I think that the transmission of cultural information involves both convergence and imitation. Neither cognitive nor cultural theories of transmission provide a full explanation for religion’s persistence when taken in isolation. I suspect that the Standard Model attributes too much religious variation to convergence driven by a common cognitive structure. On the other hand, the Standard Model’s moderate position seems firm: the cognitive capacities engaged during religion were cobbled together by selection and adapted for purposes that happen to be particularly supportive of religious concepts.

Evolutionary psychology does not offer a full picture either. EP analyses will never be able to acquire sufficient information about historical environmental circumstances, in every relevant part of the world, to draw plausible conclusions about selection pressures. As a result, EP risks falling into the reverse engineering trap: the mind evolved in response to selection pressures that reflect the functions it currently performs. Such circuitous thinking assumes a correspondence between the mind’s functions and the selection pressures that shaped them. At one level, EP’s evolutionary thinking helpfully tells us more about what the mind responded to, or in a crude way, why the mind operates as it presently does. The trap occurs, however, when selection pressures and cognitive functionalities are mapped directly, leaving little room for evolutionary by-products. EP leads to a proliferation of modules, each one ostensibly responsible for a present cognitive capacity caused by a putative selection pressure. Nevertheless, claiming that adaptationist descriptions are ‘just-so’ stories does not constitute an argument against any trait as an adaptation (Sosis 2009, p. 324).

The third variation I considered takes a weak evolutionary position emphasising religion’s social and cultural productivity. The weak view offers no reason to treat religion as a pre-programmed or canalised cultural behaviour. In fact, religion is no more an inevitable outcome of the mind’s cognitive features than any other prolific cultural activity. There could be many universal, or nearly universal, human activities
that depend upon evolved psychological capacities. Computer literacy has become almost universal in some Western nations, and like religion, owes its success to cultural transmission. I think such comparisons go too far, including Thagard’s deliberately over-the-top remark equating television to religion.

Group and cultural selection theories downplay the significance of cognitive endowments. Nothing in religious practice may be considered unique to human cognition or behaviour, and religious activities only become sacred when imbued with special meaning determined by socio-cultural forces. Group selection views religion as an adaptive cultural trait that offers survival advantages to practicing groups, in turn ensuring that the groups become stronger, more influential, and attractive to join. A variation I considered involves cultural selection only, where units of cultural information—memes—adapt and propagate in a parallel Darwinian-style evolution. All that exists genetically is the capacity to build a cultural context in which religion can be successful, and the cultural environment may encourage specific genetically endowed traits at the expense of others.

Since religious beliefs have delivered advantages to individuals with inherent predispositions toward its practice, I cannot eliminate group and cultural theories. However, I do find group selection less plausible on practical grounds given the necessity for no outside genetic interaction. I reject the notion of memes that operate in a Darwinian fashion, finding fit and reproducing with fidelity. However, the idea that certain memes can dominate certain groups leading to survival advantages seems uncontroversial.

The Standard Model holds that religion comes as a by-product of natural selection. I agree in that the cognitive functions engaged during religious practice and belief were the by-products of evolutionary selection pressures. I think the most likely explanation is that cognitive mechanisms were exapted for use in religion. Exaptations—pre-existing traits that perform roles unrelated to their original adaptation—can arrive as unintended by-products used for new purposes, or selected for one purpose but co-opted for another. Standard Model theorists believe that cognitive mechanisms fit the second form of exaptation, having evolved for more prosaic but essential adaptive tasks. In my opinion, Sosis (2009, p. 324) framed the debate appropriately. An important question is
whether or not the cognitive mechanisms exapted by religion have also been adaptively modified by religion’s socio-ecological niche. If the answer is yes, then a case can be made that religion constitutes an adaptation rather than an exaptation. The evidence required for a resolution remains unavailable.

I find Thagard’s perspective the most solid, simply because it cautiously awaits a resolution based on more evidence. Like Thagard, I think that human beings are susceptible to religion, along with every other culturally prolific activity. However, I have presented evidence over numerous chapters suggesting a relationship between culturally prolific activities and cognitive capacities. I think it likely that some convergence pressures influence cultural activities, but repeat my argument that the pressures lead towards more generic tendencies such as the ability to hold belief sets, rather than the predisposition to hold religious beliefs. Religion is not a unique domain but operates as an extension of the general domain of social relationships between agents. The Standard Model satisfies evolutionary ‘plausibility’, but it leaves numerous loose ends. Perhaps the greatest challenge to the Standard Model comes in its ability to stimulate intersections with theories based at other levels of analysis. In the following chapter I prosecute my argument that progress for emerging, inter-disciplinary research programs must include the ability to generate novel connections between theories and data from different analytic levels.
Chapter 11. Integrative Power of the Standard Model

Introduction

In this chapter, I introduce a second, new analytical criterion I term ‘integrative power’. On my usage, integrative power describes the capacity of the Standard Model to assimilate or make coherent evidence from different levels of explanation, where a level represents an analytical stratum (McCauley 1986, pp. 189-191). The presence of analytical levels tends to be assumed in reductive views of science. For example, a reductive approach to analytical levels presumes that nature is organised into wholes and parts subject to componential examination, whether structural, functional or both. In principle, hierarchical levels of analysis in science correspond to those found in nature. Lower, more basic levels of analysis seek to explain higher levels. Or, in more formal terms, the altitude of an analytical level is inversely proportional in size to the domain of events it describes (McCauley 1986, p. 189-190). With respect to cognitive science, neuroscience represents a lower level of analysis than biology, which is a lower level than psychology. Accordingly, a level of analysis is directly proportional to the complexity of the systems it describes.

As I explored in chapter three, most commentaries on scientific progress focus on intra-level issues. They relate to theories (or models) at the same analytical level, often with respect to continuity or discontinuity between an existing theory and its prospective successors. However, this chapter takes a particular interest in relations between levels. With an inter-level emphasis, continuity refers to the potential for reduction, or at least intersection, between levels. Discontinuity, on the other hand, refers to an absence of reduction, interaction or connection between levels. Where continuity between levels explaining the same phenomenon leads to reduction / unity, discontinuity leads to pluralistic, unique accounts of phenomenon at their respective levels.

In this chapter I examine the Standard Model’s capacity to accommodate inter-level theories. Given the Standard Model’s goal of providing a unifying framework for the cognitive study of religion, its potential for inter-level integration seems pivotal to its performance. I argue like Saler (2010, p. 338) that “… we can and should allow for multi-level and multi-faceted explanations of complex phenomena … How, for instance, might multi-level and multi-faceted theorizing improve on Boyer’s account of
Notions about an afterlife?” My answer arrives with an assessment of the Standard Model’s account of relationships between levels of explanatory theory. In so doing, as in the previous chapter, I venture beyond Thagard’s cognitive science-specific theory evaluative criteria. Specifically, I will comment on the relationships between representations, domain computation and neurological activity, beginning with the nature of inter-disciplinary exchange. My argument culminates in the view that increasing inter-level relations reflect progress and should therefore suggest greater confidence that a framework will continue to yield fruit.

**Inter-level Theory and Inter-disciplinary Exchange**

The study of religion and spirituality has become highly differentiated involving numerous fields and disciplines such as neuroscience, biology, psychology, sociology, anthropology, phenomenology and history (Anttonen 2002, pp. 14-15). While each of these areas has contributed to the study of religion through successful theories, frameworks for integrating them all remain elusive. After all, a unifying framework needs to explain religious cognition, experience, belief and cultural expression, within a plausible evolutionary context. Such a reductive framework would deliver what Ezquerro and Manrique (2004) called a vertical correlation. However, a successful framework can also reveal connections between theories at a horizontal level (Ezquerro and Manrique 2004, p. 57). Here, the framework does not unify or reduce. Rather, it identifies connections, as if theories from different analytical levels can intersect, their perpendicular but not hierarchical paths colliding through a common point of explanation. Darden and Maull (1977) called horizontal theoretical correlations ‘inter-field’ theories, while Abrahamsen (1987, pp. 355-356) described them in terms of ‘bridging boundaries’ instead of ‘breaking boundaries’. To take the idea of inter-level theories further, I need to consider the role of boundaries and the disciplines science employs to constrain them.

A discipline, according to Fuller (1985, p. 2), is bounded by its procedure for adjudicating knowledge claims, consisting of “an argumentation format which restricts word usage, borrowings permitted from other disciplines, and appropriate contexts of justification/discovery (some claims may be grounded on ‘reason alone’, some on unaided perception, some on technically aided perception, etc.).” Fuller’s argumentation format encourages a careful look at the Standard Model’s disciplinary and theoretical
coverage, as well as how it adjudicates between similar knowledge claims. For example, the claims between psychologists, anthropologists, biologists and neuroscientists are mounted in competing and often incompatible argumentation formats. I can think of three approaches to adjudication that any explanatory framework such as the Standard Model might employ.

The first gives greater weight to the discipline holding the strongest claim in the area, allowing the most compelling argumentation format to infer the right approach to dealing with a given claim. Of course, this in itself would be contested and would probably lead to a constantly shifting argumentation formula. I cannot imagine that it would be a sustainable option, and perhaps, would encourage even greater fragmentation and specialisation. A shifting argumentation format will undermine, or even preclude, a progressive research program. Holton’s (1988) ‘themes of science’ holds core a common argumentation format. Lakatos (1978) made a similar claim concerning the building blocks of a coherent research program.

The second approach reflects the Standard Model’s position, where greater emphasis falls upon one particular argumentation format, which holds sovereign when it comes to contested claims. I have already demonstrated that the Standard Model commits to a modular, domain-specific, computational-representational view of cognition. In so doing, the Standard Model discards, or at least discounts, evidence emerging from competing formats. According to Saler (2010, pp. 333-334), the cognitive science of religion supports and adopts the methodological preferences of the cognitive and evolutionary sciences. These include, for example, controlled experiments, clinical ethnographies, developmental analyses, and pre-historical studies. Saler wrote: “Overall, there is an intellectual commitment to ‘science’, by which I mean a commitment to an epistemological stance that places a premium on the systematic and replicable testing or evaluating of claims to knowledge. In CSR that sometimes involves deriving predictions from one’s theoretical hunches and then testing them in the world” (p. 333). The Standard Model therefore embraces an epistemological conception of program development. Saler continued: “Where it is not feasible to test predictions or knowledge claims directly, science-as-epistemology supports the idea that the plausibility of hypotheses or posits is enhanced when those hypotheses or posits relate logically to whatever evidence we do have in hand” (p. 334). However, we must be
vigilant before leaping to conclusions. In a recent review of the Standard Model, Powell and Clarke (forthcoming) remind us that assessments of causality are retrospective and based on selection probabilities. An adaptation’s current contribution to fitness demonstrates nothing conclusively. Similarly, an adaptive feature does not necessarily imply it represents an adaptation. As a result, whether religion is adaptive or maladaptive today does not help us eliminate the possibility that it constitutes an adaptation.

A third approach involves synthesising research from different disciplines by constructing a common ground ‘meta-language’. Although patchy in its success, some precedents in cognitive science suggest that two disciplines normally demarcated by a boundary, need not be separated into mutually exclusive domains of inquiry. In fact, finding a shared phenomenon of interest seems to be the key. However, although two disciplines may focus on a common phenomenon like religious cognition, the laws of one do not necessarily translate to the other in ways that can be built upon. This, of course, returns us to arguments for incommensurability, at least of the semantic variety. At one end of the spectrum, if eliminative materialists are correct, then a new theory in a lower level discipline will demand the obsolescence of a theory in a higher level discipline (Fuller 1985, p. 3). In this way, disciplinary boundaries may be better seen as “fault lines concealing potential scientific revolutions” (p. 3). A more moderate remedy to incommensurability, or at least misalignment between disciplines as both Kitcher (1999) and Hardcastle (1996) have suggested, arrives with explanatory extensions bridging two theories or theoretical statements through a common link. I attempted to demonstrate in a rudimentary way how such extensions might operate in chapter seven, using the example of religious experience and religious cognition. In that case, statements about rituals serve as bridging mechanisms. However, a weaker interpretation such as from Stepin (2005), would consider my example nothing more sophisticated than ‘paradigmatic grafting’.

The adjudication problem can also be frustrated by fluid and emergent disciplinary boundaries. An outsider observer of science might anticipate a kind of bureaucratic specialisation characterised by neat partitioning and logical structures (Fuller 1985, p. 3-4). The reality is messier, particularly when programs become cloistered. For example, emergent programs aggressively pursuing an independent identity, such as the Standard
Model, tend to take an insider’s perspective. Of course, any form of disciplinary boundary might be disadvantageous. Disabling fixed disciplinary domains may be a key to new knowledge where disciplines share research problems, leading to higher critical standards all round. Drawing any disciplinary boundary always risks some form of exclusion.

Some explanatory frameworks such as the Standard Model have adopted the notion of a domain along the lines of Shapere (1982, p. 181): a body of information relating to a particular problem that specifies its own methods of inquiry. I can see how domains help converge numerous disciplines around a specific, common problem, just as with cognitive science and cognition. Shapere’s approval makes sense, but domains displace disciplinary boundaries for methodological ones. At the same time, while method determines the trajectory of domain-driven programs such as the Standard Model, method is shaped by the data and knowledge that a program accumulates.

A reciprocal relationship between method and theory cannot be escaped. As a result, inter-disciplinary research always creates tension because different disciplines typically pursue different agendas and solutions while wielding specific tools (Bechtel, Abrahamsen and Graham 1998, pp. 90-98). However, a domain focused on a problem common to several disciplines can overcome tension by adopting new sub-languages describing domain-specific information (Mattick 1986, pp. 333-339). While not strictly a bridging language, the result can be the same. Developing and sharing new languages, or information structures peculiar to a domain, helps in sharing knowledge and developing inter-field commonalities.

One implication of the sub-language view is that progressive science might be measured less by its accumulation of facts and more by their re-composition into structured bodies of information (Mattick 1986, p. 340). For example, the Standard Model might be assessed in terms of its capacity to reconfigure disjointed and unconnected theories about religious cognition into a single framework. On this view, its novel contribution to knowledge would be less important than its ability to connect fragmented knowledge. If, as Dogan and Pahre (1990, pp. 30-35) claimed, knowledge is reconfigured over time as a cycle of specialisation-fragmentation-hybridisation, then the Standard Model could play a pivotal role in shifting the study of religious thought from fragmentation to
hybridisation. Palmer (1999, p. 242) wrote: “Knowledge has perhaps always been in a state of flux, a continual process of reconfiguration with subjects merging and new domains emerging.” Progress would be seen where the Standard Model ceases to represent a specialised area and becomes instead a vehicle for connecting and reshaping previously disjoined approaches to the study of religious cognition. I suspect that Swanson (1991) would also take this line.

Even if the Standard Model proves capable of delivering a connecting framework in the future, it has not yet delivered. In fact, some would argue that a connecting framework can never be developed due to the complexity of inter-theoretical connections needed to explain religious cognition. According to Emmons and Paloutzian’s (2003, p. 395) thinking, the best we can hope for is a multi-level, inter-disciplinary domain that recognises the significance of data at multiple levels of analysis, and which delivers non-reductive assumptions. On a moderate version of inter-level continuity, the Standard Model would be assessed on its ability to make connections between theoretical levels without venturing into the extremes of reductionism or pluralism.

I think that the Standard Model performs best on this moderate version of inter-level continuity. Although still some distance from a complete explanatory framework, the Standard Model does highlight inter-connections between horizontal and vertical levels without trying to reduce, or concede to an inevitable disunity. For example, elements of anthropology and cognitive psychology can be connected using principles well-accepted by Standard Model advocates. In one illustrative case, Sorensen (2005, p. 181) represented the relationship between the cognitive and social pressures influencing religiosity. In his idealised model, charismatic authority leads to the development of new rules eventually routinised into stable supernatural agency-infused rituals. Ritual performance subsequently stimulates secondary symbolic interpretations that legitimise ritual content and reinforce corresponding doctrinal systems. However, if symbolic interpretations and doctrinisation become sufficiently regular then a triviality effect can occur. Sorenson’s conceptualisation of these relationships is reproduced in Figure 11.1.
Sorensen’s dynamic system provides a salient point of correspondence between a well-established element of the Standard Model and long-standing observations from the anthropological study of religious practice. However, Sorensen’s system presents an idealised perspective. A powerful explanatory framework needs to venture beyond a macro presentation of the relationships between cognition and practice. On this front the Standard Model offers considerable detail through its modular, domain-specific, representational position.

The Standard Model assumes that functional, task-specific brain modules process religious concepts. These modules possess no special religious operations. In fact, modules evolved in response to selection pressures favouring more prosaic, mainly social functions. Although modularity theory provides specific predictions, it also sits uncomfortably with argumentation formats from some other disciplines. For example, an anthropological argumentation stance would assess the Standard Model as weak in explaining religion’s adaptive properties. According to Antonnen (2002), the traditional scientific view of religion revolves around explaining religious thinking and behaviour through hidden, but shared, social structures. It discards theology but clings to religion
as an integrative socio-psychological construction that acts by transmitting knowledge through various kinds of symbols. Future biological and anthropological studies of religion, Sosis and Alcorta (2003, p. 272) argued, must grapple with the most basic adaptive questions. Anthropology, they contended, must work toward a comprehensive theory capable of explaining religion’s origins, the selective pressures that have shaped its expression, and the inter-cultural variation in its practice. But anthropology alone seems unlikely to provide answers to these questions without connecting with other fields, precisely because its argumentation format prioritises a single level of analysis. Anthropology offers detailed and cogent descriptions of religious rituals, but struggles to explain the knowledge required to perform them, as well as the ways in which the knowledge is transmitted or acquired (Whitehouse 2002, p. 134). Whitehouse’s (2002) emphasis on memory is a useful exemplification of the Standard Model’s utility in connecting cognition with religious practice. If the Standard Model offers promise, it should be able to help the anthropological case.

The Standard Model’s strength—explaining the cultural propagation of religious concepts through common cognitive functionality—might also be an Achilles Heel. On the Standard Model, a cultural representation originates in an individual’s mind before it spreads to other peoples’ minds through a range of inferential forms (Sperber 2006, pp. 36-53). A cultural representation may therefore be seen as an individual representation that has successfully been passed on to other members of a population. The cognitive science of religion focuses on the fit between mind and representation based on the assumption that a better fit will mean better religious concept transmission. At the vanguard of the cognitive movement, the Standard Model presents propositions and principles predicting how the mind-representation inter-relationship transpires. As I shall consider in chapter thirteen, these assumptions act as a kind of Lakatosian core, or what might be better seen as a ‘soft’ rather than ‘hard’ core.

According to Hinde (2005, p. 32), an individual’s psychological system, their network of interpersonal relations and associated religious systems, as well as broader cultural circumstances, represent the least that a decent theory or framework should explain. Few would argue, but the Standard Model’s approach avoids explanations for religiosity on the basis of a single functional perspective, like religion’s role in social solidarity. Instead, it casts a wide net where religious cognition and behaviour arrive as a tendency,
contrived through the mind’s indigenous mental systems. Hinde’s list has the emphasis backwards, of more relevance as outputs rather than inputs of analysis. However, without a specific function to study, the cognitive approach makes it more difficult to functionally decompose the mechanisms of religious activity, particular when it comes to its neurological correlates. To the Standard Model, little differentiates religious cognition other than counter-intuitive concepts about supernatural agents.

If religious cognition is parasitic upon ordinary cognition, then identifying cognition with religious content will require some extremely sensitive measurement. It would also be necessary to discern when religious cognition is occurring. This returns me to a previous argument. I proposed that the neurological study of religious cognition will be frustrated because a characteristic mode of cognition cannot be identified. Equally, a single, functional (perhaps modular) component of the brain is not exclusively responsible either. Nevertheless, I have argued that work in religious cognition will benefit from a deeper neurological account of general cognition. As a result, I see advantages in conceptualising cognition as a series of inter-connected functional mechanisms as suggested by Bechtel (2005a, 2005b) and Craver (2002).

Bechtel and Abrahamsen (2005, pp. 421-422) defined a mechanism as a structure performing a function through its parts, their operation and organisation. Religious cognition may be seen as a complex mechanism making computations through the activity of its parts and as a consequence of their organisation. The Standard Model identifies numerous computational modules, but falls far short of specifying the full set which collectively operate in a unique arrangement to produce the complex variations of religious practice. The mechanism that is religious cognition remains elusive.

Standard Model contributors explain cognition through symbolic mental representations consisting of both content and an accompanying significance. Furthermore, the brain converts, or computes, an input representation into one that has a meaning. Cognitive models are information-processing models, mapping onto the anatomy and physiology of the brain. From an inter-level theory perspective, cognitive explanations do not align neatly with mechanistic explanations (Von Eckardt and Poland 2004). For example, cognitive explanations make heavy use of computational processes involving representations. From here, full mechanistic explanations of any cognitive capacity
become difficult because representations are not governed by identifiable lower-level neural activities. A similar problem occurs when providing an account of cognitive dysfunction. Mechanisms require comparison with a norm. Pathological cognition may not be easily identified using the mechanisms associated with normal cognition. However, in chapter 13 I revisit the mechanism approach as a method that might prove fruitful to the Standard Model’s efforts towards establishing inter-level connections.

Few would argue that studying religious cognition benefits from a multi-disciplinary perspective. We should be interested in the potential for empirical convergence where a helpful explanatory framework will present data from a range of different techniques and conceptual lenses. Furthermore, even if different research methods and techniques yield compatible data, we still require a framework delivering coherence to the entire body of findings. No one questions whether cognitive functions link with neural structure. It is just not obvious what an inter-level theory describing the relationship would look like, and whether it could ever be more than a general theory of cognition rather than one that specifically deals with religious concepts. I have already expressed my view that the former will both make the latter possible as well as potentially redundant.

The Standard Model has inter-level potential because it encourages interpretive analysis while pursuing explanatory conditions. I think this is a reasonable claim when understood in the context of an inter-field framework claiming moderate ground on McCauley’s (1986) inter-level continuity scale. Anthropology tends towards discontinuity and therefore a proliferation of irreducible descriptive accounts of religious experience. Equally, strong assumptions of continuity are common amongst neuroscientists and eliminativists with the expectation of theory reduction. The Standard Model might be considered quite accommodating somewhere in the middle ground. It holds theoretical positions which lead to plausible and testable explanations, some of which are supported by experimental data (Slone 2006, p. 5). But to what extent can we expect that the Standard Model will deliver more than inter-field connections and begin to specify inter-field theories? To answer I consider how connections can be made between different analytical levels.
Inter-theoretical Connections and Integration

In this dissertation, I have discussed levels of mental activity using the following terminology. *Representations* refer to the mind’s content. The cognitive actions manipulating that content I refer to as *computations*, and the neural structures that physically perform the cognitive manipulations of content, I call *neurology*. As Kosslyn and Koenig (1992, p. 49) observed, however, representational and computational levels are not always easily differentiated from each other. Nor can work at the computational level proceed without some concern for its implementation in the brain, as cognitive processes must correspond to some form of neural activity.

Kosslyn and Koenig (1992, p. 49) modified Marr’s (1982, pp. 19-29) framework which depicted representations, computations and neural processes as a hierarchy. On the Kosslyn and Koenig version, the relationship becomes triangular where the peak represents an individual’s abilities—or the cognitive capacities to be explained—and the other two vertices identify explanations for the abilities in the form of computation and neural physiology. On this conceptualisation, there can be no explanation for computation without an explanation of how the brain performs the computation. Each part of the triumvirate interacts reciprocally with the other two. A cognitive theory has to engage all three dimensions before a characterisation of the cognitive system can be specified. Integrative theory development, as Marr (1982) advocated, should be the outcome. An approach incorporating representations, computations and neurology also helps to clarify whether apparently contradictory theories are only incompatible because they describe different levels (Repovš 2001).

If inter-level relations are possible, then either a reduction must take place from higher to lower levels, or inter-connections must be specified between different analytical levels. Hardcastle (1996) argued that an inter-disciplinary, inter-level approach is essential in cognitive science, where the connections between psychology and neuroscience hold a central place. I mention Hardcastle because her conception of the relationship between psychology and neuroscience describes the Standard Model’s treatment of the two analytical levels: without reduction but giving favour to potential bridging theories and other methods of forming connections.
The Standard Model’s account of religious cognition emerges from a representational level; religious concepts which are held in symbolic form in the mind. Religious representations undergo processing at the computational level by task-specific cognitive devices, at which point they transform into thought, or religious cognition. Little has been said about the neurological structures and physiology responsible for powering modules. Nevertheless, Standard Model commentators talk about modules as if a structure-function correspondence exists in the brain. Whether modules correspond to a localised or distributed neural architecture remains unclear. In fact, whether cognition works through physical modules or as if there were physical modules, also remains contentious. For Standard Model theorists, information processing holds the key to explaining religious cognition.

Hardcastle (1996) proposed that all the sub-disciplines of cognitive science share an interest in explaining information processing. From this first premise, she argued that an inter-disciplinary theory in cognitive science consists of two parts. The first comprises an inventory of general principles governing the cognitive phenomenon in question. Her principles operate in a similar way to Lakatos’ hard core, although with less rigidity. Principles are too general for specific predictions, so theories also need to include models of actual systems in which they operate. In practice, inter-disciplinary cognitive theories form a combination of general principles and sets of specific models from which these general principles were derived. This is exactly what the Standard Model is becoming on a larger scale, with the augmented models acting as a kind of peripheral protective belt bolstering the core principles, collectively forming an emergent explanatory framework. But, as my cautions around the Standard Model reflect, general principles (or propositions as I labelled them) may be too general to generate precise empirical predictions. Conversely, specific models may be too situational to form generalisations (Hardcastle 1996: 132-133, 138). I support Hardcastle’s suggestion that an inter-disciplinary cognitive theory needs to account for situational models. The necessity for a priori principles seems more contentious. As Von Eckhart (2000) pointed out, the presence of common principles in cognitive phenomena across populations may be an empirical question rather than an essential driver of an inter-disciplinary theory. Principles can be viewed as outcomes of theoretical development as well as tools guiding new research questions and hypotheses. I pick up on some of the implications
of inter-level relations as driven by Standard Model principles and propositions in the next two chapters. I begin next by mapping the relations.

**Inter-level Mapping in the Standard Model**

When considered from an inter-level perspective, the Standard Model offers several lessons for philosophical accounts of scientific and theoretical progress. In particular, I argue that successful research programs can emerge from explanatory frameworks containing general principles or propositions along with a supplemental set of specific theories or models of practice. I therefore take a line consistent with Hardcastle. Although my argument culminates in the next few chapters, I will note now that I depart from Hardcastle with respect to the importance she places on explanatory extensions between theories at different analytical levels.

Inter-level connections tend to produce tension between competing argumentation formats. Hardcastle responds to this tension by inventing bridging formats which provide a new, shared content. I find this approach too mechanistic because it resolves the tension by creating yet another argumentation format. Instead, I prefer that the tension remain, stimulating new empirical questions at each level. Where research tackles problems from multiple disciplines through an explanatory framework, its success can be measured by its ability to create inter-level connections—tension—that generate superior empirical work. As a result, inter-level connections provide a stimulus for better predictions, hypotheses and data, which will in turn, shed light on the connection’s nature. I think an explanatory framework like the Standard Model should first, reveal unnoticed connections between analytical levels, and second, encourage the tension between levels to be resolved through sharper empirical questions. I place a higher emphasis on data than Hardcastle, although I support her recommendation for less rigid core principles.

My case analysis of the Standard Model suggests that general principles can be assembled as related propositions serving as an explanatory framework. Around the periphery of the framework, specific models provide more detailed descriptions of a phenomenon as it operates at different analytical levels. The further an explanatory framework has progressed, the more it can create a coherent picture of a diverse set of models. Ultimately, a framework should act to functionally decompose the causal
factors governing a phenomenon by explaining the relations between higher and lower level mechanisms. On the other hand, a framework headed for collapse will fail to identify the pivotal tensions that support inter-level connections. For this reason, I argue that even uneasy, messy connections, characterised by combating argumentation formats, stimulate helpful tension. I see tension as advantageous because its resolution demands creative solutions. More tension means a greater impetus towards resolution, and therefore more empirical activity. From a macro viewpoint, progressive explanatory frameworks reveal high potential empirical questions. In my mind, progressive frameworks (or research program if it is more developed) incorporate a mechanism for canalising decisions about where to spend resources for accumulating empirical data. In the Standard Model’s case, neither has it delivered a convincing number of inter-level connections nor failed to deliver any. It occupies a purgatory for emerging research programs. I therefore consider it a useful exercise to map the inter-level relations it exposes.

Figure 11.2 provides a visual hierarchy of analytical levels highlighted by the Standard Model. Little sophistication in the inter-level relations is specified. However, the Standard Model provides for the possibility of deeper connections, although their successful exploration may not necessarily work given the Standard Model’s core assumptions.

The Standard Model begins by recognising that a biological selection imperative has acted upon the mind. As a result, neurological structure and function are a direct reflection of selection pressures. This is an important first assumption, acting as a platform for claims that cognition operates through modular computational processors acting on specific domains of functionality. At this point, the Standard Model begins to reveal it major strengths and weaknesses.

Beginning with natural selection leads to assumptions about the levels above and below mental information-processing modules. Thus, in order for both lower level neurological theories, and higher level anthropological and psychological theories of behaviour, to connect through the Standard Model, they must adhere to a core set of assumptions about the nature of computation. Conversely, lack of adherence obstructs connections. For example, modular computation sits uncomfortably with connectionist
accounts of the mind. In fact, functional specialisation in neuroscience has little in common with Fodor’s (1983) modularity. Neuroscientists think that functionally-specialised regions respond to information of different kinds, rather than acting as informational modules (Hintikka and Symons 2003). Furthermore, since modular computation also insists on a suite of particular behavioural explanations, the Standard Model has some difficulty in finding inter-level connections with pluralistic and ‘irreducible’ psychological, cultural or anthropological accounts of religious behaviour.
Figure 11.2 Standard Model of Religious Cognition Inter-level Relations Map
Since the Standard Model focuses on pan-cultural aspects of religious cognition and patterns of expression, its analytical preoccupation lies with the evolution of proximate cognitive mechanisms. That is, domain-specific cognitive devices. Of course, the Standard Model claims that the cognitive architecture so pivotal to the encouragement and expression of religious cognition was designed for non-religious, pro-social, survival purposes. Religion does not constitute an adaptation. Religion is a by-product of cognitive architecture successfully adapted to a fitness landscape where cooperation, connection and solidarity presented advantages. By implication, we run into a levels problem because cognitive approaches examine religious content as it falls upon the mind whereas evolutionary approaches emphasise religious behaviours with little interest in cognition. Similarly, the Standard Model explains little about why certain religious practices deliver adaptive solutions at both the group level (e.g. intra-group trust) and individual level (better health). Perhaps the most obvious levels issue between evolutionary and cognitive accounts of religions relates to different explanations for religious practices that are neither adaptive nor functional. A commitment to the by-product theory means that cognitive approaches do not expect all religious activities to be adaptive. On the other hand, a strong evolutionary interpretation suggests that all religious behaviours were adaptive for our ancestors at least at one time given the selection pressures of their environments. Barrett (2011, p. 233) contemplated a “collaboration” of approaches where some of the central components of religion—like rituals—could have arisen as by-products only to become sites of cultural elaboration. While appealing, this kind of ‘collaboration’ still leaves us with analytical level challenges given the complex intersection between evolutionary pressures, cognitive proclivities, and cultural nuances.

Computational modularity and connectionist interpretations also face an analytical level problem. That is, the two approaches employ incompatible, or at least poorly aligned, levels of analysis. While inter-connections between the two may be located, the two argumentation formats along with their data sets, cannot be neatly overlaid. For example, brain data acquired through single cell recording, imaging studies, and neurological deficits, indicates that the brain takes a distributed and multi-tasking approach at every level (Hardcastle and Stewart 2002). Indeed, no one can yet show where any putative module resides in the brain. If cognition operates on a distributed neural basis then modules may best be seen as metaphors or broad heuristics describing anticipated cognitive outcomes.
The problem goes deeper than a lack of data. Neuroscientists do not have the tools to resolve the modularity debate. In fact, all neuroscientific inquiry seeks to localise brain functions. For example, single cell neuronal recordings report activity as if from an independent system. Of course, this is misleading because the technique only provides data about whether the identified cell fires under certain conditions or not. Single cell recordings specify a neural correlate of an observed brain function, but do not report on causality or complementarities. It may be that cells all over the brain activate during a given function. Concluding that because one cell activates it is also located at the centre of the action may be quite wrong. In fact, the actual processing of information that occurs in an individual cell during a given function would be preceded by a cluster of other brain activities including excitatory and inhibitory inputs from other areas in the brainstem, cerebellum and cerebral cortex. An accurate description of any brain process becomes more complicated when the coordinating and amplifying functions of certain regions of the brain are taken into account. Sometimes a part of the brain becomes active merely to help pass along information. To accentuate this point Hardcastle and Stewart (2002) invoked the notion of ‘six degrees of separation’, where any given brain cell can be linked with any other in six connections or less.

Neuroscientists would perhaps counter-claim that fMRI and similar neuro-imaging techniques bypass the aforementioned limitations by showing a holistic picture of brain activity during specific functions. However, brain imaging techniques operate at a resolution several orders of magnitude removed from single cell activity. Any conclusions are based on a coarsely-grained picture. Any technical imprecision is exacerbated by the subtraction methods neuroscientists employ to determine which parts of the brain operate during certain functions. For example, a researcher might select two experimental conditions that differ only in the cognitive process under investigation. Results from the two are subsequently compared, the difference assumed to represent the neural correlates of the cognitive process under study. Consider, for instance, an experiment investigating the neural correlates of prayer. The key data reflects the difference shown in the brain images between those recorded during prayer and those of a neutral benchmark. Notwithstanding the potential for variables that cannot be controlled—like stray thoughts—imaging techniques will tend to show significant brain activity in ostensibly the same location for a wide variety of cognitive processes. Furthermore, fMRI and PET analysis picks up on potentially indirect metabolic changes which show up on imaging. Conversely, those aspects of cognition that do not have a corresponding change in metabolism become overlooked. Given the order of magnitude involved, it is a little like
assessing the activity of individual humans by studying a photograph of the earth taken from the moon.

Aligning results from different techniques attempts to provide independent, epistemic support (Bechtel 2002). In practice this means researchers seek to validate new techniques when they produce data that support an existing theory that was developed using well-known techniques. As a result, the use of novel techniques is not so much driven by convergence between the techniques themselves but between the data they produce. Data from multiple techniques offer a form of parity to calibrate one or more of the methods, leading to an artificial link between data and the phenomenon under measurement. The calibration of two research techniques may therefore compromise one another’s independence, making it all the more difficult to construct an inter-level theory that demonstrates methodological corroboration.

Scientific methods typically emphasise the importance of agreement between the evidence obtained by a new instrument and that obtained through a well-established instrument. However, it might not be as straightforward as it seems. For example, new instruments are appealing because they produce evidence that cannot be duplicated by existing techniques, rendering the data correspondence approach a minimal check rather than a rigorous test. In addition, converting the evidence generated from the new technique to a form recognisable by an existing technique may require a complex set of inferences and bridges in order to avoid risking data loss during translation. Also, researchers face the problem of what to do about a lack of correspondence after the techniques have been aligned. Normally this requires the new instrument to be calibrated into line with the tried and tested instrument; a problematic process if the new instrument is superior, or measures something even slightly different. No single technique answers all the questions researchers pose. Techniques need to be bundled in order to piece an answer together.

**Conclusion**

At present, the Standard Model provides only limited, and in most cases, suggestive, inter-level relations. Nevertheless, I attempted to create a rudimentary map of the various strata as a way of visually representing the intersecting levels. The Standard Model’s base assumptions revolve around the presence of computational, modular cognitive processing. In order for the Standard Model to progress, it must reconcile its core computational assumptions with the neurological evidence. But a cognitive neuroscience of religion faces levels and mapping
challenges. In particular, the Standard Model attempts to align socio-cultural level religious phenomena by applying deeper cognitive theories (Barrett 2011, p. 237). Such attempts also demand the mapping of cognition onto neurology. Inescapably, a cognitive neuroscience of religion must move fluidly over at least three levels.

I have argued that a progressive ‘explanatory framework’—a term I am using to describe emerging research programs—can specify interconnections between analytical levels dealing with the same phenomenon. The Standard Model shows signs of progress when it illuminates possible connections between evolutionary pressures, modular cognitive functionality, and neurological correlation.

My view remains that connections need not invoke reduction. As Mundale and Bechtel (1996) maintained, hierarchical organisation can be accepted without assuming that higher-level processes are only consequences of lower-level processes. Instead, a more ‘stratified’ view may be appropriate. My position acknowledges that a stratified view necessitates taking multiple levels of organisation into account along with explanations that link multiple levels. Thus, individual psychology links with both social contexts as well as neural processes. An integration of psychology, evolution and neuroscience of this nature holds consistent with Darden and Maull’s (1977) conception of inter-field theories, which describe potential connections between parts and wholes, causes and effects, and structures and functions. I have tentatively suggested that the Standard Model has begun to stimulate inter-field theories by first, identifying previously unseen interconnections between explanations from different levels, and second, encouraging the tensions between levels to inform novel predictions and hypotheses guiding future empirical work. I also noted that working with inter-level data mean grappling with epistemological issues arising from different research approaches. The epistemological challenge lies with aligning results from different methods, instruments and techniques for data collection. Researchers do not necessarily take the same approach to assessing the merit of techniques as they do theories. Instead, quite paradoxically, the outputs of new techniques tend to be used as the evidence validating them.

One challenge involves forestalling the inclination towards epistemic technique-matching. In a practical sense, the Standard Model has avoided attractive but over-simplistic conclusions attributing the source of religiosity to specific brain structures or cognitive modules. A more integrated approach recognises the distributive subtleties of task and function in the brain.
Wielding one technique alone, or to calibrate another technique, has dangers. For example, finding pathology in the amygdala of highly religious temporal lobe epilepsy patients does not provide a complete picture of spiritual experiences. Furthermore, when a SPECT analysis reveals that Tibetan meditators show enhanced local activity in the temporal lobe during self-reported spiritual episodes, it does not necessarily mean that the spiritual-pathology hypothesis has been confirmed. It means that the tapestry of data has added another couple of threads, and each should be examined within its place in the overall mosaic. The problem at the moment is that the tapestry looks messy and the Standard Model offers the most comprehensive argument about its likely shape. I continue to caution that pulling the modularity and computation threads could unravel the entire piece of fabric.

In this chapter, I offered support to Hardcastle’s conception of a successful theory or framework in cognitive science. She insisted on two ingredients. First, a set of general principles governing the phenomenon, similar in role to Lakatos’ hard core, but less rigid. However, because principles are too general for specific predictions, theories also need to include models of the actual systems in which they operate. In practice, inter-level cognitive theories and frameworks constitute general principles and sets of related models bolted together, with the augmented models acting as a protective belt bolstering the general principles. As I will discuss further in the following chapter, I am less enthusiastic about Hardcastle’s recommendations for bridging languages, or explanatory extensions. I prefer that an explanatory framework such as the Standard Model avoid creating new, artificial connections between levels, described in compromise terms. Instead, I think that a progressive framework encourages the tensions that arise when inter-level connections become messy. Tension leads to sharper empirical questions. In other words, I contend that progress is better served by a framework that stimulates superior empirical evidence, than one that creates a proliferation of new, speculative theories described through contrived bridges.

Rather than on inter-level criteria, upon which the Standard Model performs modestly, a better approach might take into account its capacity to reconfigure disjointed and unconnected theories about religious cognition into a single framework. Progress would be seen where the Standard Model ceases to represent a specialised area and instead becomes a vehicle for connecting and reshaping previously disjoined approaches to the study of religious cognition. In short, on a moderate version of inter-level continuity, the Standard Model would be assessed on its ability to make connections between theoretical levels without venturing into
reductionism or unification. For the moment, however, the Standard Model cannot be said to satisfy integrative power. I venture further in the next chapters about the Standard Model’s success and its implications as a case for conceptions of progress in the philosophy of science.
Chapter 12. The Standard Model of Religious Cognition: Assessment Criteria

Introduction
One of my objectives in this dissertation has been to evaluate progress in the cognitive science of religion by examining the burgeoning research program Boyer labelled the Standard Model. I have not employed a single criterion as a measure of progress, but instead have drawn from several works in the philosophy of science to aid in structuring my analysis. Most prominent has been Thagard’s criteria designed for evaluating theories of cognitive representation. In the first section of this chapter I overview the conclusions I formulated concerning the Standard Model’s progress based upon Thagard’s five criteria, plus two additional criteria I added as supplements.

To review, Thagard (2005a) offered five criteria by which theories of cognitive representation and theories of mind can be judged: 1) Representative power refers to a theory’s ability to account for a variety of cognitive representations; 2) Computational power refers to how well the processes described by the theory can perform computations; 3) Psychological plausibility refers to how likely the processes identified by the theory are performed in practice; 4) Neurological plausibility refers to the theory’s ability to describe the mental processes physically occurring at the neural level; and 5) Practical applicability refers to the theory’s capacity to explain real world behaviour and experience. I added two criteria to Thagard’s original five: 6) Evolutionary plausibility refers to the extent to which the Standard Model can be aligned with selection pressures and the biological theory of evolution, and; 7) Integrative power refers to the Standard Model’s capacity to assimilate evidence from different levels of explanation, where a level represents an analytical stratum.

In terms more specific to religious cognition, the criteria provided a framework in which reflected on the Standard Model’s capacities to: 1) explain the presence of religious mental representations (ch. 5); 2) explain the operation of cognitive devices and the way they compute or process religious representations (ch. 6); 3) explain the religious behaviour that cognitive devices encourage (ch. 7); 4) explain the relationship between cognitive devices, brain operations and religious thought and behaviour (ch. 8); 5) explain religious extremism and atheism, as well as more common religious experience (ch. 9); 6) explain the relationship between cognitive devices, evolutionary selection pressures and religious thought and
behaviour (ch. 10); and 7) explain the relationships between theories generated by the Standard Model that operate in different disciplines (ch. 11).

Thagard’s criteria were originally employed in a different context. Thagard was interested in comparing competing, generic theories of mental representation, whereas I am interested in assessing a single claim about representation and computation. However, I have found Thagard’s criteria useful because they highlight pivotal dimensions of cognitive performance and offer a structure for dissecting the various components, assumptions and propositions of the Standard Model. My goal was never to duplicate Thagard’s use of the five criteria, but rather to employ them as an organising methodology. A summary of my assessment for each of the seven areas appears next. In the following chapter, I re-introduce the other key progress concepts from the philosophy of science.

1. Representational Power
According to Thagard (2005a), representative power refers to a theory or model’s ability to account for a variety of cognitive representations. Accordingly, a superior theory explains a variety of different types of religious cognition. The Standard Model defines a religious representation as a mental theory about a category of religious information. Furthermore, religious representations occur on the back of prosaic, intuitive representations about domains. Rather than being special, religious representations employ the same cognitive processes and apparatus as any other form of representation. At the same time, cognitive scientists of religion claim that religious representations possess a specific character. A religious representation contains counterintuitive content about supernatural agents. When computed through the process of cognition, religious representations return inferences that depart from intuitive expectations. Religious thoughts therefore sit uncomfortably with our intuition about the world and how it works. Standard Model advocates claim that religious representations foil the mind’s efficient processing system, which relies on rapid inferences about the surrounding world in order to guide behaviour. Concepts like supernatural agents lead to counterintuitive but memorable inferences. A religious representation is an ordinary representation containing counterintuitive religious content about supernatural agents or events, which return inferences defying intuitive expectations. I have argued that this definition is problematic.
Although the Standard Model version of religious representations provides a useful starting point, it also contains some serious limitations that undermine its use as a foundational assumption. As a result, in chapter five I argue that the Standard Model’s representational power suffers due to an imprecise definition of the pivotal unit of representation. I have identified four major issues that arise from this fundamental limitation, which present challenges to the future of the Standard Model as an emergent and progressive research program.

First, the definition inadequately differentiates religious representations from other kinds. The Standard Model assumes that religious representations are not unique and do not require cognitive mechanisms exclusively dedicated to religion. However, religious representations incorporate counterintuitive content, leading to counterintuitive inferences, which tend to be memorable. The problem remains that the presence of counterintuitive content does not necessarily provide a quintessential measure of a religious concept. Examples of non-religious counterintuitive concepts can be readily found, such as those associated with love, sport, family and national identity. At best, counterintuitive content could be considered a necessary but not sufficient feature of religious representations. It appears likely that counterintuitive religious representations and counterintuitive non-religious representations share the same cognitive processes (Franks 2003, pp. 42-50). Equally, innumerable concepts associated with religion do not possess a counterintuitive element. For example, even if we accept that the concept of ‘God’ is counterintuitive, the concept of ‘commandments’ does not seem to be. As a result, the Standard Model ignores a significant amount of religious content by excluding the intuitive and the easily understood.

Religious representations form the fundamental unit of cognitive manipulation. Their accurate description is essential. Counterintuitivity does not offer a sufficiently unique or transparent characteristic upon which to base a definition of religious cognition.

I have proposed that if religious representations do not require religious cognitive mechanisms then it might be more useful for the Standard Model to abandon the attempt to distinguish religious representations from the non-religious. To foreshadow another conclusion, I think it impossible to definitively specify between a religious representation and a non-religious one if we accept that religious cognition is itself a form of ordinary cognition.
From this viewpoint, religious representations are no different to ‘golf’ representations or ‘furniture’ representations.

A second issue concerns some ambiguity around the relationship between implicit and explicit religious beliefs. Explicit beliefs such as those about God are conscious, high level interpretations, contrasting sharply to implicit beliefs like the expectation of gravity. The Standard Model acknowledges the relevance of implicit and explicit processes through intuitive and reflective beliefs. However, it is only just beginning to address the relationship between intuitive and reflective representations, as well as how reflective representations are influenced by counterintuitive content. The issue also connects to Thagard’s notion of practical applicability in that individuals do change their beliefs about religion. Some evidence even suggests that the beliefs individuals think they hold may not be an accurate reflection of what they actually believe. Religious beliefs constitute a complex array of intuitive inferences and reflective thoughts, which in turn are moderated by emotion and contextual forces. While I think that the concept of counterintuitivity is useful for examining religious representations, it does not have the scope to deal with either the volume of religious concepts, or the complex nature of their formation. Quite obviously, many individuals never form religious beliefs despite being exposed to counterintuitive religious concepts. Others accept counterintuitive religious concepts only to abandon them later. Counterintuitivity plays a role in understanding religious representations, but it requires significant elaboration in the context of reflective cognition and its influence in shaping intuitive inferences. Sometimes reflection trumps counterintuitive inferences however memorable they might be.

Counterintuitivity also leads to a third problem connected with teaching and learning. Boyer’s cognitive optimality hypothesis helps to explain the ‘stickiness’ of religious concepts by proposing that they possess an ideal balance of the intuitive and counterintuitive. Again, the cognitive optimality hypothesis offers a useful heuristic, but it has difficulty in accommodating the variation of religious concepts that are accepted and transmitted. It also fails to provide an overarching memorability formula or specify how and why the balance between intuitive and counterintuitive inferences can be unique to each concept. Cognitive optimality struggles to reveal how counterintuitive concepts are viewed upon reflection and critical interrogation. All manner of intuitive-counterintuitive relationships can be found in both religious and non-religious concepts that are memorable and readily transmitted. It seems likely that the nature of the original exposure as well as the repetitive effects of teaching and
learning play important roles in the acceptance of religious concepts. Perhaps these learning conditions have an equal or even greater impact upon memorability than an optimal balance of intuitive and counterintuitive elements in a concept. In the end, what is the difference between a science teacher advocating that quantum theory is correct, and a religious leader advocating that the Bible is correct, when both involve the acceptance of counterintuitive content? Cognitive optimality and counterintuitivitv are not enough to explain learning and reflection. I also introduced other variables which likely affect memorability, such as rituals, in chapter 7.

A final issue associated with the representational power of the Standard Model returns me to the parasitic relationship between religious concepts and ordinary cognitive mechanisms. If religious representations are managed by ordinary cognitive mechanisms, then numerous mental systems engage in overlapping operation in order to manage religious practice. All of these systems are ordinary in the sense that they deal with countless other forms of cognition unrelated to religion. It is more difficult to specify religious representations when they are processed alongside all sorts of other non-religious representations. Religious representations do not come in a single kind and may actually be as numerous as individuals’ thoughts. Presenting a theory of religious cognition must therefore be almost as complex as presenting a theory of general cognition.

2. Computational Power
On Thagard’s (2005a) terms, computational power refers to the operations performed on mental representations. If mental representations constitute mental symbols that stand for something, then computations convert these symbols into inferences. Accordingly, the effectiveness of a given computation can be evaluated on the basis of speed and flexibility. Faster computational processes that can solve multiple problems are preferable to slower processes as well as those capable of solving single problems. Similarly, superior solutions come from computations which operate with greater efficiency or economy.

The Standard Model advances a functionalist version of computation-representation managed by domain-specific cognitive modules. Religious representations (concepts) are computed (processed) by cognitive modules (mechanisms or devices) that operate only on specific domains (kinds of concepts). To be blunt, if computation is not managed by domain-specific modules, then the Standard Model must fill a giant hole. I make this observation in chapter six.
with considerable concern for the progress of the Standard Model as domain-specific modularity is not universally accepted outside cognitive science, and an area of fierce debate within it.

On the positive side, the domain-specific modular computation theory delivers some useful predictions about religious belief and practice. These predictions broadly satisfy Lakatos’ conditions of heuristic novelty, and I conceded that the Standard Model approach to computation offers the most comprehensive account of religious cognitive processing available. In addition, Standard Model advocates accept that the predictions emerging from its computational assumptions are probabilistic rather than causal in nature. They argue that in all likelihood, religious concepts are processed by the mind in such a way that the resulting thoughts are compelling to adopt and pass along. At the same time, domain-specific computation does not guarantee the success of religious concepts. Rather, Standard Model advocates predict that all other things being equal, religious concepts have an advantage over other concepts because they are particularly compelling once computed, and easy to pass along. Under the criteria of psychological plausibility I showed that the Standard Model has made some novel predictions that have been empirically confirmed. But, gaps and anomalies in the empirical evidence, as well as little corresponding support from work in cognitive neuroscience, suggest that domain-specific computation is not the final word on cognitive computation.

On the Standard Model, the computational mechanisms that manipulate religious representations operate as domain-specific modules with dedicated functionality, and fast, efficient processing. A practical difficulty, as I observed in the previous section, remains that numerous modules must engage during religious cognition, making it unclear which one is responsible for each kind of concept computation. Because identifying physical modules in the brain is not an option, we are left with an abstract theory of processing, potentially of no more accuracy than a loose heuristic or metaphor. I suggested that many cognitive scientists believe that theory of mind, folkbiology, number, face recognition, naïve mechanics, and folk sociology modules play crucial roles in religious cognition. It seems obvious that there could be countless others as well, with speculative new modules appearing regularly in the literature.
Although religious representations contain counterintuitive elements, their computation occurs in the same way as any other representation. This encourages a circuitous computational logic because counterintuitivity suggests that the computational process has produced a domain violation. In fact, the counterintuitive domain-violation is instrumental to the memorability of religious concepts, and therefore their transmission success. Ordinary computation must ‘fail’—it must produce a domain violation—in order to return a counterintuitive concept. Religious computation relies on the partial failure of ordinary computational inferences. I find this an awkward explanation in light of the Standard Model’s claim that religion is natural and that its concepts fall upon fertile mental soil. If religion is natural, then modules would not produce violations and we would all consider religious concepts to be intuitive; everyone would be religious. Yet, any computational process in any putative module could return a domain violation. Obviously, not all domain violations are interpreted in a religious way. In response, I suggested that religious doctrine provides a pre-computational sorter which classifies violations. The role of religion as a cultural force on cognition explains why only certain counterintuitive domain violations are considered relevant to religious belief. We are pre-trained about religious concepts and primed to accept certain violations more readily than others.

Overall, I determined that the computational power of the Standard Model is modestly acceptable, but also pointed out that future work might expose an entirely different computation mechanism that integrates more easily with the prevailing neuroscientific evidence. Whatever the replacement for modules might be, I am reminded by a suite of philosophers including Popper, Lakatos, Musgrave, Mayo, Nowakowa and Nowak, Rosenberg, and Worral, that they must generate similar or better predictions than competing models with fewer anomalies to be considered a better explanation. I suspect that domain-specific modular computation is not quite right but forms either part of the processing picture or offers a useful metaphor. Either way I remain uneasy about the Lakatosian-style hard core the Standard Model employs, built on its assumptions about computation. For this reason I favour Hardcastle’s heuristic approach, where a research program features guiding principles rather than an immutable hard core. I have used the term ‘soft’ core to incorporate the benefits of taking a Lakatosian research program approach, which I explain in further detail in the next chapters, while also acknowledging the more flimsy assumptions underpinning the Standard Model.
3. Psychological Plausibility

According to Thagard (2005a), psychological plausibility concerns the idiosyncratic ways in which individuals think. In this case, a plausible theory or account provides a match between computational-representational predictions, and anthropological descriptions of religious practice. A superior account shows how the nature of cognition helps explain religious thought. In addition, plausibility means that the mechanics of cognition influence the practice of religion. My conclusion in chapter seven reflects cautious optimism but nevertheless highlights serious gaps and uncertainties.

Psychological plausibility plays an important role in my analysis of the Standard Model because it introduces the anthropological evidence, thus connecting religious cognition with religious practice. My approach was to focus on the evidence and theory explaining the role of cognition in the covert psychological world of religious ritual. Rituals offer a unique window into the practical deployment of religious computation-representation. A key prediction holds that computational inclinations for social exchange reinforce costly commitments to supernatural agents and the ritualised performances that expose them. I suggested that rituals expose an important intersection between cognition and behaviour when considered in light of the Standard Model’s explanatory framework. It claims, for example, that specific cultural content is canalised when exposed to the inferential computations of the modular mind. As a result, the Standard Model maintains that the successful transmission of religious representations accompanies a common cognitive receptivity. In particular, counterintuitive notions of superhuman agents enhance memorability, as does the repetition and emotion exercised by religious rituals.

In evaluating psychological plausibility, I examined Whitehouse’s modes of religiosity, which explains how culturally diverse concepts expand the boundaries of recipients’ memories. Whitehouse proposed that religious concepts enjoy better recall and transmission when they stimulate two kinds of memory, semantic and episodic, the former governed by repetition and the latter by emotion. Both kinds may be found in rituals which have doctrinal, repetitive or semantic content as well as imaginistic, emotional or episodic content. Whitehouse’s two kinds of ritual content and their corresponding memory forms represent a meeting of repetition and emotion. In this respect, I suggested that rituals paradoxically provide both relief from overzealous inferential modular activity through doctrinal repetition, as well as amplifying the same inferences by adding emotional power. In addition, some religious
practitioners participate in rituals without believing in their efficacy, demonstrating that the performance of rituals will not necessarily lead to the acceptance of religious concepts.

Another cognitive-anthropological connection that bolsters the psychological plausibility of the Standard Model may be found in commitment or signalling theory. It assumes that religious practices increase group cooperation through the display of costly actions transmitting signals to prompt trust. The performance of a ritual that serves no obvious purpose can be employed to generate emotional reactions anchored through repetition. I proposed that the evidence from religious ritual studies reinforces the psychological plausibility of the Standard Model. A powerful cocktail of elements is present in rituals: the importance of counterintuitive supernatural representations; social inferences supporting group cohesion; a combination of memory triggers stimulating emotional arousal with reflection; and repetition-engraining doctrine. A problem, however, lies with the uncomfortable leap from computation to behaviour. It remains unclear which domain-specific modules trigger during each kind of ritual mode, or what interface they have with memory. Moreover, I noted that the signs suggest emotional arousal plays an extremely important role in mediating cognition, but short of Whitehouse’s theory, the role lacks a developed account.

4. Neurological Plausibility
The Standard Model tacitly presumes that the neural correlates of religious cognition cannot be differentiated from the neural correlates of ordinary cognition. Since no religion or belief part of the brain can be identified, and religious cognition relies upon ‘ordinary’ cognitive capacities, little basis exist upon which we can begin a specific neurological account of religious cognition. In chapter eight I made the point that developments in the neurological plausibility of the Standard Model will stall until the neural correlates of general cognition have been specified.

I do not suggest that nothing can be said about religious cognition from a neurological perspective. For example, the neural correlates of counterintuitive thoughts would be a useful starting point, but it would be a vast stretch to consider such correlates a neural account of religion. Although tangential, substantial progress has been made in the area of emotion and cognition. For example, Damasio’s (1999, pp. 40-42) somatic marker hypothesis shows that emotion is hardwired into cognitive processes such as decision-making. While still in its
infancy in terms of neural correlates, a neurological explanation for the relationship between emotion and cognition would be of immense value to understanding religious cognition.

Another area of relevance to the Standard Model has developed much further. Several decades of empirical work have delivered considerable data reporting on the neurological features of religious experience. I presented several major streams of research and attempted to show where they correspond and diverge. For example, Persinger’s temporal lobe hypothesis predicts that pathology or temporary dysfunction in certain structures within the temporal lobe may stimulate religious experience. When these structures fail, they destabilise the brain’s hold on time, space and self, opening the door for mystical and religious interpretations of the resulting experiences. A competing but overlapping theory, the neurotheological hypothesis, championed by Newberg and d’Aquili, focuses on the simultaneous activation of the sympathetic and parasympathetic nervous systems. Although the catalyst is presented differently, the result leads to the same kinds of structural destabilisations that Persinger noted. Lastly, the meditation hypothesis assumes the same preconditions, but adds the importance of brain wave synchrony.

In my opinion, the most important implication from work surrounding the neural correlates of religious experience lies with the significance it confers upon the emotional component of religious practice such as rituals. I suggested that the Standard Model does not go far enough in emphasising the potential for religious rituals to influence neurological activity in a way that encourages and facilitates religious experiences, which in turn require a religious doctrine for interpretation. The loop of doctrine, practice, emotion and belief requires additional examination. To emphasise this point I tentatively outlined a general cognitive-neurological inter-level theory of religious experience. My objective was to discover whether employing the Standard Model as an explanatory framework for each of religious ritual and religious experience would reveal new inter-level connections. I rated the outcome favourably. In so doing, I argued that the Standard Model’s explanatory framework shows signs of progress toward research program status.

Although a religious experience might be powerful at the time, I argued that exposure to doctrine before, and cogitation afterwards, has greater influence in determining how a religious practitioner makes sense of the experience. The data strongly point to pre-formed beliefs as central in the process of interpretation, as well as the influence of prevailing cultural
forces. Religious cognition provides meaning while religious experience provides leverage. In between the two, religious practice, whether in the form of rituals, meditation or prayer, help to connect cognition and experience by simultaneously reinforcing doctrinal concepts and prescribing cognitive activities that are more likely to create the neurological conditions conducive to peak episodes. Because cognition is not purely a mental event but one infused with emotion, it is more likely that anyone inclined toward religion or spirituality will find a peak experience religious in nature and will use it to bolster their dominant beliefs.

Religious affiliation demands sacrifice, typically through displays of commitment sublimating individual interest. As a result, emotionally motivated self-sacrifice to supernatural agents stabilises in-group moral order, stimulating competition with out-groups, and creating new religious forms. There is a strong affective component at play here as well. Belief helps to assuage the fear of death and other existential anxieties. In this sense, religious beliefs are mitigated by emotional experience, explaining the power of communal rituals which “involve sequential, socially interactive movement and gesture and formulaic utterances that synchronize affective states among group members in displays of cooperative commitment” (Atran 2002, p. 270). In addition, mystical episodes and even certain pathological states can amplify religious beliefs. Religious concepts offer particularly good explanations for religious and spiritual experiences because of their counterintuitive assumptions, which help the match between the indefinable experience and its conceptualisation.

I concluded that the Standard Model encourages a circuitous logic where belief is parasitic upon belief. This relationship seems unproblematic for the Standard Model, which claims that religious beliefs transfer through catchy counterintuitive concepts reinforced by repetitive doctrine and arousing ritual. However, the conclusion that belief precipitates belief is troublesome for the simple but decisive reason that some people never accept any form of religious concepts while others discard previously held religious concepts.

5. Practical Applicability

In chapter nine I argued that the Standard Model explains belief in general better than it does religion specifically. While many people do not accept a religious system, no human abandons all basic assumptions and models about how the world and its occupants interact. Religion might be best seen as one form of belief rather than the prototypical form of belief. I therefore proposed that the absence of religious belief does not constitute the absence of belief
systems. Furthermore, religion does not come in one consistent kind of belief all of its own. When the Standard Model refers to religious belief as if comes in one vanilla flavour, it risks a serious classification error. On the other hand, the Standard Model performs more favourably when viewed as a framework for examining cognition as it underpins any form of belief.

My proposal was that the Standard Model’s dependence on innate cognitive mechanisms may be more useful in explaining all kinds of belief rather than religious beliefs. I think that the Standard Model overestimates the universality and ‘naturalness’ of religious belief. Its prediction that religious beliefs become canalised along a narrow path of alternatives seems overzealous. On my assessment of the anthropological evidence, far more variability in religious belief and practice may be found than the Standard Model predicts.

My reasoning begins in part with the experimental evidence associated with cognitive decision making, which demonstrates systemic flaws and biases inherent in cognition. The cognitive mechanisms that evolved to help us navigate a world packed with danger also provide the very mechanisms that load our cognition with faulty inclinations. This position aligns with the Standard Model’s first principles about cognitive design. On the other hand, my argument suggests that decision-making biases make use of cognitive heuristics, of which religious thought presents one manifestation amongst many. Once again, I agree about the parasitic nature of religious cognition. However, I do not think that because religious cognition is ordinary, then religion is ‘natural’. My reading of the evidence indicates that belief systems are natural. In my view, religion might be a belief propensity—in line with the Standard Model—but not a certainty, even under contextual conditions continually reinforcing its valence. Religious beliefs usefully diminish metaphysical uncertainty and existential anxiety. But, such stresses can also be mitigated through belief systems where family, sport and even scientific progress play central roles.

Religion has particular relevance in the context of emotions and decision-making. For example, some counterintuitive concepts are true while others are not, and the attribution of one or the other might be arbitrary or contextually determined. Religion sorts of the wheat from the chaff, serving as a kind of ontological sorter, accounting for the ambiguities and paradoxes in one sweeping set of concepts. Religion delivers a useful decision-making heuristic. I concluded that the Standard Model has difficulty in explaining the absence of
belief and belief conversions, as well as the acceptance of high proportions of counterintuitive content, such as that found in cult and non-mainstream religious sects such as scientology.

6. Evolutionary Plausibility

The purpose of introducing evolutionary plausibility was to consider whether the Standard Model receives corroboration from well-accepted theories in evolutionary science. In chapter 10 I also noted where connections to less well-accepted theories restrict the Standard Model’s application. For example, the Standard Model strongly embraces evolutionary psychology. However, since there will never be sufficient information about historical environmental circumstances to make conclusive determinations about likely selection pressures, evolutionary psychology does not offer strong corroboration. As a consequence, I expressed concern that the Standard Model is vulnerable to the reverse engineering trap: the mind evolved in response to selection pressures that allow it to function as it does, leading to the assumption of a direct correspondence between the mind’s functions and selection pressures. I readily conceded the usefulness of such an approach insofar as it reveals potential environmental variables that could have exerted selection pressures. My reservations emerge with direct mapping between selection pressure and cognitive functionalities. A strong evolutionary stance concludes that religion exists because it was selected. The Standard Model takes the middle ground, although on the current evidence I favour a weak stance.

On the strong view, I rejected religion as a direct evolutionary outcome. Amongst my objections is the implication that the proclivity to practice religion has genetic, heritable causes. I can find no evidence to support this position and have already discarded the hypothesis that a God part of the brain exists. While the brain obviously possesses structures designed to act out specific activities and experiences that can be interpreted with religious or spiritual values, they also serve a myriad of other emotionally-charged functions.

On the moderate view articulated in the Standard Model, religion itself was not selected. Instead, certain inferential capacities that offered social and survival advantages were selected. Without again debating the mechanism responsible—whether modular or not—I noted growing evidence indicating that the mind stabilises and channels the transmission of cultural information towards a general convergence. But this is as far as the evidence takes me. I cannot accept that cultural information is transferred through inference alone rather than replication or imitation. In my view, the data regarding cultural transmission remains
ambiguous, variously supporting both cognitive convergence and cultural imitation. Furthermore, I contended that the Standard Model too readily discards the immense number of religious variations that have been recorded through anthropology in favour of a common cognitive structure that canalises cultural information into a handful of key categories. In my opinion, the Standard Model stands on firm and relatively uncontroversial ground when it claims that the cognitive capacities engaged during religion were cobbled together by selection and adapted for purposes that just happen to also be particularly adept at encouraging religious belief.

On the weak view, religion represents an unremarkable cultural activity, supported like all cultural activities by evolved cognitive functions. The weak view does not privilege religion as a canalised cultural behaviour and does not assume that religion inevitably springs from the mind’s cognitive features. Universal human activities must depend upon evolved cognitive capacities. Nevertheless, establishing a link to environmental pressures remains troublesome because cognitive mechanisms produce religious cognition. I am cautious about whether outputs can legitimately be adaptations as well as the instantiating mechanisms.

A final view downplays the significance of cognitive endowments in favour of cultural factors and possibly even group-level selection. On this view, nothing about religious practice may be attributed to a unique cognitive form. Religious activities only become important when imbued with special meaning determined by socio-cultural forces. Religion, therefore, should be considered an adaptive cultural delivering survival advantages to practicing groups, which consequently become stronger, more influential, and attractive to join.

A variant of the group-selection view revolves around how cultural information or memes find fit and reproduce analogous to Darwinian evolution. Where cultural memes and biological genes interact, religion acts as an adaptive trait acquired through cultural selection rather than genetic mechanisms. The cultural environment may encourage specific genetically endowed traits at the expense of others. Accordingly, religion constitutes neither a set of pre-formed concepts nor a set of cultural concepts parasitic upon ordinary cognitive mechanisms.

Since it may be argued that religious beliefs have delivered advantages to individuals and groups, I cannot eliminate group and cultural theories. However, I do find group selection less plausible on practical grounds as it necessitates the absence of genetic interaction with non-
group members. I rejected, in defence of the Standard Model, the possibility that cultural information propagates as Darwinian memes, finding fit and reproducing with fidelity. I accepted as plausible the suggestion that certain memes can dominate groups and deliver a survival advantage.

The Standard Model claims religion as a by-product of natural selection. I agree, in that the cognitive functions operational during religious practice and belief are the by-products of evolutionary selection pressures. However, they were not selected for religion, but rather for generally useful social and survival reasons. Religion offers one powerful vehicle for the transmission of social and cultural information.

7. Integrative Power
In chapter 11 I introduced the evaluative criterion of integrative power in order to examine the Standard Model’s capacity to assimilate evidence from different levels of explanation, where a level represents a stratum of analysis. In terms of progress, I considered this addition essential because a cognitive theory of religion requires a research program that can accommodate theories and data from several disciplines operating at different levels of analytical focus. Integrative power also provided case evidence directly relevant to one of my central conclusions that progress towards status as a research program in cognitive science is evidenced when a developing explanatory framework in cognitive science reveals hitherto unforeseen or unclear connections between analytical levels.

On my assessment, the Standard Model acknowledges relations between analytical levels. I found some promising connections between cognition and rituals. However, the relations it describes rely on assumptions that I consider fragile. For example, I proposed that starting with a computational-representational position on cognition leads to assumptions about the levels above and below mental information-processing modules. As a result, in order for both lower-level neurological theories and higher-level anthropological and psychological theories of behaviour to connect through the Standard Model, they must be consistent with domain-specific modularity. Modular computation, however, demands the presence of mental representations, in turn leading to disjuncture with connectionist accounts of the mind. I find some of these connectionist accounts to be more consistent with the neuroscientific data concerning cognition. In the other analytical level direction, since modular computation also prescribes behavioural explanations, the Standard Model has difficulty in finding inter-level
connections with pluralistic and ‘irreducible’ psychological, cultural or anthropological accounts of religious behaviour that do not fit neatly within assumptions of cognitive canalisation.

My assessment is that the Standard Model’s integrative power reflects a tension between promising inter-level connections and overly constrained underpinning assumptions. I also supported Hardcastle’s suggestion that an inter-disciplinary cognitive framework or theory needs to account for models that explain phenomena in different populations.

Conclusion
At the Standard Model’s cores lies the imperative to uncover the cognitive mechanisms that underpin religion. Accordingly, the mind offers the key to explaining religion; no amount of anthropological observation will explain the way in which religious thought begins, maintains or transmits. While the Standard Model acknowledges that minds operate within an influential social reality, it begins with the assumption that religion evolved as a by-product of cognitive capacities selected to meet other needs. Religion exists because the mind proficiently generates and transmits the kinds of concepts essential to religious practice. These religious concepts also deliver advantageous social conditions for adherents which encourage practice. Although there must be numerous cognitive capabilities that bolster religious concepts, the Standard Model preferences some over others, like theory of mind and the ability to attribute inference from one domain to another. To synthesise the Standard Model’s position, religious belief occurs as a natural expression of the innate cognitive capacities common to all human minds, supported by a transmission method effective in engaging emotion and memory.

The evidence I examined suggests that humans are susceptible to religious belief, but perhaps not more so than other culturally prolific activities. The Standard Model claims a relationship between cognitive capacities and culturally prolific activities, where the former restrict and prescribe the latter. I argued that some convergence pressures upon cultural activities may be likely, but the pressures lead towards more generic tendencies such as the ability to hold belief sets, rather than the predisposition to hold religious belief sets. Religion does not operate as a unique domain but rather as an extension of the general domain of social relationships between agents. The mind is also exceedingly adept at learning; people can change their minds, discard things learned in the past, and choose to become or remain an atheist.
The Standard Model concludes that the cognitive adaptations selected to solve other social and survival problems also stimulate a belief in supernatural agents. It assumes that the mind’s many mechanisms include those associated with social behaviour, emotional connection, the ability to assign agency to events, make inferences about the thoughts of others, and establish universal moral suppositions. Collectively, the cognitive mechanisms responsible for these mental abilities interact to create patterns of behaviour, amongst which religion appears as a prominent form. Religion comes as a by-product of sophisticated pattern-matching brain activity that erroneously assigns higher agency to patterns in the white noise of life. The mind does generate natural inferences that look like patterns, but I am unconvinced that religious patterns are more ‘natural’ than other culturally prolific patterns. In the next chapter I evaluate the Standard Model in terms of progress with particular attention to Lakatos’ research programs and other prominent accounts of progress that I have considered throughout this work.

Introduction

In this work I have been most interested in two kinds of progress. First, progress in a scientific program, where an emphasis lies with the development of an explanatory framework around a general problem. Specifically, I have concentrated on the Standard Model’s potential development from an emerging explanatory framework to a robust research program. Associated with this assessment, a second interest has been theoretical progress, relating to the knowledge-based set of explanatory statements contained within the Standard Model. Rather than examine each statement or proposition, I evaluated the performance of the Standard Model based on criteria relevant to cognitive theories.

In this chapter I revisit interpretations of scientific and theoretical progress and apply them to the conclusions I reached regarding the Standard Model. In particular, I introduce some final scaffolding to support my argument that emerging explanatory frameworks in cognitive science show progress when they reveal new connections and intersections between analytical levels. I begin by examining the challenges connected to building an inter-disciplinary program and theories around a framework such as the Standard Model. Inter-disciplinary theories assume the presence of complexity arising from observations of a phenomenon from multiple levels of analysis, as well as from differing argumentation formats. However, simply acknowledging the relations between disciplines and levels that pursue independent theoretical goals does not constitute inter-disciplinary theory development. Rather, inter-disciplinary relations depict connections that extend into each of the theories themselves, and therefore into different disciplines. I suggest that the majority of theoretical work in the Standard Model is *multi*-disciplinary, by which I mean that the connections between disciplines are superficial, tangential and limited in explanatory power. In contrast, *inter*-disciplinarity invokes deeper interconnections. The Standard Model currently struggles to provide explanations at multiple analytical levels. On the other hand, the Standard Model shows promise as a research heuristic, or what I termed an explanatory framework, stimulating empirical work leading to inter-disciplinary and inter-level connections. I claim that the Standard Model shows progress on this basis even if it generates data undermining its own assumptions.
In the second part of this chapter, I return to levels of analysis and their role in assessing progress in research programs founded on cognitive science. Although the traditional conception of inter-level relations has presumed the need for a reductionistic account of higher and lower level theories, more recent interpretations focus on inter-level relations as heuristics or as inter-connections between theories at different levels. Building on the evidence I presented in earlier chapters, I suggest that the Standard Model demonstrates potential in uncovering inter-level extensions between theories at different analytical levels. My position maintains that an under-developed framework such as the Standard Model shows progress when it makes connections, even when they do not introduce reductions. Emergent explanatory frameworks in cognitive science show potential when they can reveal new connections between analytical levels that stimulate new empirical work previously not considered.

My claims lead to further consideration of theoretical unification in cognitive science, which I provide in the third part of this chapter. An obstacle to unification in the Standard Model remains its prioritisation of the computational-representational view. I therefore examine the potential that future theories describing cognition will account for reductions of psychological experiences to neurological processes. While I do suggest that eliminative positions say little about the experience of religious cognition, I am pessimistic about whether the Standard Model can accommodate a strong connectionist interpretation. As a result of my gloomy take on the unificationist agenda through the Standard Model, I suggest a need to examine alternatives to traditional conceptions of reductionism. In the fourth part of this chapter, I evaluate Bechtel’s mechanistic approach to cognitive theory-building. Bechtel’s version offers integration without unification and reduction without elimination, thereby providing an account consistent with inter-field connections, and perhaps one with some promise for the development of the Standard Model and other research frameworks based on cognitive science.

In the final section of this chapter, I apply to the Standard Model Hardcastle’s specific recommendations for building theories in cognitive science. Her methods lead to the development of a two-part inter-disciplinary theory composed of general principles, and a set of loosely-linked models that operate over several levels of description and analyses. When the models are arranged together into a coherent picture using the general principles, they help towards functional decomposition. That is, the causal factors driving the cognitive
phenomenon are specified. I make special note of the importance to the Standard Model of Hardcastle’s emphasis on a cognitive theory’s general principles, a set of concepts, and accompanying predictions. Hardcastle’s model encourages a more optimistic account of the Standard Model’s progress. I also offer some modifications pertinent to the Standard Model. Next, however, I debate inter-disciplinary connections generated by the Standard Model.

**Disciplinary Connections through the Standard Model**

The Standard Model offers an inter-connecting platform of assumptions, loosely assembled into a relatively fluid core of working assumptions. However, as I continually observe, the Standard Model’s commitment to a computational-representational model of cognition limits its scope of application. In this section, I take a multi- and inter-disciplinary perspective in order to lay a platform for discussing the Standard Model’s performance across multiple levels and argumentation formats. While I will wrestle with the Standard Model’s programmatic status in the following chapter, here I note that it delivers a useful organising structure. Not only do I claim that a progressive explanatory framework makes inter-level connections, it also stimulates otherwise overlooked empirical work. On these two conditions, I claim that the Standard Model shows promise, even if the new connections and data it helps uncover undermine some of its key assumptions in the end.

Inter-disciplinary theory seeks to accommodate the complexity arising from observations of a phenomenon from multiple analytical levels, or from differing argumentation formats. For example, Newell (2001, pp. 2-3) held that for an inter-disciplinary approach to be warranted, its object of study must be multi-faceted, where the facets also cohere. He noted that a uni-dimensional, reductionist approach would suffice for a single-faceted phenomenon. On the other hand, a multi-disciplinary approach is adequate for a multi-faceted but not coherent object of study because integration is unnecessary. But, in order to qualify for both aspects of inter-disciplinary study—the application of more than one discipline and their subsequent synthesis—an object of study must be represented by a system. Because the connections between the facets will be mainly non-linear, the system must be complex by its nature.

From the complex system perspective, progress is perceived in terms of process. As a result, the Standard Model can be evaluated as the *process* of developing a framework of theories describing the entire system of religious cognition, from neuroscience to anthropology. I will expand on the opportunities associated with accounts of progress that emphasise process, such
as mechanisms, later in the chapter. The Standard Model can be viewed as a process-driven explanatory framework attempting to assemble an increasingly coherent picture of religious cognition. Under a process view, progress takes a path beginning with broad heuristics, loose models and general frameworks before moving into a tighter theoretical, research program-encapsulated form. I agree with Saler’s (2010, p. 331) endorsement of the approach taken by the Standard Model, particularly its conceptual commitment to neither begin nor end with religion: “In those senses, CSR theory-building parallels what I judge to be the best way of dealing with the seemingly endless problem of defining religion.”

A process approach to progress idealises inter-disciplinary work (see for example, Kitcher 1992). For example, it implies that creating an inter-disciplinary theory involves a linear, escalating path where revolutionary theory change or even periods of stagnation are absent. The linearity implicit in process models also suggest that inter-disciplinary theory development arrives inevitably through a force of convergence, as will theoretical progress. However, despite the evolutionary assumptions of scientific progress underpinning the process model, it does have some appeal for locating theory development efforts. For example, the Standard Model assumes a burgeoning place in its developmental process, creating common ground through a model with testable elements. In a crude way, the process approach to progress shows that the Standard Model has reached a critical mass of consensus within a part of the cognitive science establishment.

As a proxy for progress, process approaches say little about the ways inter-disciplinary theories and frameworks such as the Standard Model assemble. Most expositions of cognitive science take a multi-disciplinary approach rather than one that pursues interlocking disciplinary connections: “… Genuine inter-disciplinarity, by contrast, suggests that the relation extends into theories themselves, so that, in order to achieve their explanatory task, theories would go across several disciplines” (Sobel 2001, p. 56). The Standard Model has forged a working architecture around religious cognition, but does not demonstrate ‘interlocking’ disciplinary connections. In any case, should deep inter-disciplinarity represent a pivotal measure of progress?

A strong stance suggests that inter-disciplinarity forms a necessary property of cognitive theories (Ezquerro and Manrique 2004, p. 56). A moderate stance views inter-disciplinarity as a regulative notion where its achievement is convenient but not essential. Another moderate
alternative suggests that inter-disciplinarity arises as a consequence of the messy, nascent activity characteristic of cognitive science in general. A weak stance discards inter-disciplinarity altogether. Neither a current nor future characteristic of cognitive science, it remains an idealistic philosopher’s fantasy.

While I tend towards a normative stand, my arguments so far have also acknowledged that inter-disciplinary connections are not all equal; inter-disciplinary integration must contend with the measurement of degree. Delisle’s (2003) examination of disciplinary integration between evolutionary biology and linguistics has relevance to this point. His interest revolved around the nature of integration as well as its implications. Rather than utilise one conception of integration as a lens for his case, Delisle (2003, pp. 38-42) argued that a multiplication of case studies helps review all possible aspects of integration between scientific fields. More cases lead to more previously unforseen implications. I think that Delisle’s approach applies to explanatory frameworks and models as well. For example, my analysis of the Standard Model has revealed some of these non-obvious implications, particularly where they have highlighted ambiguity, contradiction or corroboration with other views of cognition or religion. A notable example includes my connection of religious experience to religious rituals and cognition. As Moss (2001, pp. 3-4) noted in his cautiously unity-flavoured remarks, the hallmark of an inter-disciplinary theory is a new connection between traditionally disparate disciplines. For the most part, however, although the Standard Model’s loose framework highlights plentiful connections, few venture deeply or suggest resolutions to potentially intractable issues such as the neurological mapping of cognitive modules.

Cognitive science inherently seeks to address the relationships and interactions between interconnected views of the same phenomenon by fusing discrete but related disciplines. Familiar phenomena might look different, or new phenomena revealed, under the magnification of a fused lens. Cognitive theories diffuse across disciplinary boundaries (Østreng 2006, pp. 12-15). I have outlined numerous examples where Standard Model assumptions offer a novel angle on an old problem, such as explaining belief in general, rather than just religious belief. Damasio’s (2001) proposal offers another example where the key to bridging the mind-body gap lies with understanding the role emotions play in cognitive responses, including social decision making. While understanding religious cognition is restricted by our understanding of general cognition, enough detailed case evidence—say for example, from religious cognition and religious experience—might stimulate a breakthrough instrumental to a more
general theory of cognition and emotion. In addition, as Hardcastle’s combination of principles and loosely-linked models assumes, inter-level relations emerge from specific examples teased out with generic principles. I take the levels analysis a step further next by arguing that progress accompanies connections between levels, as well as in reductions.

Levels of Analysis in Cognitive Science

My examination of the Standard Model using Thagard’s criteria concluded that a high priority should be placed upon locating relations between analytical levels which can be used as heuristics to guide theoretical predictions and empirical testing. My view reflects a non-traditional view of level relations. However, the reductionist debate has changed considerably since the twentieth century focus on inter-level relations between a higher level and a lower level theories (Boogerd et al. 2002, pp. 463-471). My view, in line with more contemporary approaches, acknowledges that inter-level theories tend to inherit the character of the theories they connect (see for example, de Jong 2002). Inter-level connections can be advantageously seen as hypotheses, which may require revision if the theories they connect change. Inter-level relations therefore serve a heuristic function.

Inter-level relations highlight connections between two or more theories covering the same or overlapping phenomena. These connections stimulate a pluralistic, domain-specific, multi-level explanatory account, rather than a reductionistic account (de Jong 2002, pp. 450-451). But equally, I claim that inter-level relations enable interpretations of micro-level phenomena in terms consistent with higher level theories. For example, religious experiences connect with religious practices when rituals are understood in terms of the brain states they instantiate. Thus, both higher and lower level theory development is bolstered by using inter-level relations as heuristics, making them an extension of existing theories rather than a reduction.

Differing argumentation formats and methodologies complicate relations between analytical levels within the Standard Model. As different disciplines wield characteristic tools, methods and standards, they also produce theories from different perspectives, despite an interest in the same phenomenon. As Thagard’s criteria helped me illustrate, religious cognition has been approached from numerous disciplines and levels. For example, psychological theories better explain what mental processes do rather than what they are. Of course, the relation between psychological states and mental conditions introduces another complication. Can a single
psychological state arise from more than one originating set of neural conditions? My answer is no, which has relevance to my position on inter-level connections between neuroscience and psychology.

Taking a strong functionalist stance associating psychological states with their behavioural consequences, Putnam (1967) claimed that the same psychological state could be realised as a result of numerous sets of brain conditions. ‘Multiple realisability’ subsequently became a key weapon in the fight against reductionism because it elegantly rejected a one-to-one correspondence between a brain state and a psychological outcome. As Churchland (2002, pp. 25-27) described it, functionalism asserts that the nature of a cognitive operation relies exclusively on the role it plays in the cognitive economy of the individual. Functionalists like Fodor advocated that the same psychological state could be the product of different operations in one brain, different mechanisms in the brains of different species, or even the result of operations performed on a computer. To the functionalist, brain hardware remains independent from the software executed in the mind. To further the computational metaphor, the same software can be played on different hardware platforms. To Fodor (1981, pp. 127-145), multiple realisability leads to the claim that psychological experience is irreducible.

If multiple realisability holds, devising bridge laws to accomplish a transformation between the physical and the psychological will be difficult if not impossible. It would mean that the Standard Model has serious limitations as a connecting framework. Moreover, a neural account of a psychological phenomenon will be inadequate to describe any form of religious cognition. Multiple realisability suggests that each form of religious cognition can be underpinned by an unknown number of corresponding neurological states. However, I have not uncovered any evidence supporting multiple realisability for religious cognition. It is, however, too early to make more than suggestive conjectures given the absence of empirical work mapping religious cognition.

Amongst those who take issue with Putnam’s and Fodor’s arguments, Bechtel and Mundale (1999) believe that multiple realisability does not assist in understanding cognition. They made several arguments against its validity. The first proposes that multiple realisability improperly characterises neurobiological states. According to Bechtel and Mundale (1999, p. 176-179), brain states should not be interpreted on the basis of physical-chemical properties. Instead, neuroscientists describe brain states in terms of brain part activity. More specifically,
neuroscientists ‘map’ brains. Their conceptions of operative brain states are coarse-grained by necessity. However, philosophers like Putnam and Fodor use a coarse-grain when considering psychological states and a fine grain when describing brain states. When researchers study individual differences they adopt a fine-grained approach for both psychological and brain states. On the other hand, an evolutionary perspective demands a coarse-grain. I have noted that this grain problem makes comparison and connection more troublesome. For example, the distance between the assumed activity of a putative module and the corresponding brain state is considerable.

Elimination presents the logical philosophical end to a strong stance on mapping and correspondence. Feyerabend (1963) initially championed an eliminative materialism where psychological theories should be replaced by new neuroscientific theories, rather than be reduced by them. In fact, eliminative materialists take their inspiration from the work of both Kuhn (1970) and Feyerabend (1975) who claimed that revolutionary change in science leads to incommensurability between two theories, inevitably ensuring that the latter replaces the former, despite ambiguously similar nomenclature. When two theories do not sit well together, sooner or later one falls, eventually overturning an entire research paradigm. The Churchlands (1981; 1986) have also argued that elimination inevitably accompanies a failed reduction. Paul Churchland’s (1981) argued that mental interpretations will be eliminated in favour of physical explanations. Not only will psychological theories fall away in the face of superior neuroscientific approaches, they will also be incommensurate with the new, prevailing physical theories.

The challenge eliminative materialists face lies with explaining the subjective experience of conscious mental states. Although he began his defence of eliminative materialism in the early 1980s, Churchland (1995) later defended his position from the subjective experience argument. Churchland claimed that an individual can, with sufficient practice and knowledge, consciously access their brain state. Perhaps conscious access to brain states would foreshadow the arrival of spiritual episodes, and either stimulate or preclude them? At present however, conscious access seems implausible.

Eliminative materialism takes a sharp knife to defences of psychology that rely on the difficulty or impossibility of reduction. Although sympathetic to incommensurability between theories, eliminative materialism also provides an alternative model of inter-theoretic
relations, emphasising the elimination of psychological theories altogether, thereby deftly sidestepping any defence by making psychological theories completely redundant.

I agree with McCauley’s (1986, p. 196-7) contention that eliminative materialism’s error has been to draw eliminativist conclusions about the inter-level relationship between psychology and neuroscience based on an *intra-level* analysis. Eliminativists have been correct in identifying conceptual discontinuities between neuroscience and psychology, but have been wrong in assuming that this incommensurability compels the elimination of one or the other: “In *intra*level contexts during scientific revolutions such crises *do* require that sort of radical surgery, but in *inter*level contexts such a measure would eliminate potentially important stimuli for scientific discovery. The history of science reveal no precedent for theory replacement or elimination in interlevel contexts” (McCauley (1986, p. 197). In the next section I continue to explore inter-level prospects stimulated through the Standard Model.

**Theoretical Unification and the Standard Model**

I argue that a lesson from the Standard Model case is that progressive, emerging explanatory frameworks in cognitive science—research programs ‘in the making’—reveal connections between analytical levels and disciplinary boundaries, in the process stimulating new predictions and empirical work. Flawed though it presently is, the Standard Model does show some potential regarding this measure. However, in order to cement its status as a robust research program, the Standard Model needs to demonstrate stronger relevance to both neuroscience and anthropology.

At some point, the Standard Model has to measure up to the connectionist account of cognition, which assumes that mental computations are performed by inter-connected networks of neurons wherein information is stored as patterns of synaptic strength (Churchland and Sejnowski 1992, Ch.3). On this account, cognitive activity involves groups of neural agents stimulating and interacting with their environment. However, finding interfaces between neurological systems and computational operations remain troublesome. Connectionist approaches do not provide descriptions of cognitive processes, at least not in computational terms. Instead, connectionist descriptions reduce (and eliminate) cognitive operations to neural activity. A better understanding of the neurological activity underpinning cognitive operations might encourage a more linear reduction. Nagel (1961, Ch. 11) provided one of the classic accounts of inter-theoretic reduction by describing the nature of the
relationship between earlier and subsequent scientific theories. He assumed that theories can be articulated as explicit sets of statements. Deductively, one theory can be reduced to another if the fundamental laws of the first can be derived from the second. In order to hold, the two theories in question must be logically consistent and share a common vocabulary and meaning.

Of course, as with connectionism and computation, sometimes one or neither of Nagel’s conditions is met. This means that the laws of the reduced and reducing theory do not share common language, what Nagel called heterogeneous reductions as opposed to homogenous reductions. In heterogeneous reductions, the terms describing the reduced theory do not constitute a subset of those in the reducing theory. The only way around the problem involves constructing additional statements to make a connection. For example, Nagel’s bridge laws express connections between two vocabularies by using language and meanings separate from the reducing theory. In addition, bridge laws seek to identify the conditions under which the properties of the new, reducing theory can be expressed by the terms of the existing, reduced theory. They show how a translation can come about. Nagel’s reduction approach requires a set of bridge laws connecting the central tenets of two theories allowing one theory to be understood in terms of a second theory.

Alternatively, and more pertinent to the Standard Model, bridge laws can be used to demonstrate that ostensibly different terms actually describe the same phenomenon. For example, according to Bechtel (1984), the reductionistic approach to theoretical synthesis ignores other forms of inter-connection. He noted that two theories can be connected by virtue of location, instantiation, functionality or causality (p. 266). These four options are important alternatives in the analysis of inter-level theory connections emerging from the Standard Model. Religious rituals provide a useful illustration in that their performance offers a causal explanation for the brain conditions that give rise to religious experiences.

Bridge laws and the form of reduction they demand, as I outlined in chapter three, do not appeal to philosophers favouring functionalist interpretations of cognition, such as Fodor and Putnam. Functionalists contend that mental states correspond to functional roles, whether cognitive or behavioural. These states may be the consequence of any number of different combinatorial arrangements, including the non-biological. A corollary is that mental states occur at a fundamentally different level than reductive, physical descriptions. Laws from the
physical to the mental therefore face significant challenges.

Even if matching psychological states with brain activity were easy, it does not render the functional characterisation of psychological states less important. After all, functional descriptions help to guide localisation efforts. Fodor (1974, pp. 101-104) insisted that psychological predicates need to be defined in functional terms, but concluded that any laws connecting psychological predicates to physical ones will necessarily end in failure. I sympathise with the spirit of Fodor’s concern that the complexity is too great to overcome, but I do not see the attempt to link the psychological to the physical as hopeless. Strict, linear reductions of the kind Nagel described do seem a distant proposition in religious cognition. On the other hand, the Standard Model has already revealed some inter-connections more in line with Bechtel’s thinking.

To contextualise for a moment, the unification of scientific theory was first seriously addressed by Carnap (1934) and his colleagues in the Vienna Circle early in the twentieth century. His reductionism involved an alignment with physics. In principle it required that all science should be reduced to observational reports of physical states, which of course, could be empirically tested. Carnap favoured a form of reduction where theories of more advanced sciences could be reduced to those of the basic sciences. If higher-level ideas can be disaggregated to a series of lower-level ideas, translation rules must be used to establish the link between the vocabularies employed in each, a problem in itself that has been the subject of substantial debate instigated under the banner of incommensurability by Kuhn, Feyerabend and subsequently others. Like Bechtel (1999), I do not think that this kind of reduction was designed to obviate the higher-level theory, but rather to provide independent, epistemic support for it, such as a neuroscientific validation of a psychological theory. In fact, this is precisely what we might expect from new empirical work stimulated by the Standard Model. To that end, while the Standard Model does not currently provide a framework for unification, its chief work lies with stimulating new work in high potential areas. ‘Potential’, in my terms, accompanies inter-connections between analytical levels. Perhaps some inter-connections will lead to reductions, while others will generate inter-level or inter-field theories.

Clearly, the term ‘reductionism’ is subject to a myriad of scientific and philosophical interpretations (Dennett (1995, p. 82). I have introduced two main views, similar to Nickles (1973, p. 197). The first involves domain-combining types of reduction where higher-level
theories reduce to lower-level theories and reduction occurs across levels. The second involves general to specific reduction, the more general theory a newer one that subsequently reduces the more specific older one. Each form of reduction seeks different objectives. The first approach attempts unification while the second seeks justification. On my argument, the Standard Model shows progress through a form of justification-based reduction, where inter-connections between levels reveal new, potential areas for empirical development. In contrast, the Standard Model does not perform well if judged on unification-based reduction. I also side with Dennett’s (1995) view about the unfavourable nature of ‘greedy reductionisms’. These occur when the phenomenon in question is ‘explained away’ instead of revealing greater understanding. For example, when a psychological state becomes reduced to the biochemical interaction of neurons. Reductionism remains desirable, but it also must provide an explanation of the original phenomena. Of course, where this point occurs may be debated (Kagan 2001, p. 175).

The answer according to Kitcher (1999, p. 337) was emphatically negative as he declared the unity of science movement dead. If philosophers ever considered that science could be organised as a hierarchy of theories emanating from basic, general principles that can reduce higher level theories, he observed, then it was the case no longer. Thus, science is bifurcated in a plural rather than a dualistic way. For example, there are a vast number of obviously connected but unresolved concepts that need to be resolved in order for unity to be established, and at the top of the list is the relationship between the mental and the physical (Margolis 1987, p. xvi). Is there any reason to believe that the examination of lower-level, fundamental-level processes will lead to the elimination, replacement or reduction of folk, or intuitive, theories? The Standard Model case does not offer evidence supporting unification. I have also argued that unification-reduction models help little in assessments of progress in cognitive science, and perhaps other inter-disciplinary and emerging frameworks. Even inter-disciplinary frameworks may lack the scope and power to explain human behaviour. For example, the “human sciences may be obliged to proceed factorially rather than compositionally, top-down rather than bottom-up…and without the least loss of explanatory rigor” (Margolis 1987, pp. 448-9). However, some cognitive theorists believe that such a concession is too defeatist. Instead, theory progression resides with finding a replacement for the inflexibility of a strictly reductionist interpretation. Any criticism of unity and its commitment to reductionism, Hardcastle (1992) observed, remains incomplete without a suitable substitute. She recommended the use of explanatory extensions.
Kitcher (1984, pp. 358, 371) proposed the notion of explanatory extensions, which represent additions to theories without the need to provide a basis in historical contexts, reference relations, or even explanatory goals. One theory provides an explanatory extension of a second theory if it can derive some of the second theory’s premises. Conclusions from a lower-level theory become premises from the high-level theory. Extending theories can contribute to progress by either reinforcing a troublesome assumption implicit to a theory, or by refining some existing part of a theory. Patricia Churchland (1986) argued for a theory reduction approach as a framework for unifying psychology and neuroscience, although her model focuses on how theory develops concomitantly between the two fields until reduction draws them into unity. Building on Churchland’s (1986, p. 374) notion that mind and brain science co-evolve and knit together, Hardcastle (1992, pp. 418-419) claimed a more concrete interpretation. She wanted to remain faithful to the different sorts of why-questions, with the different sorts of explanations they entail, including an account for the levels of investigation within and across psychology and neuroscience.

Through numerous examples, Hardcastle showed that explanatory extensions work bi-directionally in the mind and brain sciences. She argued against Churchland’s view that one or the other science needs to take precedence. Hardcastle concluded that while a close relationship exists between the mind and brain sciences, the relationship does not constitute explanatory dependence. However, psychology and neuroscience do rely on each other when it comes to locating evidence for problematic entities or processes as well as for further evidence in support of well-developed hypotheses. Like Nickles’ second version of reduction, Hardcastle advocates justification over unification. Thus, the relationship arrives in the form of explanatory extensions rather than reductions. Accordingly, explanatory extensions modify how a theory is understood, but not enough to warrant the theory’s replacement or reduction. Unfortunately, the result is a “fairly messy set of connections” (p. 425), a possibility I pick up again at the end of this chapter because it melds so obviously with the results of my Standard Model analysis. It is also noteworthy that the Standard Model fares modestly on Laudan’s problem-solving criterion. A messy set of connections does not necessarily solve more problems in the short term. In fact, inter-level connections create more questions than it solves. But, perhaps, this is precisely what a developing explanatory framework should be doing? Better to raise superior predictions and empirical questions first in order to generate the data that will eventually lead to new theories offering solutions.
Several arguments have been levelled against the possibility of establishing bridging connections between psychological and brain levels of analysis. Davidson (1973, pp. 245-255) argued that the two cannot be united because the vocabulary of psychology presupposes holism whereas those of the physical are irreducible. In my mind, the difference relates to the strictness of the laws each produces. Psychological laws are softer and hold if all other variables remain equal. Physical laws, in contrast, are strict and inviolable. An inevitable conclusion, according to Ezquerro and Manrique (2004) is that psychophysical laws would also be soft, ceteris paribus laws, a position Davidson (1993) accepted in a later work. Ezquerro and Manrique, however, argued that Davidson’s claim is worthy of generalisation: “Only basic science has strict laws, and given that all cases of reduction involve two theories, one of which must be, necessarily, non-basic, any attempt of reducing would be impossible” (p. 59).

In line with Hardcastle, I argue that the case of the Standard Model speaks to integration without unification and reduction without elimination. As originally proposed by Darden and Maull, inter-field theories mark progress. More recently, Bechtel and Hamilton (2007, pp. 22-23) suggested that inter-field theories integrate by bridging fields rather than by establishing a single unified theory. Their premise leads me to so-called mechanistic approaches to explanation, which take an alternative view on reduction. Where traditional reductionism focuses on explaining theories by reducing them to other lower-level theories, the mechanistic approach seeks to explain phenomena by uncovering the mechanisms of their operation. Although a little early in the Standard Model’s development, I can foresee how the mechanistic approach could prove useful in making some of the connections that I propose are essential for progressing an emerging research framework. In this case, intersections and corroborations are more likely than reductions and eliminations.

**Reduction and Mechanisms**

Contrary to deductive methods that derive behaviour from laws and theories, mechanistic approaches disaggregate phenomena into their constituent operations localised in parts. A mechanism is a structure which performs a function through its parts, their operation and their organisation. A mechanism performing in an orchestrated manner creates one or more phenomena (Bechtel and Abrahamsen 2005, pp. 421-424; Glennan 2002, p. S344). Mechanistic explanations possess a reductive element, but unlike conventional reductionistic approaches, acknowledge that the components do not work in isolation and do not account for
the phenomenon. Instead, mechanistic explanations try to explain why a mechanism as a whole behaves as it does (Bechtel and Hamilton 2007). Holistic behaviour is different from the behaviour of each of the mechanism’s components, and no individual component can explain the overall performance of the mechanism.

I think that the Standard Model has the potential to connect theories operating at different analytical levels. But these connections do not necessarily appear effortlessly. As I noted earlier, for example, theorists sometimes have to devise bridging laws and explanatory extensions in order to make links. The mechanistic approach holds interest because it does not require bridging laws. In the traditional theory-reduction approach, bridging principles make the leap between components and the whole, because different vocabulary describes each. Mechanistic reduction does not demand translation rules. Instead, it focuses on the operation and organisation of components so that the mechanism’s behaviour as a whole is fully described. However, mechanism organisation may not take a convenient or linear structure.

Craver and Bechtel (2006, p. 469) described four aspects to mechanisms: 1) a phenomenal aspect; 2) a componential aspect; 3) a causal aspect; and 4) an organisational aspect. The phenomenal aspect is associated with what the mechanisms do. In Craver and Bechtel’s (pp. 469-471) example of a mousetrap, the phenomenal aspect is to catch mice. Of course, a mousetrap has parts or components, such as the trigger, latch and spring. Moreover, the parts of a mechanism are those relevant to the phenomena it produces. Mechanisms also have properties irrelevant to the phenomenon of interest like the buoyancy of a mousetrap’s wooden platform.

Components of mechanisms interact with each other. This is the causal aspect, without which nothing actually happens. Finally, mousetraps are only mousetraps when their components have been assembled in a particular way. Thus, the organisational aspects reflect the temporal, spatial and other relational properties.

Mechanistic explanations decompose systems into both component parts and component operations. The two are closely tied together because the working parts play an active role in the performance of operations. Nevertheless, the differentiation of the structural and functional components within a mechanism is important because this relationship leads to localisation. Because mechanisms may themselves be composed of other sub-mechanisms at
lower levels of organisation, the process of analysis has a reductionistic flavour. Bechtel, however, noted that a reductionist approach does not mean that mechanistic explanations always operate downwards. For example, mechanisms are influenced by the contextual pressures in which they operate. These pressures affect the behaviour of the overall system, which means that one mechanism may be part of another that regulates its behaviour in some way. In short, higher levels of organisation explain the behaviours of lower levels as well as the reverse. In specifying the roles and relationships, it is also necessary to identify the levels of organisation at which different mechanisms occur. On this view, levels of organisation are different from levels of analysis.

In terms of levels of organisation, Bechtel presupposed that mechanisms are more than the aggregate of their parts. He suggested abandoning the idea that levels exist as strata across nature, to be replaced with a focus on specifying the component parts and operations that combine to deliver a particular phenomenon. Components typically execute different types of operations at different levels of organisation. Only when operations are understood in their correct organisation can the operations of parts be seen to produce behaviour that exceeds the capacity of any sub-mechanism unit.

Merely reducing mechanisms to their parts is only part of the picture (Bechtel 2005, pp. 315-320). For example, topographical features of the brain like the gyri and sulci are parts that do not help in explaining mechanisms in the same way that neurons and cortical layers do. The challenge lies first in finding the candidate component parts, and second in designing experimental approaches that reveal the actions of the parts in producing the mechanisms. The process can be powerful because the operations within a mechanism differ from the behaviour of the mechanism itself. In order to reveal cognitive operations within mechanisms, Bechtel offered two strategies. One would employ techniques such as neuroimaging in order to show when a common brain area is involved in different tasks, with the intention of isolating the shared aspects. Another option would involve a comparative psychology of different species to determine which tasks require the same brain area. No simple formula seems to exist for revealing the operations accounting for a behavioural system. Accounts of operations may be flawed if constructed on the basis of observations from an inappropriately high or low level, a problem endemic to the study of religion in general.
Mechanistic reduction offers two fresh perspectives which might be useful in forthcoming empirical work on religious cognition. First, unlike theory-reduction, it does not deny the importance of context, higher-levels of organisation, or the role of components parts in generating phenomenon. Context, at the least, is likely to be important in any account of religious cognition. Second, where theory reduction may be seen as transitive given that higher-level theories reduce to lower levels, mechanistic reductions may only proceed for a few iterations. The knowledge of how component parts operate is not available in lower-level disciplines as these parts operate in specialised contexts unlikely to be investigated by the lower-level discipline. Arriving at a mechanistic explanation means representing the component parts and their operations exactly as they are organised. As the Standard Model reveals potential sites for inter-connection, it should also generate new empirical work striving towards psychological and behavioural decomposition.

Mechanistic explanations have several sweeping implications for cognitive science in general and the Standard Model in particular. One of the most serious is the rejection of extreme claims about modularity. Massive modularists would find their analysis undermined by the mechanist pursuit of fine levels of analysis. Mechanistic analysis demands that a cognitive task be decomposed into component operations where each contributes differentially to the performance of the task. Since the performance of most cognitive tasks, like agent detection, requires the activity of numerous components within the cognitive system, it is unlikely that the task falls under the locus of a single, global modular subsystem. On the other hand, if mechanistic analyses work on cognitive systems, then massive modularity will fall.

A second distinguishing implication is that the mechanistic approach yields a version of reduction salient to religious cognition. Unlike conventional reductionist accounts, lower-level operations do not replace higher level explanations or render them subservient, because mechanisms are hierarchical, multi-level structures where each component operation functions differently to the whole system. In this way, the mechanistic approach assumes that component operations combine to create mechanisms in an emergent way. It is not enough to identify the component operations of a mechanism; their very structure and organisation explain how the combination delivers the mechanism’s aggregate functions. Mechanisms do not reduce one level of organisation to another, but instead explain the relationships between levels, thereby connecting them. Classical inter-theoretic reduction is therefore discarded in mechanistic analyses because the reduction cannot be expressed in terms of axioms,
postulates or laws. Instead, mechanistic analyses lead to a form of inter-field or inter-level theory. As I have noted on several occasions, the concept of inter-field or inter-level theory development has relevance to the Standard Model case. Craver (2000, pp. 111-115) observed that disciplinary integration leads to the development of inter-field theories for the description of mechanisms.

The third implication of mechanistic explanations relates to theory development. Wright and Bechtel (2007) advocated for mechanistic analyses to play an active role in scientific discovery rather than merely a descriptive account of already articulated laws. Thus, mechanistic explanations help in developing heuristics, uncovering components and operations, revealing levels of organisation, and discovering the relationships between different phenomena acting at different levels within religious cognition.

Mechanistic explanations of cognitive processes defend decomposition and localisation (Bechtel, 2002, p. 230). On the mechanistic account, cognitive neuroscience revolves around identifying functional components relating to a system’s structural components. On the basis of a disaggregated combination of structure and function, mechanisms can be located in terms of underpinning componentry that interact to produce specific functionality. According to Bechtel (2002, p. 231), the conventional argument against decomposition revolves around the assumption that precise explanations for the potentially non-linear interactions of system components are ultimately impossible. Nevertheless, despite the current shortcomings of methods and tools, Bechtel claimed that persisting with the mechanism approach in cognitive neuroscience will yield results. Referring to Uttal’s (2001) analysis of the current limitations of cognitive neuroscience, Bechtel (2002, pp. 232-234) conceded that localising function faces serious challenges. However, he maintained that while troublesome, cognitive neuroscience is too early in its development to give up on localised functionality. For example, Bechtel observed that progress in the life sciences has prospered with the application of a decomposition and mechanism approach. Thus, the chief argument revolves around the degree to which psychological and cognitive phenomena can be the beneficiary of mechanistic decomposition to the same extent as in the life sciences. Bechtel (2002) summarised the implication of Uttal’s contention: “If the cognitive system is not functionally decomposable, then current projects in cognitive neuroscience are bankrupt” (2002, p. 230).
Despite a general contemporary trend to dismiss the unification/reduction agenda, cognitive scientists do not agree on the best measures of theoretical progress. Some tentative agreement exists regarding local unifications or inter-connection, although as Newell (1990, Ch. 1) cautioned, local integration is not enough to create a cognitive theory. At the same time, proposals describing how local connections may be structured vary substantially. For example, one prominent argument is that inter-connections should not be recognised until reduction has illuminated how two or more phenomena share the same compositional elements and causal mechanisms (Friedman 1974, pp. 14-16). Another typical view holds that theoretical unification may be misleading in a theory appearing unified while its active ingredients, such as neurons or thoughts, remain disparate (Morrison 1994, pp. 365-370). As a result, theoretical unifications may provide a neat mathematical uniformity but still not offer much in the way of causal, practical connections.

I have argued that the Standard Model’s performance as an inter-field or inter-level framework provides a marker for progress. I see value in pursuing the mechanistic agenda to provide guiding heuristics in the process. However, mechanistic outcomes will take some time, if they are going to come at all. As a result, I return to the more conventional bridging methodology outlined by Hardcastle.

The Future of the Standard Model as a Cognitive Theory

Few commentators have explicitly addressed theoretical progress in cognitive science. Two accounts, however, provided by Hardcastle (1996) and Thagard (2005a) respectively, stand out. Both take a different approach to evaluating theoretical progress. Since I employed Thagard’s perspective explicitly as a structural guide to this dissertation, I will focus on Hardcastle’s views here.

Hardcastle’s (1996) book, *How to Build a Theory in Cognitive Science*, prescribed several key ingredients for theories in cognitive science. Given that cognitive science encompasses several different domains, Hardcastle (1996, pp. 138-139) noted that any inter-disciplinary theory may extend over different levels of description and analysis. However, the middle and lower levels of analysis should count as a functional decomposition of higher level psychological theories. In the presence of technical or theoretical limits obstructing functional decomposition, models from different domains may be used to extend one another. A set of overarching general principles loosely tie together the various extensions and provide
discipline-based scientists with a common view of their individual systems. The principles also guide empirical work, although Hardcastle emphasised that they should not necessarily determine it: “Instead, they inspire general investigative avenues within the contexts of specific models” (p. 138).

In addition to the general principles, different models can be united into one theory through middle level descriptions specified in common language. As a result, scientists can relate their data to the theoretical framework. However, it is not a similarity in data interpretation that unites the models because different domains have access to completely different types of data. Instead, Hardcastle (1996, p. 139) maintained, it is how scientists analyse what the data mean with respect to the general principles and other related models that allows the various specific models to work together as a single theory. Like the propositions I identified for the Standard Model, Hardcastle’s principles operates as heuristics guiding the interpretation of data from diverse levels and stimulating additional research questions. Hardcastle’s argument is exemplified in my analysis of the Standard Model. A loose confederation of principles can offer an explanatory framework linking previously unconnected data and theory. As Kohler (1940, p. 116) observed, “The most fortunate moments in the history of knowledge occur when facts which have been as yet no more than special data are suddenly referred to other apparently distant facts, and thus appear in new light.”

Hardcastle discarded expectations that different models will collapse into a single overarching account, or that any version of reductionism occurs. The vast amounts of data from the various disciplines within cognitive science cannot be expected to yield a neat deductive-nomological theory such as those found in physics and mathematics. Investigations in cognitive science, according to Hardcastle, leave “lots of messy details lumped together from different levels of analysis, different theoretical frameworks, and different investigative questions” (p. 141). Of course, my analysis of the Standard Model delivers plenty of messy details lumped together. Equally, I have shown how the Standard Model helps reveal patterns and prospects amidst this lumpy mess.

To summarise, on Hardcastle’s account, a two-part inter-disciplinary theory will best explain cognitive phenomena. A cognitive theory comprises first, general principles, and second, a set of loosely-linked models operating over several levels of description and analyses, and where no single level has preference. In turn, when the models are arranged together into a coherent
picture using the general principles, they act to functionally decompose the causal factors of the central cognitive phenomenon by explaining the relations between higher and lower level mechanisms. I have argued in the previous chapters employing Thagard’s criteria that the Standard Model has taken some steps in this direction. For example, my speculative model of religious experience pertains to several analytical levels, and can be brought into focus using the Standard Model’s propositions. As more models or case examples from different domains become available, the chance that the general principles can expose connections between them improves.

There are some obvious challenges in explaining aspects of cognition following Hardcastle’s approach. For example, psychological theories at present seem too far removed from theories of neuroscience to readily connect with general principles. Hardcastle’s response is to employ a form of bridge science in a similar manner to the explanatory extensions advocated by Kitcher. Hardcastle used the example of evoked response potentials (ERPs) to illustrate. ERPs are recordable neuronal responses in the form of electrical activity that occur as a consequence of external stimuli. ERPs provide a neural correspondence to cognitive stimuli, and in this example, provide a bridging explanatory framework for both psychological and neuroscientific paradigms (Hardcastle (1996, p. 143). A bridge science is therefore an interdisciplinary link between two disciplines. It comprises a program in its own right that contributes to both psychology and neuroscience in a way that also partially unites them.

On the previous account of explanatory bridges, the presumption is that neuroscience will provide a method of identifying cognitive processors without having to rely on behavioural measures or reports of cognitive experience. An obvious problem faced by the Standard Model is that the connections through potential bridge sciences are likely to be untidy and inadequate to coherently integrate any two domains into a single theoretical framework. In addition, the level of detail specified by each domain may leave only subtle hints of correspondence rather than the firm connections required for an inter-disciplinary theory. One unambiguous lesson from the Standard Model case study has been that explaining religious cognition is a messy business; general heuristics and principles may help connect different levels of data through cognition, but the results are not particularly elegant. It is for this reason that I argue for an account of progress in cognitive science that accommodates its hard fought nature. I think that bridging concepts help because they offer a route to make inter-
connections between levels, which in turn, I have proposed as the most promising way forward for an inter-disciplinary cognitive framework such as the Standard Model.

In terms of the Standard Model, Hardcastle’s formulation of bridge sciences leads to a search for some connective model wherein two domains dealing with religious cognition might intersect. Such an exercise is part of the research program undertaken by Standard Model advocates, as they have already established a relatively stable set of general principles to guide their activities. On Hardcastle’s recommendations, there can be little differentiation between religious cognition and any other form of cognition, as all would demand a bridge level linking psychological experience and neurological function. Given the complexities and varieties of religious cognition, it seems unlikely that bridge sciences—to use Hardcastle’s terminology, such as neuropsychology, neurophysiology or cognitive neuroscience—will be capable of establishing direct correspondences between psychology and neuroscience any time soon. As religious cognition invokes a vast range of cognitive functions, rather than a single unique one, the wait for a genuine inter-disciplinary theory bridging the psychology and neuroscience of religious cognition will take as long as it takes to deliver a comprehensive generic theory. This might explain why Standard Model scholars are working with disciplines and levels where correspondence is easier to determine, such emotion and cognition.

I think the most important lesson from Hardcastle’s advice about how to build a theory in cognitive science comes in the centrality of a set of general principles. In this respect, the Standard Model might be said to have made a key step in its progress toward programmatic legitimacy. The general principles articulated by the Standard Model provide a structure for creating a reciprocal relationship with empirical data; each affects the other until the general principles assume at least a theoretical status in cognitive science, even if not on a genuinely inter-disciplinary level. I proposed earlier in this dissertation that the general principles are a kind of soft Lakatosian core. I pick up this thread in the following chapter.

The lack of an obvious bridge science does suggest that Bechtel’s approach to mechanisms might provide a localised approach to certain, specific aspects of religious cognition. However, since the Standard Model so vigorously defends the position that religious cognition is parasitic upon ordinary cognition, we are still left with the immense enterprise of dealing with all forms of cognition before any religious aspects can be addressed. Progress of
the Standard Model will be easier with bridging attempts across disciplines where explanatory levels are contiguous. Theory connecting anthropology to neuroscience is a larger leap than from anthropology to psychology. This leaves the general principles of the Standard Model as the focus of any evaluation, thus returning me to the analysis I have performed throughout this work.

**Conclusion**

I began this chapter by arguing that there is little consensus regarding the best approach to progressing developing inter-disciplinary research programs. Indeed, there is even little consensus about what it means to be inter-disciplinary in the first place. I emphasised the paradox of inter-disciplinary theory pursuits: the potential to locate interactions and connections between disciplinary lenses is constrained by the necessity of their division. In order for genuine inter-disciplinarity to occur, relations have to extend into theories, which would have to mean that explanations would be embedded in theories across several disciplines. On this basis, I continued my argument for a measure of progress in cognitive science that acknowledges new inter-level connections.

The Standard Model case reveals the absence of neat unification and reduction in inter-disciplinary programs. In this case, reduction presents a regulative ideal rather than a practical reality. On the other hand, I suggested that inter-disciplinary connections represent a consequence of progressive work in cognitive science, messy though the work might be. However, as the Standard Model illustrates, we must still address the ‘messiness’ problem. Any theory or framework attempting inter-disciplinary integration must contend with the degree to which the integration is attempted, and the degrees to which the integration reduces, unifies, explains, and eliminates.

Progress in the Standard Model also reflects the wider challenge of connecting psychological experience and neurological process. The most fundamental type of inter-theoretic reduction involves the explanation of higher level phenomena by lower level phenomena. However, such reduction is complicated by the paradigms and methodologies associated with competing explanatory levels, leading to a lack of correspondence between different ways of explaining the same phenomenon. Furthermore, if a single psychological state can be instantiated by more than a single physical condition, then one-to-one correspondence between the physical and mental becomes vastly more complex, if not impossible. Caution about confusion
between grain sizes in brain taxonomies remains salient. On the other hand, if correspondence can be established, the logical extreme end to physical to mental mapping is elimination. Mental states will be cast aside in favour of explanatory physical conditions.

I advocated a kind of non-reductive but connection-driven middle ground of the sort occupied by Hardcastle. For example, in earlier chapters, I suggested that some promising explanatory extensions might be found in the early inter-field theories around religious cognition and religious experience, as well as between religious cognition and religious practice through rituals. These models, as Hardcastle would refer to them, provide hints and connections that may be organised through general principles.

Messiness and complexity also means that I am inclined towards a more inclusive rather than exclusive view of assessing progress. Since I am adamant that the key to significant progress is the resolution of the levels issues, I have suggested that Bechtel’s mechanistic approach is worthy of further pursuit. The mechanistic approach is conditionally reductive in highlighting component operations within parts, but also strives to reveal complex, non-linear organisation. Operations within a mechanism are often of a different sort to the behaviours of the mechanism as a whole. Thus, mechanisms reveal explanatory strategies at multiple levels through an emphasis on localisation and decomposition. The catch with mechanistic decomposition is an ongoing mapping problem where matching structure and function is not only complex, but at least currently, technically difficult. Any results for the Standard Model from mechanistic approaches will have to wait.

The Standard Model presents a messy picture of a developing research program struggling to establish a robust stream of theoretical and empirical work. Progress remains difficult to specify on the basis of traditional measures that prioritise theory replacement. I argue for an expanded view of progress for cognitive science and inter-disciplinary work, where the ability to reveal new inter-connections between levels offers an indicative marker. Hardcastle’s conception of principles used as guidelines and heuristics is also displayed in this case. I labelled the Standard Model an ‘explanatory framework’; a research program in the making. In chapter 14, I consider how the Standard Model fares against a Lakatosian program benchmark. I also make a case for a revised interpretation of research programs, incorporating Hardcastle, Lakatos, and my interest in inter-level connections.

Introduction
I have aimed to demonstrate that progress in the cognitive science of religion must contend with the sticky problem of inter-theoretical relations, specifically the capacity of the Standard Model to provide a framework for uncovering novel connections. That is, a framework for revealing connections between theoretical levels that have hitherto remained unidentified or poorly understood. My analysis had led to several indicative and distinguishing markers of progress. In this case, I conceive of progress as the strengthening of an evaluative framework towards becoming an acknowledged research program. In this chapter, I consolidate my arguments about the Standard Model’s potential as a research program and finalise my case for explanatory frameworks containing fluid ‘soft’ cores capable of inter-level insights.

I claim that progress is encouraged when housed within an explanatory framework—a research program in development—containing a flexing core or a set of principles as described by Hardcastle. This case study suggests that frameworks advantageously offer an architecture around which theoretical possibilities can be stimulated, and empirical realities tested. Such architecture has particular salience to accounts of cognition that must acknowledge multiple methods and ostensibly unconnected empirical observations. I favour Hardcastle’s principles because her thinking has been formed around cognitive problems. Her approach assumes that the principles guiding a framework are not unassailable; in fact, they are best employed as heuristics. For this reason, I argue for a soft core at the heart of an evaluative framework that operates as a set of guidelines and allows for them to be challenged by research programs that lie outside the traditional domain of inquiry. In the case of the Standard Model, cognitive interpretations of religion must pay more attention to neurological accounts of the mind in addition to anthropological descriptions of religious practice.

My case analysis of the Standard Model has also highlighted a tension between the need for an organising framework and the dangers of wielding under-developed principles. From one vantage point, it might be argued that progress can occur even when exercising a framework containing flaws. As long as the framework stimulates new empirical work around key questions, it is likely that it will also produce the evidence needed to re-evaluate or replace the core. While strident advocates of the Standard Model produce evidence for its veracity in line with the Model’s core, other researchers on the periphery generate data revealing unforeseen
connections and further anomalies. I do not think that this empirical work would have been pursued in the first place without the framework provided by the Standard Model. However, the Standard Model has not yet forged a true Lakatosian hard core. Rather, I consider it a ‘soft’ core operating as a set of heuristics but still supple enough to accommodate change. I conclude that it would be premature to discard the Standard Model, imperfect though I have argued it presently is. As a result, this case underpins the importance of a soft core serving as a guide to novel predictions, and to encourage and direct the accumulation of empirical observations.

Progress towards a research program as seen through this case suggests that a working soft core in exposing unforeseen connections between observations made at different analytical levels. I consider this finding particularly significant to work in cognitive science and other inter-disciplinary fields. Unforeseen connections between levels offer robust corroborative evidence despite turning up without an antecedent novel prediction.

Finally, in this chapter I note that progress in religious cognition remains contingent upon developments in general cognition. The two connect inextricably because the soft core of the Standard Model includes propositions directly acquired from the core of cognitive science. In this dissertation I have repeatedly highlighted the limitations and dangers of this allegiance, especially in the absence of a general theory of cognition. Having conceded this problem, I return to the practical advantages for investigators interested in religious cognition to proceed with some form of soft core to begin with. My conclusion holds in line with my earlier observations that the practical deployment of emerging programs in science may include, or even necessitate, the conscious acceptance of theoretical uncertainty or imperfections.

The Standard Model as a Research Program?

Popper’s (1959) dismissal of classical empiricism rejected the idea that knowledge comes exclusively from experience and experimental observations. Science, Popper contended, should be distinguished by the use of falsification, where theories containing specific propositions and hypotheses face the test of data: corroboration or falsification. Accordingly, a theory and its hypotheses are spared elimination if they predict empirical results. In fact, they should remain scientifically credible until falsification occurs. However, rather than demonstrating how a phenomenon actually works, falsification also risks accumulating data about how it does not work (Ketelaar and Elis 2000). The problem stems from the potential
for theories to be approximate and helpful, but vulnerable to being discarded prematurely; a potential of particular salience to my arguments regarding the Standard Model.

Over time, theories and their associated assumptions and propositions are redefined, reformulated, corrected, expanded, and even nurtured (Newell 1990, p. 14). In this respect, although some specific propositions that have emerged from the Standard Model may be falsified, it would be counter-productive to discard the entire framework. Clearly, the Standard Model does not present a fully coherent, unifying framework to explain religious cognition. But as I have argued, some evidence suggests that while parts of the Model stand on shaky ground, other parts stimulate novel inter-level connections. In addition, making systematic and related predictions without the explanatory framework provided by the Standard Model becomes problematic. Frameworks guide empirical work. Without organisation, research in an under-developed area such as religious cognition can become undirected or random. While far from a comprehensive program explaining religious cognition, it has formed a working set of assumptions and principles around which predictions and propositions have stimulated research. I therefore consider Lakatos’ presentation of progress in the form of research programs as a more useful tool for understanding the development and future of the Standard Model than Popper’s approach.

According to Lakatos, a research program’s hard core comprises basic assumptions. These assumptions are subsequently used to construct theories explaining uncertainties lying on the program’s periphery. Once the key assumptions have been embraced within a research program’s core, they tend not to be directly tested again. Instead, assumptions form the basis for theoretical predictions emanating from the core. As a result, theories radiate from the core in direct proportion to the certainty with which the research program holds them defensible. In Lakatos’ language, the less certain zone of theorising consists of a middle-level ‘protective belt’ of hypotheses and propositions designed to direct empirical activity. The protective belt serves as a tether between new empirical work and already established assumptions. Over time, a progressive research program’s core expands to encompass more of the protective belt, while new meta-theoretical predictions stimulate new veins of research at the periphery.

An obvious limitation in a Lakatosian research program is the propensity to compound mistakes if some misplaced assumptions in the hard core erroneously gain support. Since paradigmatically, results from empirical tests associated with the protective belt are more
likely to be consistent with the core by virtue of the utilisation of its assumptions, progress may be slowed and activity diverted towards resolving discrepancies in the belt symptomatic of faulty core assumptions. On the other hand, inconsistencies should be expected if theories are viewed as approximations of greater or lesser comprehensiveness. Thus, tinkering with middle-level theories eventually leads to enough data to resolve discrepancies or mount a challenge to the core in a quasi-Kuhnian revolution.

Middle-level theories tend to be specific in application, directed toward a particular content domain. From here, numerous predictions can be devised at varying levels of confidence. Like Popper’s falsification, the failure of a prediction to correspond to observation means that it is discarded and replaced until an alternative compounds sufficient empirical confirmation. Replacement demands a return to basics where the core assumptions of a program generate heuristics, channelling possible propositions, predictions and hypotheses down a restricted path of alternatives. Lakatos (1970, p. 135) viewed heuristics as a partially articulated set of guidelines that help deal with refutable variants that arise in the protective belt.

Lakatos’ claims about progress in a research program has application to the Standard Model, although it leads to an ambiguous outcome. According to Lakatos, a research program may by adjudged progressive or degenerative on the basis of its predictive power. A progressive program advances knowledge through systematic explanatory power, which comes about when theoretical predictions foreshadow empirical observations. A progressive research program makes successful predictions about empirical observations. Not just any predictions, either, but novel, unanticipated predictions that could only have come about as a consequence of a sound theoretical platform (Lakatos 1978, p. 11). On the other hand, a degenerative research program fails to create novel predictions and provides only a limited explanatory power of key phenomena.

On my analysis, the Standard Model exhibits credible explanatory power, but rarely provides predictions displaying deeper levels of novelty. In addition, the Standard Model’s core—what I termed its propositions—does not constitute a Lakatosian hard core. Rather, as I noted in the previous section, these propositions form a kind of soft core, functioning as heuristics or Hardcastle’s version of principles. On the other hand, I have observed that progress in a developing explanatory framework goes beyond satisfying novel predictions. A progressive multi-disciplinary explanatory framework should reveal unforseen as well as predicted
connections, especially since most predictions centre on a single analytical level. There are several other issues connected to Lakatos’ conception of research programs worthy of concern in the context of this case study.

To begin with, a hard core provides useful assumptions about the protective belt because its theories anticipate many but not all observations. Since Lakatos would argue that a theory should be retained if it is the best available explanation despite inconsistencies, the only way the core of the Standard Model will be challenged will be when there is a better alternative set of assumptions. At present, although I think that some of the Standard Model assumptions contain vulnerabilities, a superior explanation for religious cognition already in a cohesive form remains unavailable.

In addition, Lakatos’ hard core is enveloped by a protective belt of middle level theories and hypotheses. This protective belt connects theory to data by way of novel predictions, placing the protective belt under scrutiny rather than the hard core. I have observed this kind of approach in cognitive scientists’ work on religious cognition. While it may appear justifiable—indeed even essential—to make the core unassailable in order to progress the Standard Model, I do not think that the core has developed the robustness Lakatos described as critical to a progressive research program. That is, the Standard Model’s core remains hotly contested, whereas Lakatos’ idealised research program contains a hard core that has withstood rigorous testing.

Nevertheless, I think that the work on the Standard Model’s protective belt via its propositions has been fruitful, leaving me with something of a dilemma. Is it possible that the core of an explanatory framework can be flawed but still provide enough of a platform for the protective belt to prosper? If this were the case, it would mean that whatever replaces or corrects the core must also stimulate similar predictions to those currently being tested in the protective belt. For example, a modular presentation of the mind leads to useful predictions about religious cognition. But I do not believe that modules constitute the last word on the mind’s cognitive structure. I can see how a more comprehensive theory about the mind’s structure-function relations could undermine the propositions making up the soft core of the Standard Model without derailing its promise as a fully-fledged research program. Modularity might be analogous to Newtonian theory; technically flawed but still full of useful predictions. Alternatively, the computational-representational view of the mind is completely wrong, even
if it has made practically helpful and novel predictions, and the Standard Model will crumble along with it.

Perhaps the Standard Model’s set of propositions and assumptions represent a hard core in the making; one that has yet to be consolidated. What if the hard core of the Standard Model is really more of a protective belt? Not quite right yet, but progressive. This possibility raises another issue that I flagged earlier: the hard core of any cognitive theory must correspond with the foundations of a general theory of cognition. In fact, no religious cognition exists per se. Such a vantage point implies that any theory offering greater specificity than general cognition must exist on the periphery and in the protective belt.

While I do not think that the Standard Model perfectly mirrors the idealised development of a Lakatosian research program, I have found it useful to think of the Standard Model in a pre-program phase where its core reflects central assumptions present in the computational-representational view of the mind. A lesson from this case study is that a research program need not have a water-tight hard core in order to be progressive. Identifying new inter-level connections leading to high potential research questions can be just as important as intra-level predictions. The Standard Model has been adept in stimulating empirical work in the right places even though some of the emerging data corresponds poorly with core assumptions.

**Problem shifts in the Standard Model**

Lakatos (1978, p. 110) insisted that the basic unit of progress appraisal must not be a theory or an unconnected set of theories, but rather a research program. Program appraisal replaces theory appraisal. In practice this means deciding which amongst competing programs represents the superior investment. But appraising a program becomes problematic in the absence of serious competitors or if two or more programs appear similarly placed. Also, as with the Standard Model case, the program can be emerging or pre-programmatic and still without serious competitors in the same space. Here, the real question concerns whether the burgeoning ‘program in the making’ will transform into a fully-fledged research program.

In chapters five to 11 I scrutinised the theories and propositions inherent to the Standard Model in detail. This micro analysis dissected the Standard Model’s performance in key areas associated with explaining cognition. My appraisal of theoretical components of the Standard Model collectively informs the status of the more elusive explanatory framework they reside
within. But we might expect that the individual assessment of a theory or proposition to be more easily undertaken than a full program. We do, after all, expect these theories and propositions to change. After all, Lakatos (1978, p. 5) observed that all theories are born refuted and die refuted. The more complex issue revolves around whether the Standard Model will be superseded or rendered irrelevant before it becomes established. To address this possibility I return to Lakatos’ conception of progressiveness in research programs.

Lakatos’ (1970, p. 175) Methodology of Scientific Research Programs (MSRP) provides criteria for adjudicating research program progressiveness, or what he referred to as ‘problemshifts’. Lakatos foresaw two kinds of developments: ‘intra’, or those associated with modifications to the protective belt of auxiliary hypotheses; and ‘inter’, or those program changes which come about because the hard core needs to be reformulated. Intra- and inter-program problemshifts may be progressive or degenerative. The key determinant between the two lies with the extent to which the problemshifts are ad hoc; that is, when theory lags behind the facts.

First, a degenerative or ad hoc program problemshift makes fewer novel predictions compared with its predecessor program. Conversely, a progressive program produces novel predictions: “What really count are dramatic, unexpected, stunning predictions: a few of them are enough to tilt the balance; where theory lags behind the facts, we are dealing with miserable degenerating research programmes” (Lakatos, 1978, p. 6).

Assuming that the problemshift successfully predicts novel facts, the second ad hoc criterion concerns whether the predictions have been empirically confirmed. If not, the program occupies uneasy territory, vulnerable to, or already suffering from, degeneration.

Finally, once empirical content has been accounted for, does the result lead to theoretical amendments of the protective belt in accordance with the program’s positive heuristic, or do the theoretical modifications contradict the negative heuristic and lead to an amendment of the hard core? The former represents an intra-program progressive problemshift, the latter an inter-program progressive problemshift, as Figure 14.1 illustrates.
<table>
<thead>
<tr>
<th>Theoretical Amendment Criteria</th>
<th>Ad Hoc Degeneration Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theoretical amendment produces predictions of novel facts</td>
<td>NO  Problemshift is ad hoc&lt;sub&gt;1&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>YES</strong></td>
<td></td>
</tr>
<tr>
<td>Some of the predicted novel facts are empirically confirmed</td>
<td>NO  Problemshift is ad hoc&lt;sub&gt;2&lt;/sub&gt;</td>
</tr>
<tr>
<td><strong>YES</strong></td>
<td></td>
</tr>
<tr>
<td>Theoretical amendment contradicts negative heuristic and changes the hard core</td>
<td>NO  INTRA Program Problemshift</td>
</tr>
<tr>
<td><em>Theoretical amendment is consistent with positive heuristic</em></td>
<td></td>
</tr>
<tr>
<td><strong>YES</strong></td>
<td><strong>YES</strong></td>
</tr>
<tr>
<td>INTER Program Problemshift</td>
<td>PROGRESSIVE Problemshift</td>
</tr>
<tr>
<td>PROGRESSIVE Problemshift</td>
<td></td>
</tr>
</tbody>
</table>
To begin with, assessing the degree of novel predictions made by the Standard Model is complex and ambiguous. In what unit is novelty measured? The Standard Model certainly makes predictions, but can they be considered novel, let alone dramatic, unexpected or stunning? In its strictest form, novelty can be measured on the basis of temporal conditions where a prediction shows novelty when its success appears improbable or impossible in light of previous knowledge (Lakatos, 1970, p. 118). I have maintained that the Standard Model contains only a limited amount of novelty. For example, in chapter five I recounted the predictions associated with minimally counterintuitive concepts, and concluded that they make reliable proxies for memorability. However, that a counterintuitive concept offers a memory trigger does not constitute an improbably prediction. Similarly, in chapters six and seven, I respectively examined computational predictions based on modular inferences, and predictions based on ritual performance.

Swinging the other direction, Lakatos (1970, p. 118) conceded that temporal novelty was too strict and offered the more permissive view that when a new theory explains an old fact in a new way, it satisfies novelty. I have argued that the Standard Model excels at this form of novelty. For example, the Standard Model offers promising reinterpretations of rituals and spiritual experiences. However, the problem as Musgrave (1974, pp. 11-13) pointed out, is that excessive watering-down of the novelty criterion actually destroys it altogether. It is comparatively easy for a new theory to reinterpret an old fact. Moreover, the reinterpretation approach has little to say about the accuracy of the new angle. While temporal novelty appears too strict, reinterpretation seems too lenient. In terms of the Standard Model, I think its ability to explain old facts comprises a necessary but not sufficient progress condition. In any case, what strength would a developing program claim to possess without even a new way of looking at old facts? My case study suggests that some predictive element must be driving a progressive explanatory framework. As I have argued, for the Standard Model this arrives in a more general heuristic form, in line with Hardcastle’s position on the key elements in building a cognitive scientific theory.

Heuristic novelty proposed by Lakatos and Zahar (1975, pp. 375-376) and elaborated upon by Worrall (1978), considered whether the fact being used to bolster a theory played a role in that theory’s original construction. Worrall (1978, pp. 48-49) saw this as the rule that one cannot use the same fact twice. Double-counting data by using evidence both in a theory’s construction and in its support is out of the question. Of course, we do not know whether for
any given scientist he or she had prior knowledge of a salient fact, or had considered it a heuristic or an anomaly. So while heuristic novelty and eliminating double counting seems appropriate, it remains difficult to establish one way or the other. In practice, I think it likely that cognitive scientists have used existing facts in shaping the Standard Model’s core propositions. Perhaps they would even consider it a sound approach to devise meta-theory in the cognitive domain based on induction from other sources?

Musgrave (1974, pp. 15-16) proposed that novelty sits relative to background theory. A new theory shows novelty when it predicts something not predicted by its background theory. For example, if the background theory takes the form of the computational-representational view of the mind from cognitive science, then the Standard Model fails the background test. In this case, Musgrave’s background novelty condition offers a particularly elegant test of progressivity as virtually any theoretical move in the Standard Model reflects the computational-representational standpoint. But would we render the Standard Model degenerative on this basis?

Another less rigorous way of looking at Musgrave’s novelty involves conceiving religion as a new domain wherein the Standard Model has progressively extended some background assumptions into a new context. Technically speaking, the computational-representational view says nothing about religious cognition specifically. In this respect, perhaps the Standard Model does blaze new territory predicted by its background theory. Alternatively, if the computational-representational view does not constitute a sufficiently immutable background theory, another alternative would be to use a well-supported theory such as evolution as the background. I dedicated chapter ten to this examination and returned a cautiously optimistic appraisal. Nevertheless, the Standard Model makes no novel predictions that evolution and its associated theories have overlooked.

More contemporary philosophy of science has tended to dismiss both temporal and heuristic novelty as limited measures of progress. I can see that the MSRP is constrained although I agree with Leplin’s (1997, p. 78; p. 99) observation that theories should be capable of novel predictions, particularly in this case where the assessment of inter-level progress has relevance. I am inclined to follow Mayo (1996, p. 208) in her suggestion that novel predictions can be reframed in terms of novelty test severity. Some predictions are reliable while others are more severe. Novelty might be best viewed as a continuum where the
Standard Model has strayed little in the direction of Lakatos’ ‘stunning’ or Mayo’s ‘severe’
tests. I suspect this is the only useful way of dealing with Lakatosian novelty. Hands (1991),
for example, lamented that Lakatos changed his mind and sometimes appeared to hold
numerous views about novelty simultaneously. Apparently once enthusiastic about the MSRP,
Hands observed, “I have spent a great amount of time with the Lakatosian literature and I
have no idea what Lakatos ‘really meant’ by novel facts” (1991, p. 94).

Different assumptions about what constitutes novelty will lead to conflicting conclusions
about the progressiveness or degeneracy of the Standard Model. Since I favour a lenient and
broad assessment of the Standard Model, I have given preference to heuristic novelty,
particularly as it applies to the manner in which theories generate empirical content. But,
novelty is not an exclusive criterion for establishing progress, especially in the case of the
Standard Model where the research framework might expose new and unforeseen inter-level
connections without having ever predicted their presence. In the messy, complex world of
inter-disciplinary science, progress in the form of novel connections could be side-effects of a
progressive program as often as they were the original targets of empirical investigation. I fall
in line with Whewell’s (1967 [1847]) conception of progress here, in that a theory is more
compelling when it explains evidence associated with a phenomenon for which it was not
composed to explain. To that end, I reiterate my claim that a progressive explanatory
framework reveals unforeseen connections between analytical strata generating new empirical
work around high potential links.

The MSRP advantageously views science in terms of theories associated with a common hard
core, rather than a linear set or series of theories. Based on my assessment of the Standard
Model, both connections and misalignments between theory and empirical content are
present. Confrontations between theory and data are not simple matters of confirmation or
rejection. Rather they signal complex matters of grain and degree. On my assessment, the
Standard Model will be imperilled if it cannot or will not examine its relationship to
competing data. For the moment, however, the countervailing evidence might prove a suitable
stimulus for re-conceptualising the Standard Model’s (soft) core. My scientific evaluation has
revealed as much grey area as it has unambiguous refutation or confirmation of Standard
Model predictions.
Theory Testing and the Standard Model

Typically, theory testing proceeds smoothly until observations do not correspond with predictions. Perhaps the most incautious action that can occur despite disconfirmatory observations is the continuation of data collection or analysis, or a revision of procedures until observations correspond to theoretical predictions. Of course, Popper (1959) expressed an acute awareness of the dangers associated with confirmation-seeking approaches. Empirical knowledge, he maintained, grows with critical, falsification-seeking methods. However, as I noted earlier, falsification risks a needless and perhaps distracting accumulation of negative information.

Kuhn (1970), on the other hand, thought that normal scientific activity thrives under conditions where puzzles are tackled through an existing paradigm, at least until enough anomalous observations accumulate to bring about a major change. Such an approach might be needlessly slow. For Kuhn (1970, p. 169), the decisive factor determining paradigmatic success lies with its capacity to retain the puzzle-solving power of its predecessor while simultaneously solving more outstanding anomalies. From a Kuhnian perspective, the Standard Model presents a problematic case. Anomalies have emerged but do not present a challenge to key assumptions. I do not anticipate a crisis yet either, as the Standard Model’s advocates will likely continue under the cognitive science paradigm. At the same time, one researcher’s anomaly is another researcher’s irrelevancy (Graham and Dayton, 2002, p. 1483). At best the Standard Model operates in a pre-paradigmatic stage. But, if the computational-representational paradigm within cognitive science succumbs to a crisis, so too will the Standard Model.

This case study provides some evidence relating to the dangers of theory-testing as a primary objective of research and as the pivot-point of progress. I believe that some Standard Model advocates were vulnerable to confirmation bias when they revised procedures until their results were consistent with the core, or theory-predicted result were yielded (Greenwald et al., 1986, p. 216). I noted several instances of confirmation bias in the theory-centred research strategy that I recorded throughout this dissertation. A good example arose around tests for cognitive optimality and the memorability of counter-intuitive concepts.

I favour a more results-centred strategy, such as condition-seeking, which focuses on identifying limiting conditions for a known finding, and design-seeking, which emphasises
discovering conditions that can produce a previously unseen result. Either of these approaches moves away from theory verisimilitude in favour of producing specified patterns of data; reducing the generalisability of findings by specifying as precisely as possible under what conditions the procedures can be expected to produce a finding in line with a theoretical prediction. With a condition-seeking approach, a research question would be expected to delineate the conditions under which a given, predicted result would be obtained as well as those conditions under which it would not be obtained. In the case of the Standard Model, predictions would need to account for the conditions under which the major assumptions about religious cognition will succeed or fail. As I argued at length in chapter 9, the most significant issue remains under what conditions atheism prevails. It is not therefore only a matter of specifying the conditions whereupon religious concepts successfully propagate, which appears an overriding concern of the Standard Model.

Under a design approach, Standard Model researchers would focus on specifying the conditions that can produce a result presently unobtainable. The approach works to engineer a desired result. Examples include: under what conditions do atheists resist pressures to accept religious concepts; under what conditions are environmental events attributed to supernatural agents; and under what conditions do religious concepts actually reduce the likelihood of acceptance and transmission. These examples reflect some of the unresolved research questions I have claimed constitute a major gap in the Standard Model’s propositions.

Gaps in an emerging explanatory framework must be expected. A limited amount of empirical content is available upon which to base or corroborate a theory. Add to this the fact that theory and empirical content in general cognition lacks development and what does exist inspires controversy and questions about reduction. As a result, the condition-seeking that routinely occurs around a research problem as a collective product of theoretical competition has not yet transpired.

My suggestion to infuse the Standard Model with a research protocol that makes greater use of result-based approaches like condition-seeking and design review has implications for the definition and evaluation of progress. Greenwald (1986, p. 225) for example, maintained that progress is signalled when limited conditions on theories reduce over time producing more economical statements with fewer ‘riders’, accounting for uncertainties and rogue variables. This approach implies that theory can obstruct progress when theory testing assumes a central
goal and the researcher has more faith in the theory than in the procedures employed to test it. A theory’s longevity correlates to its ability to generate effective procedures. In the case of the Standard Model, the most compelling procedural developments can be found in cognitive neuroscience. Neuroimaging procedures and techniques, while only in their relative infancy, may completely undermine the central propositions and assumptions of the Standard Model, and of cognitive science. In the end, the Standard Model will have to perform on Niiniluoto’s (1999) scale of greater explanatory power within simpler structural complexity, without compromising Losee’s (2004) requirement for corroboration from multiple levels. However, we still have the potential for an analytical level misalignment problem. How will the Standard Model reconcile human behaviour with neural correspondence?

Analytical Levels and a Lakatosian Hard Core

Connectionist versions of mental processing have much going for them on the basis of the evidence emerging from cognitive neuroscience, but they do not have much to say about specific forms of cognition. Equally, anthropological accounts of religion reject the behavioural canalisation assumed by cognitivists. They instead emphasise greater flexibility in tackling the myriad, countless, and possibly irreducible forms of religious activity. However, anthropological interpretations are context-specific, focusing on descriptions of individual religious thought rather than on theories about religious cognition as a universal mechanism. While fragments of evidence from neuroscience and anthropology suggest that the Standard Model offers only part of the puzzle, no other accounts provide a coherent approach to religious cognition. Hard cores tend to generate a protective belt at the same analytical level. As the protective belt consolidates and the hard core expands, novel predictions in the periphery arise to embrace new analytical levels. This is precisely what I have observed in the Standard Model: the majority of its work deals with the analytical level in which its propositions most adeptly work. While the Standard Model generates hypotheses that venture into lower and higher levels, the theories operate at the cognitive level. Of course, we would expect that the cognitive level would represent the hub of theorising, but it also leaves the Standard Model with gaps and uncertainties in terms of its inter-level explanations.

Another problematic aspect for the Standard Model’s progress is that its core represents an assemblage of meta-theoretical assumptions from several different disciplines. Cognitive science emerged as a multi-disciplinary field converging upon cognition from various perspectives. As such, the Standard Model draws from each to nurture its core. The problem,
however, is that the Standard Model’s soft core presents a smorgasbord of disciplinary theories cobbled together from evolutionary theory, cognitive psychology, anthropology, neuroscience and artificial intelligence. While there is nothing inherently wrong with such an approach, not all of the contributing disciplines hold equal sway. In fact, the Standard Model imports an argumentation format from cognitive psychology. With this starting point, chunks of theory and evidence from other disciplines connected with cognitive science have been selectively grafted on. At the same time, some contradictory theory and evidence has been ignored, overlooked or discarded. I think this process has delivered a core different to what Standard Model advocates believe it to be. Although I am convinced that the computational-representational, domain-specific modular presentation of the mind offers an incomplete account of cognition, I can see how it might remain part of the picture or alternatively, be replaced with a more subtle, distributed version of cognition that generates similar but more focused predictions. Resolving the analytical levels issue needs to go further than stimulating inter-level connections, as important as I have argued this is. We also need to get to the bottom of the Standard Model’s soft core and its relationship to the hard core of computational-representational cognitive science.

Earlier, I argued that the Standard Model possesses a ‘soft’ rather than hard core. But from a Lakatosian research program perspective, I think that the Standard Model relies on a hard core imported from the computational-representational paradigm within cognitive science. In fact, I raise the possibility that emerging explanatory frameworks—with under-developed cores—need to draw upon a hard core from a parent field in order to establish their own, independent, fluidly evolving cores.

Lakatosian-style conceptualisations of progress through research programs do not explicitly acknowledge the analytical level at which programs operate. The fragmentation of scholarship and proliferation of so-called hyphenated disciplines introduces a complexity difficult to accommodate. Accordingly, I employed McCauley’s typology of inter-theoretical relations to express the relations within and between levels.

In quadrant 1 of McCauley’s typology, Scientific Evolution, new theories correct or replace existing ones with a high level of continuity at the same level of analytical interest. Scientific evolution implies that theories gradually head toward unification, gaining in comprehensiveness in modest increments. Lakatos’ research programs tend to fit neatly
within this perspective of progress. Although an inbuilt mechanism exists for triggering a paradigmatic revolution, it necessitates a long-term failure of the protective belt. Programs assume evolution will occur. Continuity is, after all, the point of a program.

Popper’s evolutionary epistemology with falsification also focuses on corrective, incremental theoretical progress occurring at the same analytical level. Both the Popperian and Lakatosian approaches provide useful insights into the progress of the Standard Model, and as I have already observed, I consider the latter of greater practical utility because of its focus on positive knowledge rather than on what can be eliminated. To that end, Lakatos’ programs represent a useful starting model through which an observer might come to understand how advocates see the Standard Model. In Figure 14.2, I outline the Standard Model’s treatment of a hard core and protective belt. I do not mean to suggest that I think the content reflects a genuine Lakatosian hard core. But I do think the exercise illuminates how advocates employ Standard Model propositions as well as key assumptions from cognitive science. My diagram conceptualises the way I believe the Standard Model has developed with the (perhaps quintessentially pre-programmatic) incorporation of a hard core imported from cognitive science.

Any delineation I make of the Standard Model as a research program could be justifiably contested and would be unlikely to elicit the universal approval of its membership. The most obvious point of ambiguity is whether the Standard Model should be represented in broad or narrow terms (Backhouse, 1998, pp. 3-4), and by implication, which components belong in the hard core, positive heuristic, protective belt, or if they constitute theories, assumptions, principles or predictions (Lane, 1992, p. 378). Even if decisions on these can be agreed upon, there may well remain debate about the specific format of each component. In practice an impartial observer of the Standard Model cannot categorically record its hard or soft core. I have chosen a broad delineation chiefly because it was the most inclusive approach and allowed for more scope in terms of assessing progress. Also, as I outlined earlier, I believe the real hard core can be located within the assumptions of cognitive science. The weighting I attribute to assumptions from cognitive science reflects the Standard Model’s youth because I do not think that the Standard Model propositions are sufficiently robust. Perhaps the Standard Model should not be considered an explanatory framework in its own right. Instead, it is really just an extension of a dominant stream of cognitive science. However, I think that
the Standard Model constitutes an emerging research program that possesses a fluid protective belt, and a soft core working as a set of heuristics.
**Figure 14.2 The Standard Model of Religious Cognition Hard Core and Protective Belt. A Neo-Lakatosian Conceptualisation**

<table>
<thead>
<tr>
<th>HARD CORE</th>
<th>PROTECTIVE BELT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FUNCTIONAL PERSPECTIVE</strong></td>
<td><strong>COMPUTATIONAL-REPRESENTATIONAL MODEL OF THE MIND</strong></td>
</tr>
<tr>
<td>Cognitive Psychology</td>
<td>Artificial Intelligence</td>
</tr>
<tr>
<td><strong>DOMAIN-SPECIFIC MODULARITY</strong></td>
<td><strong>EVOLUTIONARY PSYCHOLOGY</strong></td>
</tr>
</tbody>
</table>

### HARD CORE

<table>
<thead>
<tr>
<th>Functional Perspective</th>
<th>Computational-representational Model of the Mind</th>
<th>Domain-Specific Modularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cognitive Psychology</td>
<td>Artificial Intelligence</td>
<td>Evolutionary Psychology</td>
</tr>
</tbody>
</table>

### PROTECTIVE BELT

**Middle-Level Meta-theories**

<table>
<thead>
<tr>
<th>All forms of cognition are based on domain-specific modular processing</th>
<th>The mind makes intuitive domain inferences about kinds and categories</th>
<th>The mind is sensitive to agency detection</th>
<th>The mind makes inferences about other minds</th>
<th>Cognition is sensitive to emotion</th>
<th>The mind prefers social exchange</th>
<th>The mind possesses innate moral intuitions</th>
</tr>
</thead>
</table>

### Hypotheses

| Ordinary, domain-specific cognitive functions support religious representations | Intuitive domain inferences are violated with minimally counterintuitive concepts | Agency detection leads to suppositions about the presence of supernatural agents | Intentionality inferences stimulate judgements about the intentions of supernatural agents | Emotion detection assigns emotional states to supernatural agents along with existential implications | Social exchange inclinations reinforce costly commitments to supernatural agents and ritualised performances | Innate moral intuitions generate the conception of supernatural agent’s wishes |

### Predictions

| Religious cognition is dependent upon the functionality of specific cognitive modules | Religious concepts are more cognitively ‘sticky’ than other concepts and therefore are more easily maintained and transmitted | Supernatural agents are easily attributed with responsibility for unseen or unexplained events or situations | The wishes of supernatural agents are inferred from interpretations of events in accordance with doctrine | Emotions amplify religious behaviour and reinforce doctrinal conditioning in turn encouraging repetitive ritual performance | Religious rituals containing costly sacrifices are used to enhance group solidarity and demonstrate commitment | The wishes of supernatural agents correspond to intuitive moral assumptions |
As the diagram illustrates, Lakatos’ structure provides an immediate theoretical hierarchy, which is advantageous for several reasons. First, it depicts the Standard Model’s fundamental assumptions in the form of a hard core. To the extent that the hard core turns out to be worthy of its label, the protective belt represents the future of the Standard Model. It would be reasonable to expect that the middle-level theories it has specified gradually become more comprehensive and begin to be subsumed by an inflating hard core. While some of the outer layers are likely to fall away, new predictions will always be waiting in the wings, ready to take the stage. It is also likely that some new predictions will prove prescient and will help to connect some of the disparate theories from different disciplines within cognitive science that appear only tangentially relevant at present. On the other hand, as I have foreshadowed, there is the chance that some new predictions and hypotheses will routinely under-perform until the hard core is questioned within the cognitive science of religion movement as well as from outside it.

If the Standard Model does undergo a theoretical revolution, a Lakatosian observer would predict that it will be slow in coming. To me, revolution seems unlikely. However, a significant correction might arrive to compensate for an existing core containing some inaccurate assumptions. I also suspect that the change will be slow in coming as a consequence of scholarly fragmentation. Little waits in the wings to replace the Standard Model’s hard core with neither a cohesive neuroscientific nor anthropological alternative available that generates detailed predictions about religious cognition.

The potential for revolutionary theoretical progress in the Standard Model is depicted under the progress perspectives in McCauley’s second quadrant, Scientific Revolutions. For example, Kuhn’s paradigms or Feyerabend’s incommensurability would anticipate that the Standard Model will be forcibly and comprehensively replaced by a new core. In my view, however, revolution appears unlikely.

Despite the fact that the Standard Model does not agree neatly with views about both cognition and religion generated from other disciplines, the analysis I have conducted shows numerous points of intersection and overlap. Rather than a propensity for revolutionary change, my analysis points to a different form of theory development where the Standard Model’s protective belt, and ultimately its core, accommodates theoretical propositions from numerous different levels of analysis. Although commentaries on progress have been
dominated by evolution and revolution, they fail to capture the potential for inter-level connections.

McCauley’s third quadrant, Microreductive Contexts, represents a change in inter-theoretic context. It acknowledges that progress can occur at multiple levels of analytical interest as well as at the same level. Microreductive Contexts describes when high inter-theoretic continuity occurs at different theoretical levels. On this view, different theoretic perspectives intersect irrespective of analytical level and without constraint by disciplinary boundaries. In addition, connections between analytic levels depict sites of theoretic intersection. A common phenomenon such as religious cognition can be examined at different levels of analysis (like psychology, anthropology or neuroscience), and some of these theories may connect. Theory replacement is therefore less relevant than explaining inter-connections. While the Standard Model has revealed inter-level connections of some promise, it will face challenges incorporating them within its protective belt and soft core. How will the Standard Model change as a consequence?

A strong interpretation would suggest that when a lower level neuroscientific theory explaining religious cognition becomes sufficiently robust, it would undermine other levels rather than stimulate inter-level theories. Churchland’s eliminative materialism is one such view. However, my analysis offers little to justify the elimination of cognition in general, or religious cognition specifically. While I have argued for an increasingly important role for lower level theories emerging from neuroscience, I do not predict that higher analytical levels will become obsolete.

A more likely scenario reflects a moderate version of inter-theoretical progress along the vein articulated by Nagel’s bridge laws, Kincaid’s unification as a matter of degree, Kinoshita’s part-whole relations, and Hardcastle’s explanatory extensions. In addition, I have proposed that Bechtel’s use of mechanisms provides a useful practical approach.

My analysis suggests that weak versions of inter-level theoretical progress are most likely, in a form corresponding best to Darden and Maull’s inter-field theories. The Standard Model will progress toward more inter-field theories around its protective belt. To that end, progress should measure the Standard Model in terms of its ability to provide a single framework through which disparate and previously unconnected theories and evidence might be
assembled. I hesitate to use the term unification, but I do mean to suggest that the Standard Model has the potential to reconfigure the study of religious cognition around a stable nexus. Theoretical progress would match the degree to which the Standard Model becomes a vehicle for reshaping all disciplinary approaches to the study of religious thought and activity.

It seems unlikely to me that the Standard Model will become a unifying program with reduction. I do not suggest that reductions will be impossible, but I have laboured the point that reduction is implausible until the neural correlates of every form of cognition invoked during religious practice and reflection emerges. Even presuming this occurs, the neural correlations may only offer the neurological component to the inter-field theory. Little evidence suggests that a full account of the neural activities occurring during religious cognition will remove the need to employ psychological and anthropological theories to explain higher levels. Nor will it obviate the pursuit of biological accounts grounded in evolutionary theory to help explain their ultimate presence. In a perfect scientific world, where religious cognition can be explained in terms of its complete neurological expression, cognitive theories would remain essential to understand neurological activity in terms of religious thought. Religious cognition will have to embrace data from a lower analytical level.

**Problem-Solving and Progress in the Standard Model**

Laudan’s problems-based approach does not emphasise analytical level or continuity between competing paradigms or replacement theories. Of relevance here is Laudan’s emphasis on the conceptual liabilities and assets in theory selection without necessarily considering them in the context of a given theory’s empirical performance. For example, Laudan’s (1977, p. 17) ‘anomalous problems’, or empirical problems that a theory has yet to reconcile, relate to progress in the Standard Model as it applies to inter-theoretic relations. The best research traditions are the best problem-solvers (Laudan, 1977, p. 130).

Both Laudan (1977, p. 127) and Kuhn see progress in problem-solving terms. The revision and progress of scientific knowledge does not have a linear character. Progress comes through revolutions because more problems are solved, although there is no guarantee that the same old problems are solved in addition to new ones. Nor is there necessarily a correspondence between greater problem-solving and more knowledge. Nevertheless, Laudan (1977, pp. 30-40) reached the seemingly reasonable conclusion that measuring the importance and number of problems reveals whether the gains outweigh the losses.
I think Laudan’s suggestions that theories have malleable hard cores, and that making ad hoc modifications to a theory is both acceptable and progressive in the absence of other explanations, have relevance to the Standard Model case. However, Laudan’s (1977, p. 25) approach to specifying solutions to problems seems generous and permissive: any theory can be regarded as having solved an empirical problem if it functions in any schema of inference in which the conclusion is a statement of the problem. This would allow deduction from weak premises. Laudan accepts that a problem-solving theory could encompass only an approximate statement of the empirical result.

Laudan’s problem-solving approach is only partly helpful given that it cannot yield immediate assessments in this case. Research programs involve general assumptions about a phenomenon and the best processes for the investigation of its associated problems, and ultimately the construction of explanatory theories. Developing such a tradition takes time, making the instant evaluation of progress impractical. From Laudan’s perspective (1977, p. 81), any research tradition that has generated successive theories to solve problems within its domain satisfies progressivity. However, Laudan offers no mechanism to determine whether a problem solved in one research tradition has more significance than a problem solved in another. Competition resolves over time as some traditions become stagnant while others gain dominance. If the Standard Model is ultimately abandoned, and the understanding of religious cognition regresses, then it would be hard to conclude that any progress occurred. On the other hand, embracing Laudan’s assessment of progress means that spending time on a pseudo-problem may still be regarded as progress.

I find the Standard Model case consistent with Duhem’s (1991[1906], pp. 183-187) position that theories are not actually falsified directly upon appeal to empirical evidence. In fact, an empirical result does not falsify a hypothesis in isolation, but the combination of a hypothesis and a conditional statement. Thus, the statement about conditions could be false rather than the hypothesis itself. In this case, potentially falsifying evidence is inextricably connected to theories via conditional statements, auxiliary hypotheses and assumptions. For example, religious practice represents a conditional context that can be used to explain falsifying evidence contradicting predictions derived from the computational-representational, domain-specific, modular presentation of the mind. Thus, empirical material cannot be the source of conclusive verification for a theoretical position. Of more use is the corroboration of theories from multiple levels of analysis. Diversity and variety of evidence is essential according to
Losee (2005, p. 155). It does not matter whether diversity is established as the result of a novel prediction or accommodation. Equally, the convergence of diverse experimental results to a single value is advantageous (Losee, 2005, p. 166). For example, Whewell’s (1967), p. 65) ‘undesigned scope’ serves as a condition to justify theory replacement when a theory applies to a new class of phenomena. A theory becomes more compelling when it explains evidence associated with a phenomenon for which it was not composed to explain.

A final alternative views theoretical connections as loose heuristics. McCauley specified this possibility through his fourth quadrant, Explanatory Pluralism, as depicted in Figure 14.3. It represents the possibility that progress reflects multiple and disparate explanations of phenomenon. Here, inter-disciplinary excursions represent heuristic approaches to discovery due to low inter-theoretic continuity. Theoretical progress is not only discontinuous at the same level, but also at different levels as well. On such a basis we would expect the Standard Model to generate more explanations rather than consolidating existing ones.
At present, the study of religion in general appears to be fragmented where the theories generated have only loose connections at best. What looks like pluralism now might remain the same in the future. Progression will bring with it fuller descriptions, explanations and theories within each specialty, but nothing that will improve continuity. Levin (1979) suggested that a current theory must explain all the facts and problems that its predecessor
explained, as well as more, including some that its predecessor failed to explain. The chance that an old theory will be replaced by a new theory diminishes over time because every revolution that occurs was less likely than the previous one. Of course, this approach leads to a sticky situation as the Standard Model neither resolves all the problems raised in other theories nor seems likely to be the precipitant of a revolutionary theory of religious cognition.

One of the main challenges that the study of religious cognition faces is the absence of an independent form of religious cognition. I have argued that religious cognition does not appear in a single or exclusive kind. In fact, innumerable kinds of computations occur in the minds of religious adherents during practice and reflection, all deployed by the same functional processors. I do not need to be convinced about the presence and domain specificity of modules (which I am not) to conclude that no plausible evidence supports the existence of a religion module or a part of the brain dedicated to religious activity.

Religious cognition constitutes regular cognition that happens to deal with religious content. As a result, the Standard Model has focused its attention on determining what it is about religious content and concepts that are special, with the intention of demonstrating how the mind’s processing system deals with them. Our interest revolves around ordinary cognition rather than any special religious kind. The theories specified by the Standard Model focus on how ordinary cognition engages religious concepts or representations. With countless different kinds of concepts, and countless different kinds of regular cognition, it seems almost futile trying to devise a single theory to explain it all. Each kind might be subject to a theory, but theorising about the whole collection could lead to a fragmented mess. In the end, significant contributions towards progress in understanding religious cognition may come through connections and developments that were never predicted or deliberately sought. Complexity and unpredictability may just rule.

**Conclusion**

A critical mass of religious cognition research and commentary has led to the emergence of an explanatory framework. While the only cohesive explanatory framework available for religious cognition, the Standard Model faces challenges within cognitive science, as well as from other disciplines connected with cognition. My interest stems from this combination of nascence and vulnerability; the emergent explanatory framework for religious cognition could
consolidate or falter, and an assessment at this decisive juncture represents a revealing case in the philosophy of science.

Progress for the Standard Model means overcoming the inter-disciplinary paradox: interactions and connections between disciplines may be undermined by specialisation pressures. With specialisation comes isolation, and therefore reduced intersections between areas. For theories that do successfully cross disciplinary boundaries, as those in cognitive science aim to, relations must extend into and between at least two theories. Inter-disciplinary theories in cognitive science can vary from general heuristics to reduction-based unification. This case encourages a middle ground where inter-disciplinary theory connections tend to be messy, non-reductionist affairs with incomplete, tangential inter-connections. For the Standard Model, I see a future characterised by inter-connections, rather than the unification of inter-level explanations. In the following and final chapter, I bring together my argument around progress, the future of the Standard Model, and summarise my contribution.
Chapter 15. Conclusion and Final Comments

Introduction
In this dissertation I evaluated progress in the developing research cluster around the cognitive science of religion. I refer to this research concentration as the ‘Standard Model of Religious Cognition’ following Boyer (2003, p. 3). The term refers to a consensus of loosely-assembled principles and propositions. To that end, I claimed that the Standard Model constitutes an explanatory framework for the acquisition, maintenance, and transmission of religious concepts with an emphasis on cognition, or thoughts about religious concepts. It provides “… an important bridge into the future. But that bridge is narrow, and it is not exclusive. The standard cognitive science of religion model commands our admiration, but it is not enough in itself” (Saler 2010, p. 339).

Assessing progress in the Standard Model is important for several reasons. First, religion’s social and personal significance underscores its importance as a focus for research. A robust assessment of the Standard Model foreshadows the return on investment from this research activity. Second, conducting the assessment required a customised analytical framework. The framework I have provided could be employed in other assessments of emerging research programs in cognitive science. Third, philosophy of science has focused more on criteria for evaluating competing theories than criteria for evaluating program development or potential. The Standard Model offers an illuminating case in progress, signposting important markers of application in other emerging research programs. Finally, the Standard Model presents a contemporary case of inter-disciplinary scientific activity—and in particular cognitive science—suggesting new ways for evaluating progress in emerging programs engaging multiple disciplines.

In order to conduct my assessment of progress I applied numerous interpretations and criteria from the philosophy of science. As an organising framework I adapted the five criteria for assessing a theory in cognitive science devised by Thagard (2005a). To those five criteria I added two supplemental criteria. I argued that the collection of seven criteria represent a practical structure for assessing a developing explanatory framework in cognitive science.

Based on the outcomes from the seven criteria, I have concluded that the Standard Model contains severe flaws and gaps. At the same time, it also provides a connective framework for
linking research threads associated with religious cognition produced by different disciplines. I used the case of the Standard Model to reflect on philosophic notions of progress in science and cognitive science. The case suggests that an explanatory framework in cognitive science can be simultaneously flawed and progressive. It also reinforces my suggestion that progress concepts in the philosophy of science focus on theory replacement at the same analytical level. This case demonstrates that an explanatory framework’s ability to expose connections between different disciplines and analytical levels represents a salient measure of progress.

I have defended the position that an explanatory framework in cognitive science shows progress when it exposes hitherto unforseen connections between disciplinary and analytical levels, thereby stimulating new predictions and empirical activity around high potential intersections and questions. I have shown where some of the new data emerging as a consequence of the Standard Model’s connections undermine key assumptions. In addition, I have predicted more to come.

This chapter has three objectives. First, I reproduce the Standard Model’s central features. Second, I report on my evaluation of its strength as an explanatory framework for religious cognition based on Thagard’s (2005a) analytical criteria. Third, I consider the lessons from the Standard Model as a case study in the philosophy of science. To repeat, I conclude that the Standard Model provides a helpful framework for encouraging new hypotheses, testing predictions and theorising about religious cognition. However, I hold misgivings about its reliance on under-substantiated assumptions imported from cognitive science. The case also reveals the shortage of tools for assessing scientific progress in a multi-disciplinary field spanning numerous analytical levels.

**The Standard Model of Religious Cognition**

Religious cognition is thinking about religious content. Cognitive scientists focus on the mental correlates of religious content; the symbolic, psychological ‘representations’ about domains. In this context, a domain is a distinct kind or type of content (Hirschfeld and Gelman 1994, p. 21). By analysing representations about domains, cognitive scientists make suppositions about religious thoughts. According to cognitive interpretations, religious content accompanies ordinary thought processes as natural by-products (Atran 2002, Ch. 1, Boyer 2001, p. 50, Dawkins 1982, Norenzayan and Atran 2002, Pyysıainen 2003a, pp. 5-8, Sperber 1996). Minds possess a suite of cognitive capacities attuned through natural selection
to solve ‘domain-specific’ problems (Slone 2005, p. 199). For each major problem domain, a specific cognitive mechanism offers an efficient, modularised and intuitive solution. In turn, cognitive mechanisms facilitate and constrain religious activity (Boyer 2005). Studies of religious cognition emphasise the operation of these domain-specific mechanisms, also known as cognitive devices or modules (Pyysiainen 2003a, p. 209). For efficiency, cognitive devices mainly operate without conscious awareness, providing intuitive assumptions and inferences about the world and its contents. Information is processed, categorised and stored in unconscious templates delivering ‘minitheories’ about how best to navigate the world. Cognitive devices also ‘prime’ human experience (Van Slyke 2005, p. 5), and according to the Standard Model, create a propensity for certain patterns of religious thought.

I have used the term ‘Standard Model’, following Boyer (2003, p. 3) and for the convenience of an existing label, without intentionally suggesting a level of acceptance held by the standard model of physics. I present the Standard Model below through seven propositions consistent with Boyer (2005, pp. 4-6).

First, the computational processes of domain-specific cognitive devices lead to religious representations as a natural by-product (Atran, 2002a, p. 266). As a result, religious cognition is ‘parasitic’ upon ordinary cognitive functions. Religious cognition is not a unique or distinct category independent from other forms of cognition.

Second, domain-specific cognitive devices generate intuitive inferences, but religious representations violate these unconsciously-generated thoughts. Religious concepts may therefore be described as ‘counterintuitive’, meaning that they defy ordinary expectations about the world and its contents. Religious concepts enjoy a transmission advantage as a result because counterintuitive concepts tend to be memorable (Boyer 2001, Ch. 2, 2003, p. 18-23; Pyysiainen 2003a, p. 53).

Third, the mind intuitively attributes agency and goal-driven behaviour to events and situations (Leslie 1994; 1996). Religious practitioners naturally infer the presence and interests of supernatural agents, to whom responsibility for the unexplained may be assigned.
Fourth, cognitive devices encourage assumptions about the intentions of supernatural agents (Boyer 2001, pp. 45-46; Dennett 1987, 2006). Religious practitioners imagine the intentions and judgements of supernatural agents and interpret events in accordance with doctrine.

Fifth, the mind’s ability to identify and interpret emotions encourages religious practitioners to ascribe emotional states to supernatural agents. Emotions also strengthen religious behaviour by reinforcing doctrinal conditioning. In addition, emotion-detection alleviates or amplifies existential anxiety by connecting the judgements of supernatural agents with rewards or punishments in the afterlife (Thagard 2005b).

Sixth, cognitive devices facilitate social exchange and ritual performance (Whitehouse 2002). Practitioners demonstrate their preparedness to endure costly sacrifices in order to prove worthy of both supernatural agents and peer social networks.

Seventh, innate moral reasoning underpins a natural inclination to conceive the wishes of supernatural agents (Bering and Johnson 2005, p. 136). The imagined wishes of supernatural agents correspond to intuitive moral assumptions. Religious practitioners accommodate by behaving in line with the recommendations of doctrinal experts.

In order to assess the Standard Model, I employed Thagard’s (2005a) five criteria for evaluating competing cognitive theories. To this organising structure, I added two criteria of my own. The following section reviews the outcomes of this assessment.

**Assessing the Standard Model of Religious Cognition**

1. **Representational Power**

   The first evaluative criterion, representational power, refers to the Standard Model’s ability to account for a variety of cognitive representations. It helps to explain the presence of religious mental representations. A religious representation is a mental theory or symbol about a category of religious information. The prototypical religious representation is a thought about God. However, religious representations can be thoughts about any kind of religious content from Noah’s Ark to ghosts. Representations lead to intuitive assumptions that shape belief and behaviour. For example, representations about rocks lead to inferences about their nature, as well as expectations about what happens when kicking or being hit by one. An important
challenge for cognitive theorists lies with specifying how religious representations diverge from non-religious representations.

The Standard Model answers that religious representations lead to inferences that contradict normal expectations about the world and its contents. These arrive in the form of counterintuitive (CI) concepts. Boyer (1994) takes the idea of counterintuitivity another step by introducing the notion of minimally counterintuitive (MCI) concepts. MCI concepts contain a small proportion of CI content within a concept set of mostly intuitive content. For example, the concept of a ghost activates intuitive inferences about the domain ‘person’; ghosts possess functioning minds and psychological needs. But ghosts also challenge intuitive assumptions about the domain of ‘person’ as well because they operate without corporeal brains or bodies.

According to the Standard Model, MCI content both distinguishes religious representations and explains their successful transmission. Boyer’s (1994, pp. 117-124) cognitive optimality hypothesis claims that MCI religious concepts possess an ideal balance of intuitive and counterintuitive content, thereby enhancing memorability. In testing Boyer’s prediction, empirical studies have shown that MCI concepts do enjoy modest memorability and transmission advantages (Barrett and Nyhof 2001, Boyer and Ramble 2001, Norenzayan and Atran, 2002, Norenzayan, Atran, Faulkner and Schaller 2006). The enhanced memorability of religious content represents a successful prediction from the Standard Model. However, better memorability does not explain religion’s universality, nor does it separate religious concepts from non-religious concepts. As a result, the predictions generated by the cognitive optimality hypothesis seem limited. For example, Lakatos (1978, p. 6) proposed that ‘stunning’ predictions carry weight, while Mayo (1996, p. 208) wanted to see ‘severe’ tests of a theory. Like much of the Standard Model, cognitive optimality provides partial answers, but falls well short of making stunning predictions.

Using CI content as a key element in the definition of a religious representation leads to several troublesome issues. To begin with, CI content inadequately separates religious representations from other kinds. A representation becomes quintessentially religious with the presence of CI or MCI content. However, CI and MCI content can be found in non-religious concepts too, including science. It remains unclear how a MCI religious representation and a
non-religious one can be distinguished if religious cognition presents a form of ordinary cognition.

Another problem lies with the relationship between implicit and explicit religious inferences. Explicit inferences such as those about God are conscious, high level interpretations, contrasting with implicit, unconscious inferences like the expectation of gravity. The Standard Model acknowledges implicit and explicit processes through intuitive (implicit) and reflective (explicit) inferences, but has not yet come to terms with how CI content plays a role. For example, how an individual interprets ‘seeing’ a ghost depends upon their reflective thoughts about the incident. Perhaps, as Sperber (1996) suggested, the relationship between the intuitive and CI can be murky or mixed. An individual might instantly react as though he or she had seen a ghost, but upon later reflection might reach an alternative conclusion. Religious beliefs incorporate a complex array of intuitive inferences and reflective thoughts, moderated by emotion and contextual forces. While the concept of counterintuitivity helps to distinguish religious representations, it does not explain all religious concepts, or the complex nature of their formation. Many individuals never form religious beliefs, yet might be exposed to the same CI concepts as dedicated religious practitioners. Others accept CI religious concepts only to abandon them later in life. Some people think they have seen a ghost, others think their minds have tricked them.

Another problem for the Standard Model lies with accounting for the effects of exposure and learning. For example, repetitive exposure to religious concepts will reinforce beliefs. Some evidence also suggests that children are intuitive theists who become more critical of religious concepts as they age (Bodgan 2005, Kelemen, 2006, p. 104). What is the difference between a science teacher explaining quantum theory and a religious leader explaining the resurrection, when both involve the acceptance of CI content? The Standard Model does not provide a theory accommodating learning and reflection.

Finally, the Standard Model cannot specify the number or scope of the cognitive devices influencing religious representations. Each cognitive device could deal with countless forms of cognition, only some of which might be related to religious content. Religious representations do not come in a neat, single kind and may actually be as numerous as individuals’ thoughts.
2. Computational Power

The second evaluative criterion I employed, computational power, relates to how well the Standard Model describes mental computations. It helps to explain the operation of cognitive devices and the way they compute or process religious representations. Where representations are the mental symbols of religious content, computations are the mental processes that convert these symbols into inferences. However, the presence and nature of domain-specific devices remain contentious both within and outside cognitive science. Assuming that cognition operates through domain-specific cognitive devices could be a vulnerable premise upon which to base the Standard Model. The algorithmic assumption inherent in the computational model constrains the understanding of cognition to an input-output function. Necessarily, computational functionality depends upon a mechanism undertaking the processing, which dismisses context and contingency in favour of predictable representation to cognition relations.

According to Standard Model advocates, domain-specific cognitive devices possess dedicated functionality, and fast, efficient processing. However, religious cognition could engage numerous devices simultaneously, making it unclear which one/s activate during each kind of concept computation. It is also unclear how many different devices actually exist, although cognitive scientists commonly argue that theory of mind, hazard-detection, folkbiology, number, face recognition, naive mechanics, and folk sociology devices play crucial roles in religious cognition (Atran 1998, p. 548, Barrett 2004, Ch. 3, Boyer and Walker 2000, p. 152). Each one of these putative devices undertakes specific functions, and some evidence suggests that the mind does produce inferences about religion consistent with the presence of several prominent devices (see for example, Barrett and Nyhof 2001, Boyer and Barrett 2005, Leslie 1994, Leslie and Frith 1988). However, the claim for domain-specific devices comes from a reverse-engineering method common in evolutionary psychology starting with the intuitive assumptions made about the world and its contents. More powerful predictions (e.g. Musgrave 1974, pp. 15-16) would introduce novel expectations, such as the presence of a form of religious behaviour impossible with domain-general cognition (or the absence of domain-specific devices). Other key questions about computation remain unanswered as well. For example, what are the processing boundaries of each device? What happens when concepts associated with different devices occur concurrently? Do numerous domain-specific devices engage seamlessly? Standard Model accounts presume that numerous devices activate
during religious thought and behaviour, blurring the distinctions between domains (Pyysiainen 2002a, p. 1), but without providing an explanation as to how.

A final challenge returns to the problematic role of counterintuitivity. Ordinary computation must fail—it must produce a domain violation—in order to create a CI concept. Religious concepts therefore rely on the partial failure of ordinary thinking processes. Perhaps religious doctrine provides a pre-computational sorter which helps to classify violations? The cultural forces acting on cognition might explain why only certain CI content registers as religious, a possibility relevant to the anthropological data about religious practice considered next.

3. Psychological Plausibility
The third criterion, psychological plausibility, reflects how well the cognitive devices described by the Standard Model predict religious behaviours. Psychological plausibility builds upon computational power to explain the idiosyncratic ways in which religious practitioners actually think. The hidden psychological world of religious thought can be exposed by observing religious ritual and practice. Rituals communicate multi-layered meanings through action and symbols (Dulaney and Fiske 1994, p. 245). The Standard Model claims that religious rituals hold importance because they demonstrate how human behaviour is constrained by cognitive devices. The evidence offers support for this position, but also reveals sizable explanatory gaps.

Experimental evidence indicates that the doctrinal repetition in rituals can relieve existential anxiety (Boyer and Lienard 2006). At the same time, other studies suggest that the emotional intensity embedded in rituals can amplify fears of death and an unpleasant afterlife (Sorensen 2002, pp. 180-184). A possible reconciliation might be found in Whitehouse’s (2002, 2004) modes of religiosity theory, which proposes that religious concepts enjoy better recall and transmission when they stimulate two kinds of memory, semantic and episodic, the former governed by repetition and the latter by emotion. Accordingly, religious rituals represent a powerful intersection of repetition and emotion.

Extending upon modes theory, Tremlin (2005, pp. 171-184) introduced a ‘dual-process’ model contrasting explicit (reflective) with implicit (intuitive) cognitive processing. Tremlin’s theory predicts that intuitive thinking trumps reflective thinking because it is faster and emotionally charged, making it a more powerful mode of religious cognition. For example,
religious practitioners with stronger emotional reactions to rituals also experienced stronger, deeper and longer levels of meaning reflection (Richert, Whitehouse and Stewart 2005, pp. 140-143). Once stimulated, reflective thinking is psychologically demanding, but it plays an important role in creating personal meaning. On the Standard Model, the key to successful religious systems lies with the balance between intuition and reflection, representing an optimum composition based on ease and relevance. Although helpful, the modes and dual-process theories are limited to description rather than explanation because the two cannot be easily separated (Day 2005, p. 86, Hinde 2005, p. 33, Pyysiainen 2005).

The psychological plausibility of the Standard Model also receives support from commitment or signalling theory, which assumes that religious practices increase group cooperation through the display of costly actions serving as signals to prompt trust (Alcorta and Sosis 2005, pp. 325-328, Dow 2006, p. 70). The performance of a ritual that serves no obvious purpose can be employed to generate emotional reactions that become anchored through repetition (Sosis and Bressler 2003, Sosis and Ruffle 2004).

The interface between belief and behaviour always returns to explanations connecting cognition and emotion. All decision-making contains an emotional dimension (Damasio 1999, pp. 40-42, 1994, Fazio 2001), and emotion infuses religious cognition, particularly through symbols (Thagard 2005b, pp. 60-63). Inferences about which beliefs to accept and which behaviours to enact do not rely on hypotheses and evidence, but rather on the associated emotional values (Thagard 2005b, p. 72). The relevance of emotional arousal is undeniable but with little explanation in the Standard Model for its role in cognition. Nevertheless, some clues can be found in the brain itself.

4. Neurological Plausibility

The fourth evaluative criterion, neurological plausibility, refers to the Standard Model’s ability to describe the neural activities corresponding with religious cognition. It helps to explain the relationship between cognitive devices, brain operations, religious thought, and religious practice.

Alper’s (2001) ‘God part of the brain’, and Hamer’s ‘God gene’ (2004, Ch. 5) remain unsubstantiated. On the other hand, neuro-imaging research has exposed patterns of brain activity associated with reported religious experience. The Standard Model provides a framework in which neurological research can potentially intersect with religious behaviour as well as religious thought. Although the Standard Model does not venture far into relationship between cognition and neurology, Atran (2002) and Boyer (2003) view religious experience as a useful conduit to further explorations.

Two prominent theories seek to explain the neurological features of religious experience. First, Persinger’s (2001, 2003) temporal lobe hypothesis predicts that pathology or temporary dysfunction in certain structures within the temporal lobe may stimulate religious experience. When these structures fail, they destabilise the brain’s hold on time, space and self, opening the door for mystical and religious interpretations of the resulting experiences. A competing but overlapping theory, the neurotheological hypothesis, focuses on the simultaneous activation of the sympathetic and parasympathetic nervous systems (D’Aquili and Newberg 1998, pp. 80-85). Although the catalyst arrives differently, the result leads to the same kinds of structural destabilisations that Persinger noted. Similarly, Atran (2002, pp. 182-186) proposed a theory emphasising the role of ritual and ceremony in creating simultaneous sympathetic and parasympathetic nervous system activity.

Research on the neural correlates of religious experience reinforces the importance of emotion in religious practice. In fact, cognitive-neuroscientific research connecting emotion and cognition has flourished (Azari and Birnbacher 2004, p. 902, 906-907). Damasio’s (1999, pp. 40-42) somatic marker hypothesis, for example, explains how emotion is hardwired into cognitive processes. While still in its early stages, specifying the neural relations between emotion and cognition would be of immense value to understanding religious cognition. The Standard Model needs to explain how rituals influence neurological activity in a way that encourages and facilitates religious experiences, leading to the use of religious doctrine for interpretation.

A clue to the relationship between neural activity and cognition has emerged from seminal neuro-imaging research examining the brain states associated with belief, disbelief and uncertainty. Harris et al. (2008) reported that each of these cognitive states differentially activates distinct regions of the prefrontal and parietal cortices, as well as the basal ganglia.
“Truth may be beauty, and beauty truth, in more than a metaphorical sense” (Harris et al. 2008, p. 141) as the brain responds to disbelief in the same way as it does to disgust. In follow-up work, Harris et al. (2009) used functional magnetic resonance imaging to identify the neural correlates of religious belief by comparing the brain responses of Christians and nonbelievers. In both groups, religious cognition activates brain regions governing emotion, self-representation, and cognitive conflict, while ordinary facts draw more heavily upon memory retrieval. Religious and non-religious cognition engage different regions of the brain, but the difference between belief and disbelief appear to be independent of content. That is, belief in anything stimulates roughly the same brain regions as religious belief. Work on the neural correlates of counterintuitive thought would also be productive, but has not yet been undertaken.

The loop of doctrine, practice, emotion and belief requires additional examination. However, to speculate based on Standard Model assumptions, pre-formed beliefs mitigate the interpretation of religious experiences, as do prevailing cultural forces (Boyer 2003, p. 121, Livingstone 2005, pp. 84-87, Pyysiainen 2003a, Ch. 5, Watts 1997, p. 250). Religious practice, whether in the form of rituals, meditation or prayer, help to connect cognition and experience through repetitive doctrine and emotionally-stimulating practices. Because emotion infuses cognition, religious practitioners will be more likely than non-practitioners to interpret a peak experience as religious in nature and use it to bolster their dominant beliefs. Religious concepts place structure and meaning around difficult to define experiences. However, the Standard Model still struggles to explain why the ‘natural’ inclination towards religion does not always gain traction.

5. Practical Applicability
The fifth evaluative criterion, practical applicability, concerns the Standard Model’s capacity to explain real world behaviour and experience. It helps to explain religious extremism and atheism. The Standard Model explains belief in general better than it explains religion specifically. While some people do not accept any religious doctrine, all humans make assumptions about how the world and its occupants interact. Religion might be best seen as one type of belief rather than the prototypical type. Nor does religion come in one consistent kind or package of beliefs. The specific composition of religious beliefs varies within denominations, and may even be unique to every practitioner (Slone, 2004, Ch. 1).
The Standard Model’s dependence on innate, domain-specific cognitive devices may be useful in explaining the structure of all kinds of belief. For example, while religious beliefs can ameliorate uncertainty and existential anxiety, these stresses can be mitigated through other belief systems too, like those associated with ethnicity, family, sport, and even science. I think that the Standard Model overestimates the universality and ‘naturalness’ of religious belief. It overzealously claims that the nature of cognition strongly encourages religion. However, more variability in religious belief and practice can be found than the Standard Model comfortably explains. For the moment, at least, Jensen (2009, p. 131) takes firms ground in claiming that you can explain some aspects of religion in cognitive terms, others demand other kinds of explanation.”

My assessment also considered work in the cognitive processes behind decision-making. These data show that systemic flaws and biases exist in cognition (Hsee and Hastie 2005, p. 31, Kahneman et al. 1993, p. 401, Van Boven and Loewenstein 2003, pp. 1165-1167, Wilson and Gilbert 2005, pp. 131-133). The cognitive devices that evolved to help us navigate a world packed with danger through intuitive shortcuts, also load our thinking with faulty inclinations, some of which reinforce religious cognition.

All humans make some decisions on the basis of irrational or incorrect assumptions, irrespective of religious content. For example, in a non-religious context, Strange and Katz (2002) empirically demonstrated that individuals’ beliefs can shift dramatically following exposure to a fictional narrative. On the positive side for the Standard Model, this evidence implies that humans are primed to believe dramatic fiction, while on the negative side it suggests that supernatural and religious content are unnecessary.

The Standard Model has difficulty in explaining the absence of religious belief, and belief conversions, as well as the more extreme beliefs found in cults and non-mainstream religious sects. In cases of backwards conversion, previously held beliefs are discarded or replaced. Given the likelihood that each case may be unique in cause and situation, it is difficult to pinpoint the cognitive devices that encourage belief exchange. It remains unclear whether abandoning some beliefs is driven by discontent, an escalation in reflective thought, or some other cultural or cognitive mechanisms (Rambo 1999; Davis and Rambo 2005). No putative cognitive devices explain why one person can relinquish religion while another embraces it. Individual, social and environmental forces may be the sovereign factors at play in both
religious and backwards conversion. Yet if the Standard Model has practical relevance, it must explain conversion and belief exchange in both directions.

One explanation for conversion holds that individual, social and environmental forces are more influential than the Standard Model assumes. While innate cognitive devices do impel religious belief, religious belief can be abandoned as a result of even more powerful individual, social or environmental pressures. Another alternative suggests that cognitive devices work in ways that facilitate belief in general, rather than religious belief in particular. Beliefs get modified, exchanged or supplemented rather than dismantled entirely. There are no belief vacuums. I think this interpretation has its basis in the most basic notions of evolution and natural selection.

6. Evolutionary Plausibility

The sixth evaluative criterion, evolutionary plausibility, describes the extent to which the Standard Model can be aligned with selection pressures and the biological theory of evolution. It helps to explain the relationship between cognitive devices, evolutionary selection pressures, and religious thought and behaviour. The Standard Model assumes that we do not simply learn through exposure and mimicking, but through what we have been prepared to learn (Boyer 2001, Ch.1). Concepts do not travel fluidly and intact from one mind to another. Instead, the communication of concepts requires inferential processes. Individuals become mindful of the cues offered by others’ behaviours, infer their intentions, and predict the impact of various responses (Sperber 1996, pp. 41-43).

According to the Standard Model, evolution has limited the possible expressions of religious beliefs (Anttonen, 2002, pp. 14-19, Dawkins 2006, p. 164, Kamppinen 2002, p. 269). To explain this effect, Atran (2002, pp. 10-15) employs a metaphor where culture is a mountain valley landscape formed by different ridges. Religion represents specific sets of emotional, social and cognitive features, or mountain ridges, each with a unique contour carved by evolutionary time. Numerous evolutionary formations influence religious cognition, including those associated with emotion, social interaction, and domain-specific cognitive devices. Human experience may lie anywhere along the evolutionary landscape, but like rainwater, converge along a common channel (Atran 2002, pp. 265-266). Religion represents a by-product of cognitive and emotional mechanisms that evolved through natural selection for the
purpose of undertaking survival tasks, including socialisation (Atran and Norenzayan 2004, pp. 748-749).

The evolutionary by-product perspective is exemplified by Atran (2002a) and Boyer (2001) who view religious concepts as analogous to music or art in that they reflect side effects of ordinary cognitive capacities that must have proven useful in ancestral environments, such as the ability to create maps or imagine scenes. To anthropologists, the complications around religion seem innumerable: different roles, cultural interpretations, religious institutions, ecological variables, and tribal expressions such as myth, ritual, taboo, symbols and altered states of consciousness. To some extent the Standard Model sweeps away all of these uncertainties by relegating the breathtaking myriad of religious variations to outcomes of a common cognitive structure (Atran 2002a, p. 266). The Standard Model assumes that the mind stabilises and channels cultural information. However, the evidence does not demonstrate that the transmission of cultural information operates through inference alone. But on my analysis, the Standard Model too readily conflates the immense number of religious variations to a common cognitive structure that canalises cultural information into a handful of key categories.

The Standard Model takes a defensible position when it claims that the cognitive capacities engaged during religion were cobbled together by natural selection, and adapted for survival and pro-social purposes that also encourage all kinds of belief, including the religious. But it goes too far when it claims that religion is natural as a result. In addition, the cognitive drivers of religion could work synergistically with cultural selection in a form of exaptation. Group selection could work by narrowing variation to increase the probability that fitness-supporting aspects of religion arise consistently. I think the Standard Model should embrace this possibility more readily (although some advocates already do). Doing so would also assist in explaining anthropological observations. Perhaps the greatest challenge to the Standard Model comes in its ability to provide intersections with theories emerging from other levels of analysis.

7. Integrative Power
The seventh evaluative criterion, integrative power, refers to the Standard Model’s capacity to assimilate evidence from different levels of explanation, where a level represents an analytical stratum. It helps to explain the relationships between theories generated by the Standard
Model that operate in different disciplines. In order to offer a robust explanatory framework, the Standard Model needs to assimilate evidence from different levels of explanation, from psychology and anthropology to neuroscience and biology (McCauley 1986, pp. 189-191). A starting point would reconcile the presence of domain-specific cognitive devices with the neurological evidence. This would come through a method of connecting evolutionary pressures, cognitive functionality, and neurological correlation evidence without the need for reduction (Hintikka and Symons 2003). Possibly, as Mundale and Bechtel (1996) suggested, hierarchical relationships can be explored between theory and data from different levels without assuming that higher-level processes come from lower-level processes. Such a stratified view means linking cognition, psychology, neurology and anthropology. The notion of an inter-connection between psychology, evolution and neuroscience is consistent with Darden and Maull’s (1977) conception of inter-field theories, which describe potential connections between parts and wholes, causes and effects, and structure and functions. The Standard Model has been loosely moving in this direction.

Another approach to integrate the diverse research evidence around religion would take into account the Standard Model’s capacity to reconfigure disjointed and unconnected theories about religious cognition into a single framework (Dogan and Pahre 1990, pp. 30-35, Mattick 1986, p. 340, Palmer 1999, p. 242). Success would mean that the Standard Model ceases to represent a specialised area and instead becomes a vehicle for connecting and reshaping previously unconnected approaches.

**Lessons from the Standard Model of Religious Cognition**

The Standard Model proposes that domain-specific cognitive devices encourage inferences about the presence of hidden but active supernatural agents. In fact, cognitive devices help attribute goals to this clandestine work because religious practitioners interpret the wishes of supernatural agents through a combination of environmental cues and doctrine. These powerful presumptions lead practitioners to invent or rehearse symbolic displays of loyalty, often involving costly sacrifice. Through over-sensitised emotion detection cognitive devices, religious practitioners conceive the wishes of supernatural agents and act accordingly. According to Boyer (2005, p. 6), these propositions evolved on the back of what he described as a ‘Standard Model’, where scholars utilised a common but ‘simple strategy’.
I consider the Standard Model an explanatory research framework based on assumptions allied to a malleable or ‘soft’ theoretical core. As a result, the Standard Model reflects a precursor to a Lakatosian-style research program. The propositions employed within the Standard Model and examined here through Thagard’s criteria (and two of my own), make predictions that have partly been tested. Sound theories make predictions that correspond to observational data. Since the Standard Model explains more aspects of religious cognition than any other set of propositions or theories, it holds a default position as a leading explanatory framework. But, if the most successful research traditions deliver the best problem solving (Laudan, 1977, p. 130), then the Standard Model has a mixed track record. Laudan’s (1977, p. 17) ‘anomalous problems’, or empirical problems that a theory has yet to reconcile, has relevance here because although the framework raises as many questions as it answers, it still solves more problem than before its arrival. On my assessment, not only does the content of the Standard Model leave many unanswered questions including the essential details of modules, but it also has yet to systematically study numerous common features of religious systems. Barrett (2011, p. 232) named religious architecture and art, divination, meditation, pilgrimage, prayer, prophecy, sacrifice, scripture interpretation and use, and worship as examples. There remains the danger that cognitive accounts of religion discount important cultural variables. Like Machamer’s (2009, p. 358) assessment of philosophy of science’s role in religion, I note that neither humans nor human brains are closed, isolated systems.

I have expressed my concerns in the previous chapter that Standard Model advocates operate with tacit neo-Lakatosian assumptions about progress. Problems are solved by modifying the peripheral elements in the protective belt with less inclination to question middle-level theories or return to first premises and the core. By implication of embracing a core and protective belt, the Standard Model meets Lakatos’ progressivity criterion because it successfully generates novel predictions and resolves anomalies. However, the Standard Model tends only to deal with anomalies that emerge when following its own basic propositions. It does not attempt to resolve anomalies emerging from other research disciplines and argumentation formats.

The Standard Model presents an enlightening case in the history and philosophy of science because it reveals how an emerging explanatory framework stimulates new hypotheses, predictions and empirical activity on the path to credibility as a robust research program. In
In this respect, its application of a soft, principles-based core emphasises the positive heuristic as well as empirical discovery.

The Standard Model also offers a contemporary case illustrating the difficulties of determining progress in a multi-disciplinary domain. In particular, the case highlights some deficiencies in philosophical accounts of progress. For example, Kitcher’s (1993) ‘practical progress’ is achieved in the form of the scientific instrumentation and methods cognitive scientists have devised for studying religious cognition. Nevertheless, this would seem a narrow view of progress, and Kitcher was probably on the right track to focus on conceptual and explanatory progress. ‘Conceptual progress’ comes with revision to the properties and relations of physical systems. Boundaries are adjusted in order to provide more adequate specifications of phenomenon (Kitcher, 1993, p. 96). ‘Explanatory progress’ involves improvement in patterns of explanation. As I argued through my review of Thagard’s criteria, Kitcher’s explanatory progress is satisfied despite gaps and anomalies. A summary of all the approaches to progress I have highlighted measured against the Standard Model’s performance is located in Appendix B. My consistent assertion has been that most offer superficial accounts that do not accommodate the multi-disciplinary nature of cognitive science.

Perhaps the simplest contemporary view of scientific progress was proposed by Bird (2007, p. 64) who claimed that science makes progress when it shows the accumulation of knowledge. An episode in science becomes progressive when it displays more knowledge at the end than it did at the beginning. On this simple epistemological measure, progress can be seen in the case of the Standard Model.

Another interpretation relevant here views scientific progress as an evaluative criterion used for assessing the success or momentum of a research area. From this perspective, progress can be noted when a research area coheres, taking the form of ‘paradigms’ (Kuhn 1962), ‘research programs’ (Lakatos 1970), ‘research traditions’ (Laudan 1977), or ‘themes of science’ (Holton 1988). For example, Lakatos (1970 p. 133) argued that a progressive research program contains a ‘hard core’, constituting its almost inviolable theoretical principles. In contrast, the Standard Model employs a looser set of principles assisting ‘paradigmatic grafting’ (Stepin 2005, p. xiii) from one discipline to another, more like those specified by Hardcastle (1996, pp. 138-139). Hardcastle’s principles help expose progress in the Standard
Model because her thinking has been formed around cognitive problems where assumptions operate best as flexible principles. For this reason, I argue that progress in nascent research programs can benefit from a ‘soft core’ concept employing general but fluid principles or propositions.

As I noted earlier, while the lessons of any given case in science are too often, like any non-representative data, incautiously generalised, this case suggests that the concepts around progress are out-dated. For example, Hempel (1962) accepted that theories and laws cannot be conclusively verified, but asserted that they can be more or less probable on the basis of evidence. He noted inductive confirmation by the available evidence in terms of quantity and variety, simplicity, and support from other theories, as relevant factors to determining probability. I showed in chapter 8 on neurological plausibility and in chapter 10 on evolutionary power, that the Standard Model shows moderate consistency with accepted theories from other disciplines. At the same time, in chapter 11, I express some optimism that the Standard Model shows signs of making connections between numerous levels.

We also confront the ongoing challenge of describing the predictive value of theories and frameworks. Huber (2008) claimed good theories to be informative along the lines of Popper (1968, p. 399) where a highly informative theory is unlikely to be accompanied by a high probability of accuracy, because a probable hypotheses is not particularly revealing.

A surplus in informativeness becomes advantageous where its implications for plausibility are sufficiently modest, a condition Huber (2008, p. 6) described as continuity. Predictive novelty has relevance to corroboration, but probability and informativeness are not casually linked for any given theory. While it might be true to say in simple terms that a more detailed theory with empirical corroboration is more robust than a less detailed theory with empirical corroboration, there is no causal reason to conclude that either theory performs with greater or lesser accuracy.

Informativeness offers a good platform to make choices between competing theories, but a lack of informativeness is not a good platform for concluding that a theory is flawed. I have concluded that the theoretical premises driving the Standard Model are plausible, but lack informativeness. However, when considered as an explanatory framework, the Standard Model fares a little better as it has provided a helpful set of propositions to guide the
collection of a coherent body of data. My concern is that the absence of informativeness is a reflection of under-supported assumptions. For example, I have mused that the actual mechanisms of cognition are unrelated to domain-specific modularity, but also lead to similar patterns of religious thought and practice. In addition, one of the issues I have confronted with predictive novelty is whether the theoretical premises within the Standard Model were designed to accommodate already well-known phenomena. If, all other things being equal, explanations for novel predictions possess greater power than explanations for already known phenomena, then the Standard Model has not produced as many stunning or radical predictions as Lakatos or Mayo would have demanded.

Despite reservations, I have argued that the Standard Model makes a definitive contribution to understanding religious cognition. I view the framework as progressive because it has fostered a coherent approach to data collection, although the resulting data are not all consistent with the Standard Model’s propositions. In fact, these data will likely challenge some of the assumptions inherent in the Standard Model. Progress must inescapably be concerned with satisfying empirical observations, so if the Standard Model has stimulated empirical work that reveals some new possibilities, then the Model has been progressive. I also see this progress in light of Hintikka’s (1999, p. 206) idea that the utility of information is measured by its ability to eliminate uncertainty. The more possibilities that a theoretical statement excludes, the more informative it is. Perhaps also, a coherentist interpretation might lead to a stronger endorsement of the Standard Model. For example, according to Olsen (2002), statements cohere or ‘hang together’ if they are true together or false together; the more coherent statements appear, the more likely they are true together (Shogenji 1999, p. 338). The Standard Model has generated a coherent account of religious cognition that hangs together well by virtue of its explanatory framework.

A tension exists between the need for an organising framework and the excessive rigidity of a dominating argumentation format. The computational-representational (Thagard 2005a) view of cognition incorporating strong domain-specific devices remains incomplete. Any imperfections inherent in such background assumptions transfer to research conducted in religious cognition. While advocates of the Standard Model produce evidence for its confirmation, other pockets of research in disciplines such as anthropology and neuroscience, suggest alternative interpretations of cognition. On the other hand, the Standard Model’s assumptions provide a productive architecture around which theoretical and empirical
connections can be scaffolded. The Standard Model has not forged a true Lakatosian hard core, largely unassailable and thoroughly tested. But it has generated a ‘soft’ core set of heuristics. Soft cores help direct the accumulation of empirical observations, even when the underpinning assumptions guiding research remain controversial or uncertain. As a result, the soft core guides the rules of a research program’s ‘Bayesian algorithm’; the way it incorporates additional evidence to improve the probability of correct predictions. I suggest that the subjective probability is presently modest, by which I mean that I am not confident the predictions are all correct. However, a soft core does offer a conditional mechanism so that new evidence can be used to help confirm or disconfirm predictions. Some connections might also be observed with Bechtel and McCauley’s (1999) version of the Heuristic Identity Theory, which stipulates that psychoneural identities are not the conclusions of scientific research but the hypothetical premises. For example, the differences between theories at different analytical levels should encourage adjustments to concepts in each level, which in turn generates new, fine-tuned interpretations.

Another obstacle for the Standard Model as an emerging research program lies in revealing novel connections between theories and observations arising from different analytical levels. This case shows the need for measures of scientific and theoretical progress that account for observations at different analytical strata. Where science operates in the gaps between well-defined domains and disciplines, the ability to specify novel inter-level relations reflects a powerful account of progress. I agree with Machamer’s (2009, p. 356) suspicion of eliminative reduction; whatever cognitive mechanisms involved in religious behaviour are multi-levelled and simultaneous.

**Summarising a Contribution**

Not only is progress in this case messy, but its messiness is conducive to the identification of new inter-connections. The case suggests that progress in an inter-disciplinary area can be achieved without a unifying or reducing model, and may even be best seen through a messy set of relations that facilitate the development of novel predictions and the specification of inter-level connections.

I argue that the lessons from the Standard Model case underscore the importance of a working, explanatory framework in the form of a principles-based, neo-Lakatosian ‘soft’ core
facilitating unforeseen connections between theories and observations arising from different analytical strata. Specifically:

1. The Standard Model represents a progressive explanatory framework for accumulating empirical content about religious cognition. The framework plays a pivotal role because it systematically makes predictions through propositions and hypotheses that can be tested, and that if corroborated by empirical evidence, solve problems about religious cognition. This case suggests that progressive research programs are driven by frameworks with pliable assumptions and principles at the core which are used as heuristics to guide predictions and propositions for testing.

2. A research program driven by a progressive framework can contain under-substantiated assumptions as part of the heuristic principles or soft core, and still produce useful empirical content. In fact, fluid cores might be more advantageous than hard cores because they encourage correspondence between theory and empirical content. Heuristic-based soft cores are not unassailable and usefully accommodate inter-level relations for this very reason.

3. Progress around an inter-disciplinary program focusing on a common problem such as religious cognition needs to be assessed in light of performance in establishing inter-level relations. In fact, inter-connections between analytical levels provide markers of progress when replacement theories and programs at the same analytical level are unavailable. That is, progress measures in this case are not about theory replacement but about inter-theoretical connections.

4. A progressive framework exposes previously unconnected propositions or theories from different analytical levels. The case illustrates how progress can come about through unforeseen connections as well as through predictions. Progressive frameworks make new and more numerous links.

5. I suggest that a progressive framework encourages the tensions that arise when inter-level connections become messy. Tension leads to sharper empirical questions. In other words, I contend that progress is better served by a framework that stimulates superior empirical
evidence, than one that creates a proliferation of new, speculative theories described through contrived bridges.

My analysis had led to broader but indicative and distinguishing markers of progress as it applies to the case of the Standard Model.

First, the measurement of theoretical progress is most easily housed within an ‘emerging’ research program—what I have termed an explanatory framework—such as in the form of a set of principles as specified by Hardcastle. Frameworks are advantageous because they offer an architecture around which theoretical possibilities can be constructed. Such architecture is especially salient to accounts of cognition, which demand the acknowledgement of multiple methods and ostensibly unconnected empirical observations. I favour Hardcastle’s principles. She allows for greater flexibility reflecting an expectation that principles are not unassailable and are best employed as heuristics. For this reason, I argue for a ‘soft core’ that operates as a set of guidelines and accedes to the imperative for them to be challenged by research programs that lie outside the traditional domain of inquiry. Unlike Hardcastle who emphasises theory development, I have argued that superior emerging frameworks stimulate new empirical work around key problems and inter-level intersections. In the case of emerging explanatory frameworks, I prioritise data over theory.

Second, my case analysis of the Standard Model argues for accepting the tensions between the productivity of an organising framework and risks of propagating inaccuracies. Progress in this case is perhaps ironically served well by pursuing an imperfect emerging program. While strident advocates of the Standard Model produce evidence for its confirmation, other streams of research offer evidence about religious cognition that could undermine the Standard Model. I do not think, however, that this work would have been pursued in the first instance without the Standard Model’s substantive framework. In this respect, I do not believe that the Standard Model has forged a true Lakatosian hard core. It is more of a ‘soft’ core; operating as a set of heuristics, but still supple and susceptible to change. I have therefore concluded that discarding the Standard Model would be premature, flawed though I have argued it presently is. As a result, this case underpins the importance of a soft core serving as a guide to the specification of novel predictions and directing the accumulation of empirical observations.
Third, progress in the cognitive science of religion is expressly contingent upon developments in theories of general cognition. The corollary is that the two proceed in tandem where the soft core of the Standard Model includes propositions directly acquired from the hard core of cognitive science. I have repeatedly highlighted the limitations and dangers of this allegiance. Having conceded this problem, I return to the practical advantages for investigators interested in religious cognition to proceed with some form of soft core as guidance. My conclusion is that the practical deployment of science may include, or even necessitate, the conscious acceptance of theoretical uncertainty or imperfections. For example, I argued that the Standard Model explains the presence of strong forms of belief in general better than it explains religious belief in particular.

Finally, I reinforce the importance of frameworks or soft cores that suggest novel inter-level connections in cognition. The Standard Model must contend with the problem of inter-level relations and its ability to provide a framework for novel connections between theories and observations arising from different analytical levels that have hitherto remained unidentified or poorly understood. I argue that one of the key lessons for the assessment of progress from this case is the need for measures that account for theoretical and empirical developments between analytical strata. In an era where science increasingly operates in the gaps between well-defined domains and disciplines, I propose that the specification of inter-level relations presents a pivotal issue in contemporary accounts of progress.

Final Comments

The Standard Model defends the position that the mind’s cognitive apparatus lends itself to the formation, maintenance and transmission of religious concepts and beliefs. Religious beliefs enjoy an advantage being easy to acquire, maintain and pass on. In contrast, the Standard Model claims that the manner in which the host mind processes information determines its acquisition, transmission and expression. I would summarise the Standard Model view as follows: Religious belief is the natural expression of the innate cognitive capacities common to all human minds deployed through methods of practice and doctrinal repetition refined to work optimally on emotion and memory.

The Standard Model is founded upon a range of assumptions that remain contentious in the broader scientific arena. These controversial assumptions return to some of the most basic notions of cognitive science, including the role of evolution and selection, the process of
adaptation, the presence of domain specificity, cognitive canalisation, and structure-function relations in the brain. Atran (2002b) concluded that religion is not an evolutionary adaptation but rather is a constantly re-emerging cultural path through which individuals navigate the evolutionary landscape that gives rise to cognitive, emotional and material conditions for ordinary human interactions. I agree with Atran’s position, but have misgivings about some of the assumptions underpinning the Standard Model. To put it another way, I think that the Standard Model has yielded some useful predictions and subsequent data, but I am concerned that the assumptions will not hold up to fine-grained analysis or correspond to data emerging from other levels of analysis. Like all arguments favouring the evolution of modular capacities, substantiation is problematic.

I have argued that religious concepts and beliefs are not an exclusive consequence of the cognitive apparatus that host them. I have presented evidence suggesting a relationship between culturally prolific activities and cognitive capacities. I accept some convergence pressures upon cultural activities, but think that the pressures lead towards more generic tendencies such as the ability to hold belief sets, rather than the predisposition to hold specifically religious belief sets. Religion is not a unique domain but an extension of the general domain of social relationships between agents. The human mind is exceedingly adept at learning; we can change our minds, discard things we have learned in the past, and choose to become or remain an atheist.

My account also prioritises several features of religious concepts and practice I consider pivotal. First, religion demands behavioural practice via rituals that signal belief, stimulating emotional connections and setting up cognitive dissonance until the beliefs are embraced. This process allows practitioners to partition their counterintuitive beliefs from rational interrogation. With these cognitive firewalls in place, counterintuitive concepts undergo cognitive rehearsal until the beliefs become engrained. Counterintuitive beliefs enhance meaning making because they demand a cognitive commitment and elicit reflective thought. In other words, counterintuitive beliefs demand cognitive and emotional resources, which represent a sunk cost. They require a constant cognitive engagement, leading to cogitation, repetition, indoctrination, and emotion response.

Religious practitioners rehearse their belief set through doctrine and emotive rituals. Religious cognition might be easy to hold in the mind, but it is too ambitious to claim religion as
‘natural’. While I favour the cognitive by-product position on the religion-as-adaptation debate, we cannot dismiss a variety of interactions and alternatives. For example, a cognitive mechanism supporting religion could be a by-product and still be exapted by natural selection. Equally, the same mechanisms could help some groups find solutions to problems around cooperation and defection, conferring advantages over generations. Belief in Gods could be a spandrel, but as long as some mechanism ensures that it is heritable with behavioural consequences, then natural selection can act upon phenotypic variation to favour the success of believing individuals and groups. I also accept that under certain circumstances, religious concepts can be transmitted via cultural replication, propelled by hyperactive cognitive mechanisms attuned to learning. In the end, the only explanation I feel confident to discard involves a God part of the brain, exclusively dedicated to religious thinking. At the same time, the Standard Model needs to better accommodate data from other analytical levels. In particular, it should focus on epigenetic theorising, seeking to explain how extra-genetic, non-biological factors impact upon the expression of religious cognition. No doubt innumerable social, cultural and environmental variables sharpen and blunt the operations of indigenous cognitive mechanisms as they orchestrate religious thought.

Steven Pinker (2002, p. 242) wrote: “We are certain to die, and smart enough to know it. Our minds are adapted to a world that no longer exists, prone to misunderstandings correctable only by arduous education, and condemned to perplexity about the deepest questions we can entertain.” Cognitive scientists conclude that the belief in supernatural agents arrives through a set of cognitive adaptations that accompanied the selection process to solve other adaptive problems; a by-product of sophisticated pattern-matching brain activity that erroneously assigns higher agency to patterns in the white noise of life. I have argued that the patterns do not have to be religious in nature. I have also claimed that emerging research programs in multi-disciplinary pursuits such as cognitive science demonstrate progress when they reveal previously unforeseen connections between analytical levels.
References


“Meditation alters perceptual rivalry in Tibetan Buddhist monks”, Current Biology 15
(11):R412-R413.
York: Oxford University Press.
conservatives and liberals come hand-in-hand”, University of Chicago Working Paper
Series, 1-45.
Choi, I., R.E. Nisbett, and A. Norenzayan (1999), “Causal attribution across cultures:
Variation and universality”, Psychological Bulletin 125:47-63.
State University.
Churchland, P. (1979), Scientific Realism and the Plasticity of the Mind. Cambridge:
Cambridge University Press.
Churchland, P. (1995), The Engine of Reason; The Seat of the Soul: A Philosophical Journey
into the Brain. Cambridge, MA: MIT Press.
of Philosophy 78:67-90.
Cambridge, MA: MIT Press.
Press.
Press.
Colzato, L.S., I. van Beest, W.P. van den Wildenberg, C. Scorolli, S. Dorchin, N. Meiran,
A.M. Borghi and B. Hommel (2010), “God: Do I have your attention?”, Cognition
117(1):87-94.
variable analysis of working memory capacity, short-term memory capacity,
processing speed, and general fluid intelligence”, Intelligence 30 163-183.


Lane, R. (1992), Political culture: Residual category or general theory?” Comparative Political Studies 25(3):362-387.


The Nervous System
The nervous system is made up of specialised cells whose function is to receive sensory stimuli and transmit it to organs for action (Snell 1997). It is divided into two structural parts in order to better understand their respective functions: the central nervous system and the peripheral nervous system. Although the central nervous system comprising the brain and spinal cord is centrally located, and the peripheral nervous system comprising the somatic and autonomous division is located at the body’s periphery, the division between the two is somewhat arbitrary as the two systems work collaboratively. The nervous system has three specific functions (Mader 2005): 1) the sensory input via sensory receptors in the skin and organs which respond to external and internal stimuli by generating nerve impulses that are sent to the brain and spinal cord; 2) the integration of all the data collected by the brain and spinal cord; 3) the motor output from the brain and spinal cord to the muscles and glands throughout the body.

Nervous Tissue
The cells of the nervous system are complex and difficult to neatly summarise without compromising some precision. Nevertheless, most of the cells in the nervous system can be classified as either neurons—nerve cells that transmit nerve impulses—or neuroglia, the structures that support and sustain neurons (Mader 2005). The volume of neurons in the average human brain is at best an educated guess, perhaps around a hundred billion. But these neurons are not independent. Just as important is the number of connections between neurons which can be as many as ten thousand for each neuron. However, while neuronal interconnectivity is immense, it is not complete. This point is essential to arguments underpinning emergentism: “The balance between a fully interconnected system and a completely independent one is necessary for self-organization to occur. If the system were fully interconnected, additional neural communication would be severely limited” (Kahn 2005, p. 139).

Although neurons come in many shapes and functions, all have three parts: a cell body or soma, dendrites and an axon. A cell body contains a nucleus and other organelles. It is responsible for producing the neuron’s enzymes, structural proteins, membrane components and some chemical messengers (Nolte 1999). Dendrites are tentacle-like extensions that
receive signals from sensory receptors or other neurons. Signals are carried from the dendrites to other nerve cells via a length of axon, the nervous system’s equivalent to a telephone cable. Long axons are considered nerve fibres and are covered by a white myelin sheath made of membranes of tightly wound neuroglia. These myelin sheaths are important to the way information is transmitted down a nerve fibre (Young and Young 1997).

Classified according to their function and shape, neurons are typically divided into four groups roughly corresponding to their connections (Nolte 1999). The first, motor neurons, transmit nerve impulses from the central nervous system (CNS) to muscles and glands. They are the delivery system of the CNS. The second kind, sensory neurons, perform the reverse function by sending information to the CNS. The third kind, interneurons, perform an association role within the CNS. Interneurons are multipolar, which means that they are capable of transmitting information in both directions. This is important within the brain and spinal cord where the complex pathways are needed to move messages from one side to another, such as in the neuronal activity involved in thinking, memory and language (Mader 2005). The fourth kind, projection neurons with long axons, is involved in communicating information between different parts of the brain or spinal cord. In a broader sense, the term afferent neurones is used to describe nerve cells that carry information from the peripheral receptors to the CNS, while the term efferent refers to those neurons which carry impulses away from the CNS (Crossman and Neary 1995).

**Neuronal Function**

Axons, or the part of the nerve cell that transmits information, can either be in an active or resting state. When resting, axons transmit nothing, but when active they are engaged in what are called action potentials. Transmission is dependent upon the chemical polarity of the axon. During a resting potential, a nerve’s membrane is polarised; the outside is positive and the inside is negative. In chemical terms, when an action potential is stimulated, there is a corresponding change in polarity known as depolarisation (FitzGerald and Folan-Curran 2002). It is this process that channels information along a neuron, the speed of conductivity is affected significantly by the presence of myelin sheaths along the axon. In an unmyelinated axon the action potential travels about 1.0m/sec whereas myelinated axons transmit an action potential around 100m/sec (Mader 2005). Because of the nature of chemical transmission, an action potential is an all or nothing event. A message’s strength is determined by the number of nerve impulses generated during a given period. Electrical signals are therefore used to
convey signals rapidly from one part of the neuron to another, where chemical transmission is employed to carry signals between neurons (Nolte 1999). Mader wrote: “It is interesting to observe that all functions of the nervous system, from our deepest emotions to our highest reasoning abilities, are dependent on the conduction of nerve impulses” (2005, p. 143).

To summarise so far, information is received by a neuronal dendrite, integrated by the cell body, conveyed down the axon and finally passed on to another neuron via a synapse, the junction between two neurons which facilitates the transmission of a signal from one to the other. There are numerous synaptic configurations depending on the neuronal connection and signal direction. Each reflect different structural types including axon to axon, axon to dendrite, axon to cell body, dendrite to dendrite and axon to muscle fibre (Nolte 1999). Most synaptic junctions are chemical synapses wherein a chemical known as a neurotransmitter diffuses information across the narrow space between two cells, or from the presynaptic to the postsynaptic membranes. The purpose of the transmitting cell—and the nature of the chemical process—determine whether the effect produced will be an excitation or inhibition of the receiver cell. In other words, the information transmitted can either be to stimulate action or prevent action. Much less common are electric synapses where the pre- and post-synapses are closely enough positioned to allow a low resistance electrical pathway to occur. There may be as few as several dozen synapses attached to a neuron or as many as hundreds of thousands, depending upon its size and extent of dendrites. Nolte (1999) observed that the total number of synapses in the human brain is unimaginably huge.

Chemical synapses are classified according to the type of chemical or neurotransmitter that is used to fulfil the transmission, and are stored in the synaptic vesicles located in the presynaptic ending (Crossman and Neary 1995). However, many synapses in the CNS employ more than one neurotransmitter with the effect that neurons will receive multiple chemical messages (Burt 1992). Nevertheless, the impact of each chemical message is determined by the receiving synapse, the postsynaptic receptor. According to Mader (2005) at least 25 different neurotransmitters have been identified. Five common categories which are referred to in research examined in this dissertation are: 1) Acetylcholine; 2) Monoamines (noradrenaline, adrenaline, dopamine, serotonin); 3) Glycine; 4) GABA; and 5) Glutamic acid. In addition, two natural brain peptide neurotransmitters, endorphins and enkephalins have been associated with powerful inhibition effects (Afifi and Bergman 2005). This kind of
inhibition can prevent pain signals from reaching the brain, and have been measured, for example, in meditation studies.

Burt (1992) observed that at the molecular level the nervous system is flexible, subject to fine-tuning through chemical modulators. Chemical receptors are frequently modified toward greater or lesser sensitivity according to neuronal circumstances. For example, some peptide hormones act as modulators, mitigating the effects of neurotransmitters. Common modulators include oxytocin, vasopressin and cholecystokinin. A summary of nervous system organisation appears in Table Appendix 1.

Table Appendix 1. Nervous System Organisation Summary

| The basic structural and functional unit of the nervous system is the nerve cell or neuron |
| Neurons are broadly categorised according to their function; afferent neurons send information to the CNS whereas efferent neurons send information away from the CNS |
| Neurons are comprised of a cell body for metabolism, an axon for channelling a message, and dendrites for receiving messages from other neurons |
| Myelination along an axon greatly increases the speed of information transmission |
| Information passed between neurons is principally by chemicals at synapses by neurotransmitters |
| Neurotransmitters act on post-synaptic (receiving) terminals by instigating either polarisation or depolarisation, effectively stimulating them to do nothing or pass on the message |
| The effects of neurotransmitters are mitigated by neurochemical modulators |

Adapted from: Crossman and Neary (1995)

The Brain

Semi-solid and sometimes described as having the consistency of a hard-boiled egg, the brain is sufficiently malleable to conform to the shape of its container. Afifi and Bergman (2005) recorded that the average adult brain mass is approximately 1,400 grams, although the male brain is typically marginally heavier than the female brain. Given the vulnerability of its softness, the brain needs every bit of the protection afforded to it by the skull, three layers of connective tissue and membrane called meninges, and cerebrospinal fluid.

Crossman and Neary (1995), like many other authors of neuro-anatomical texts (Snell 1997; Young and Young 1997), described the basic organisation of the brain as comprising three ascending divisions from the spinal cord: the hindbrain, the midbrain, and the forebrain. The hindbrain can be sub-divided into the medulla oblongata, pons and cerebellum. The forebrain
may also be sub-divided into the diencephalon and the cerebrum. The midbrain is the narrow part of the brain that connects the forebrain to the hindbrain, and is included in the collective term, brainstem, encompassing the medulla oblongata and pons as well.

An external or topographical view of the brain shows that it is divided down its longitudinal centre into the two hemispheres of the cerebrum. If the brain is examined from the side, two additional landmarks can be discerned, sectioning the brain into four lobes. These lines are deeper than the characteristic folds made up of ridges or gyri, and grooves or sulci. The purpose of the folds is to increase total cortical area (Nolte 1999). Four prominent sulci along with several other visible features are used to divide the cerebral hemisphere into the frontal, temporal, parietal and occipital lobes (Watson 1991). All four are named after the bony skull plates that cover them and are common reference points for localising functional performance.

**Lobes and Localising Brain Function**

Regional specialisation has been a central theme in the study of the brain’s evolution (Crossman and Neary 1995). One conventional approach has been to localise brain functions within specific architectures of the lobes. Given that neuroscientific studies make heavy use of localisation hypotheses, it is relevant here to provide a rudimentary overview of lobe functionality.

All sensory information ultimately makes its way to the cerebral cortex, which is required for conscious awareness and thought, memory and intellect (Crossman and Neary 1995). The cerebral cortex is the motor processing unit of the brain, conceiving and directing all actions. Roughly, organisation and function proceeds as follows (Crossman and Neary 1995):

1. The posterior cerebrum receives sensory information from the outside world in the primary sensory areas of the parietal lobe, visual areas of the occipital lobe, and auditory area of the temporal lobe.
2. The information is elaborated by adjacent cortical zones in order to stimulate the identification and perception of objects. At this point the association areas of the cortex, at the junction of the three cerebral lobes, are critical to a spatial recognition of the environment.
3. The limbic system in the middle of the cerebral hemisphere enables the storage and retrieval of the information processed in the previous stage.
4. The front of the cerebrum—the frontal lobes—initiate movement and complex motor behaviour.

5. The association areas of the cortex in the frontal, parietal and temporal lobes of the left hemisphere comprehend and express language.

The specific roles of the lobes are identified next.

**Frontal Lobe**

The precentral gyrus, also known as the primary motor area or motor cortex is one of the most important cortical regions involved in movement. Its stimulation results in the movement of a single muscle or group of muscles in the contralateral (opposite) side of the body (Afifi and Bergman 2005). The lobe also contains the pre-motor cortex (Crossman and Neary 1995). Two further regions that have been associated with a specific function include Brodmann’s area and Broca’s area, the former important to eye movement and the latter for speech and language production (Afifi and Bergman 2005). Parts of the prefrontal cortex are also associated with motivation, problem-solving, judgment, emotions, behaviour and olfaction (Young and Young 1997).

**Temporal Lobe**

The temporal lobe houses the Gyri of Heschl, the brain’s primary auditory area or primary auditory cortex, which is responsible for the processing and storage of auditory information (Crossman and Neary 1995), as well as Wernicke’s area, which plays a central role in the comprehension of spoken language (Afifi and Bergman 2005). Some texts consider the limbic system including its hippocampus—a structure involved in memory and emotion—to be part of the temporal lobe, while others locate the limbic system within a fifth lobe of the same name.

**Parietal Lobe**

The parietal lobe’s postcentral gyrus, also known as the somatosensory cortex (Crossman and Neary 1995) is a primary sensory area important to general body sensation (Afifi and Bergman 2005). In addition, the superior parietal lobule is involved in determining an individual’s interaction with their surrounding space. The inferior portion of this lobule is associated with the integration of diverse sensory information for speech and perception (Afifi
and Bergman 2005). Part of the parietal lobe is also involved in taste (Young and Young 1997).

**Occipital Lobe**

The occipital lobe contains part of the primary visual area or primary visual cortex (Afifi and Bergman 2005; Crossman and Neary 1995). This area is central in vision and visual associations (Young and Young 1997). Table Appendix 2 summarises lobe location and macro functionality.

<table>
<thead>
<tr>
<th>Lobe</th>
<th>Location</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal Lobe</td>
<td>Primary motor area</td>
<td>Contralateral muscle control; motor cortex</td>
</tr>
<tr>
<td></td>
<td>Brodmann’s area</td>
<td>Eye movement</td>
</tr>
<tr>
<td></td>
<td>Broca’s area</td>
<td>Speech and language production</td>
</tr>
<tr>
<td></td>
<td>Prefrontal cortex</td>
<td>Motivation, problem-solving, judgement, emotions, behaviour, olfaction</td>
</tr>
<tr>
<td>Temporal Lobe</td>
<td>Gyri of Heschl</td>
<td>Primary auditory area; auditory cortex</td>
</tr>
<tr>
<td></td>
<td>Wernicke’s area</td>
<td>Comprehension of spoken language</td>
</tr>
<tr>
<td>Parietal Lobe</td>
<td>Postcentral gyrus</td>
<td>General body sensation; somatosensory cortex</td>
</tr>
<tr>
<td></td>
<td>Superior parietal lobule</td>
<td>Behavioural interaction with space</td>
</tr>
<tr>
<td></td>
<td>Inferior parietal lobule</td>
<td>Integration of sensory information for speech and perception</td>
</tr>
<tr>
<td>Occipital Lobe</td>
<td>Occipital Pole</td>
<td>Part of the primary visual area; visual cortex</td>
</tr>
</tbody>
</table>

**Specific Anatomic Structures and their Functionality**

Some additional anatomical structures are noteworthy in light of the studies highlighted in subsequent chapters. The most relevant of these structures can be found in the limbic system, deep within the temporal lobe of the cerebral cortex. Some anatomists record the limbic system as a lobe in its own right, plus a number of subcortical forebrain structures and portions of the brain that are functionally related (Bert 1993; Afifi and Bergman 2005). These interconnections between the system of subcortical neurons in the limbic lobe are important to memory and behaviour (Young and Young 1997).
Along with parts of the brain stem, the limbic system is amongst the oldest legacy of human ancestry; a fact some scholars consider of certain relevance to its role in spiritual experience. However, the limbic system is highly relevant in any study of religion not only because it is a commonality between contemporary humans and our evolutionary past, but also because it plays the key role in emotion and memory. The limbic system provides an emotional reaction to the information it receives from the five sensory channels, projecting this to the frontal lobes where the higher brain functions of conscious thought and goal-directed activity mitigate (Bert 1993). Emotional experience is therefore arbitrated between the primal surge of the limbic system and the tempered focus of the forebrain (Ramachandran and Blakeslee 1998).

The limbic system also contains the hippocampus and amygdala. The former is involved with recording memories, particularly those with strong emotional content. Pathology in or damage to the hippocampus has been associated with changes to spiritual and religious experience. The amygdala is believed to play a senior role in coordinating unconscious emotional states and its conscious expression. Noteworthy is the connection between the amygdala and the autonomic nervous system such as in the physiological responses to stressful or stimulating emotional experiences like fight/flight. Because the amygdala is linked to the prefrontal cortex, it also has a hand in the conscious experience of emotion. One consequence is that spiritual experiences can be simultaneously experienced and interpreted with assistance from the amygdala. Without reviewing any neuroscientific studies, it would probably be reasonable to predict that the limbic system and its constituents play some role in the neural correlates of spiritual experience. Some researchers like Persinger (2002; 1995; 2001) have claimed that spiritual experiences are an artefact of ephemeral temporal lobe change. Accordingly, spirituality has a causal connection to the limbic system. Other neuroscientists are less certain. Cognisant of the dispersed patterns of neural activation that accompany human experience, it might be best to begin without any assumptions about the limbic system. Atran (2002a) proposed that the vast subcortical connections between the prefrontal cortices, the temporal lobe, and the limbic system in general, explain the lack of localised neural substrate for extreme spiritual experiences. Indeed, no brain pathologies associated with extreme experiences including temporal lobe epilepsy, schizophrenia or autism supports the local theory, a matter that shall be taken up in later chapters.
In addition to the hippocampus and amygdala in the limbic system is the hypothalamus (Young and Young 1997), a brain structure of greater importance that its diminutive four gram size would predict. Situated at the junction of the thalamus and cerebral cortex, and with ascending fibres from the brain stem and spinal cord, the hypothalamus conveys information with weighty emotional significance, or what Barr and Kiernan (1988) described as ‘visceral’ in origin. The hypothalamus is a central player in producing responses to emotional changes and in regulating the body to maintain a constant internal environment or homeostasis. Table Appendix 3 presents an overview of the structure and function of the brain.
<table>
<thead>
<tr>
<th>Anatomical Structure</th>
<th>Description</th>
<th>General Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Cerebral Cortex</td>
<td>The white matter covering the outside of both brain hemispheres</td>
<td>Controls thinking, voluntary movements, language, reasoning, and perception</td>
</tr>
<tr>
<td>Corpus Collosum</td>
<td>Structure which connects the left and right hemispheres</td>
<td>Allows communication between the left and right hemispheres</td>
</tr>
<tr>
<td>Cerebellum</td>
<td>Cauliflower-shaped structure located in the lower part of the brain next to the occipital area and the brain stem</td>
<td>Controls your movement, balance, posture, and coordination. New research has also linked it to thinking, novelty, and emotions</td>
</tr>
<tr>
<td>Hypothalamus</td>
<td>The hypothalamus is part of the limbic system located in the internal portion of the brain under the thalamus.</td>
<td>Controls body temperature, emotions, hunger, thirst, appetite, digestion and sleep</td>
</tr>
<tr>
<td>Thalamus</td>
<td>The thalamus is part of the limbic system located in the centre portion of the brain</td>
<td>The thalamus controls your sensory integration and motor integration</td>
</tr>
<tr>
<td>Pituitary Gland</td>
<td>The pituitary gland is part of the limbic system although it hangs below the rest of the limbic system</td>
<td>Controls hormones for growth and helps regulate energy conversion</td>
</tr>
<tr>
<td>Pineal Gland</td>
<td>The pineal gland is part of the limbic system located in the internal portion of the brain</td>
<td>Controls growth and maturation</td>
</tr>
<tr>
<td>Amygdala</td>
<td>The almond shaped amygdala is part of the limbic system located in the internal portion of the brain</td>
<td>Controls emotions</td>
</tr>
<tr>
<td>Hippocampus</td>
<td>The crescent shaped hippocampus is found deep in the temporal lobe, in the front of the limbic system</td>
<td>Helps with the formation and storage of memories. May also be involved in learning</td>
</tr>
<tr>
<td>Brain Stem</td>
<td>The lower part of the brain that connects to the spinal cord</td>
<td>Associated with breathing, digestion, heart rate, blood pressure, as well as general arousal.</td>
</tr>
<tr>
<td>Mid-brain</td>
<td>The mid-brain is located in the middle of the brain behind the frontal lobes</td>
<td>Controls breathing and reflexes</td>
</tr>
</tbody>
</table>

The previous table summarised functions on the basis of structural location. The reverse in Table Appendix 4 can also be useful in helping to understand the location of functions.
Table Appendix 4. Summary of Localisation of Brain Function

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor</td>
<td>Control of voluntary movement</td>
<td>The back edge of the frontal lobes</td>
</tr>
<tr>
<td>Somatosensory</td>
<td>Bodily sensations, including heat, cold, pain, pressure, and body position</td>
<td>The front edge of the parietal lobes</td>
</tr>
<tr>
<td>Vision</td>
<td>Seeing</td>
<td>Occipital lobe</td>
</tr>
<tr>
<td>Auditory</td>
<td>Hearing</td>
<td>Top part of the temporal lobe</td>
</tr>
<tr>
<td>Speech production</td>
<td>Making sounds</td>
<td>Broca’s area in the frontal lobe in the left hemisphere</td>
</tr>
<tr>
<td>Speech planning and comprehension</td>
<td>Ability to plan and understand speech</td>
<td>Wernicke’s area at the junction of the parietal, temporal, and occipital lobes in the left hemisphere</td>
</tr>
<tr>
<td>Biologically-based motives</td>
<td>Basic biological needs, such as hunger and thirst</td>
<td>Hypothalamus, located at the bottom of the brainstem, near where the brainstem meets the cerebrum</td>
</tr>
<tr>
<td>Limbic functions</td>
<td>Emotions</td>
<td>Limbic system consisting of a group of brain areas located near the corpus callosum and extending into the temporal lobes</td>
</tr>
</tbody>
</table>

By way of structural summary, the cerebral cortex and its four lobes—frontal, parietal, temporal and occipital—envelop the deeper structures of the brain including the limbic system, which comprises the thalamus, hippocampus, amygdala and hypothalamus. In fact, the limbic system was probably the first cortex, its importance now marginalised by newer evolutionary additions (MacLean 1990). Carlson (2001) succinctly captured the principal functions of the limbic structures in noting that the thalamus is a relay station between the sensory systems and the cerebral cortex, the hippocampus helps to convert information into long-term memories, and the amygdala integrates emotional components. However, the current trend in neuroscience, and in particular cognitive neuroscience, is to focus on neural systems rather than neural structures (Gazzaniga, Ivry, and Mangun 2002).

Methodological Approaches
There are at least five conventional approaches to the investigation of cognition (Eysenck and Keane 2000). First, errors can be observed during cognitive tasks. Second, these cognitive tasks can be measured for various aspects of performance and linked to other physiological data. Third, cognitive performance can be assessed in subjects with known cognitive impairments and compared to the performance of normal subjects. Fourth, cognitive processes
may be modelled and tested. Fifth, neuro-imaging techniques and other direct measures of brain activity can be employed in order to understand the structure-function relationship between the brain and cognition.

Neuropsychology and Brain Lesions

A brain lesion is the site of tissue damage typically caused by strokes, tumours or direct injury. Matlin (2005) noted that the study of brain lesions has accelerated an understanding of the structure and function of the brain as a consequence of studying cognitive deficits that can be traced to specific brain pathology or damage. However, it has proven difficult to form a direct link between a specific location of damage and a specific cognitive deficit, as most pathology or damage to the brain is not conveniently focal nor does it typically produce a single or uniformly manifesting cognitive limitation (Gazzaniga, Ivry, and Mangun 2002). In fact, most brain injury is diffuse, and sometimes cannot even be detected by diagnostic instruments. There is also the additional problem of assessing the extent of a cognitive deficit without detailed information about how an individual was functioning prior to the pathology or damage. Furthermore, since cognitive functions are aggregated they are difficult to compartmentalise for study. For example, almost all cognitive tasks require memory. The only way of examining cognitive functionality is through behavioural testing, but it is impossible to develop behavioural tests that eliminate all but one cognitive function.

Patients exhibiting an obvious cognitive deficit provide suggestive clues to the specific operation that has been damaged. Thus, neuropsychologists believe they can lead a great deal from patients who are normal but for one specific cognitive capacity (Wright and Bechtel 2006).

Lesion research is subject to several epistemic challenges (Bechtel 2006). One central problem lies in the precise assessment of where the brain is injured. Lesion studies can also been undertaken in more precise conditions with animals which have undergone surgical procedures to damage parts of their brains. Assessing the cognitive deficits of animals is, of course, rife with constraints and challenges. Localising the affected brain region can be improved with the use of neuroimaging, but since the brain does not have clearly delineated boundaries, the results can remain ambiguous and macro. In animals, the problem of localisation can be offset by using chemical methods for creating the lesions, some of them reversible.
Bechtel argued that the biggest challenge in lesion and deficit analyses lies in the assessment of what job the damaged part of the brain performed. Analyses can be thwarted if the part is a contributor to a function that continues despite its removal or damage. Moreover, the brain has systems of redundancy and reorganisation; the system may continue to function through another channel or process, obfuscating the role of the damaged component. There is also a troublesome shift needed from the activity of the system after the removal of the component in question and the specific role of the component in that system. Bechtel employed the analogy of a mechanical system like a radio. Removing one part after the other hoping to isolate the role that it plays can lead to some faulty suppositions. For example, there are many components in radios that if disabled will render the radio inoperable. The fact that the radio no longer works after their removal does not necessarily say a great deal about what role they played in the normal functioning of the radio. To appropriate Bechtel’s example, the removal of a transistor may cause the radio to hum, but it would be specious reasoning to conclude that the transistor is a hum suppressor.

Neuropsychologists use what is known as dissociations to get around this problem. The method involves an attempt to show that damage to a brain component will compromise one mental activity but not another where the difference in the mental activities may be traced to a single operation which may be considered the task performed by the dysfunctional component. Double dissociations are particularly meaningful. Here damage to one area incapacitates one cognitive activity but leaves the other in tact, and damage to another area incapacitates the other activity while sparing the first. In the end though, as Bechtel (2006) acknowledged, even if the operations associated with a cognitive process are well-conceived, it is far from given that the brain regions responsible can be inferred. Lesions may stimulate a brain to kick in redundancies or reorganise. Furthermore, they may generally confuse analysis by severing vital inputs or feedback mechanisms, or just cause functional problems for other areas because of serial pathways.

**Electrical Activity Recording (Electroencephalogram – EEG and Event Related Potential - ERP)**

There are two main approaches to recording the electrical activity of the brain. The first involves making recordings from electrodes place on the scalp that are sensitive to electrical currents. The currents can only be recorded in an aggregate form as they are produced mostly by the pyramidal cells aligned in columns in the cortex. When these cells are activated in
concert, ion flows create an electrical charge (Bechtel 2006) which can be observed in an electroencephalogram (EEG). Electroencephalography (EEG), used to measure electrical activity in the brain, has proven a valuable technique mainly because it is non-invasive with excellent temporal resolution, meaning that it can provide a direct measure of brain activity at any point in time. On the other hand, EEG is limited by its poor spatial resolution. It is impossible to localise a brain activity and may be occurring superficially or deep. EEG is also subject to a high degree of ‘noise’ where general brain electrical activity may obscure the novel features associated with a particular cognitive task or experience. However, EEG may have the most utility when it is linked to the presentation of a particular stimulus. Another common method is to sum the response over several trials in order to account for background noise. This creates a measure of evoked-response potential or event-related potential (ERP). ERP is especially advantageous for identifying the temporal pattern of neural processing or how attention affects the processing of information.

Given the temporal limitations of PET and fMRI, some researchers have turned their attention toward the event-related potential (ERP) technique which records minute fluctuations in the brain’s electrical activity when presented with a stimulus. ERP requires electrodes to be placed on a subject’s scalp. When neurons beneath the skull fire, the tell-tale electrical activity is recorded. Researchers typically use this technique to identify fleeting changes in neuronal activity over a brief period, such as that associated with a particular cognitive task (Gazzaniga, Ivry, and Mangun 2002; Matlin 2005). The strength of ERP lies in its ability to measure highly subtle electrical activity in the brain, making it a useful tool for identifying the comparative power of neuronal output associated with two sequential cognitive tasks that occur within a fraction of a second. The catch is that ERP can only specify diffuse neuronal activity; spatial origin is difficult to pin down. An ideal technique would be able to differentiate between the activities of individual neurons.

**Single-Cell Recording**

Bechtel (2006) specified three limitations associated with cell recording’s ability to explain the mechanisms responsible for certain cognitive operations. First, the technique relies on correlation. This means that it needs a sensory stimulus, motor response, or ongoing cognitive activity against which the neural activity can be correlated. Such correlations are most easily found in the sensory and motor areas, although the history of the technique suggests that it is not necessarily a straightforward process. Second, when it works, cell recording reveals what
kind of stimulus sends a cell into action, but it does not shed much light on the role that the cell plays in processing that information. Naturally, knowing the kind of stimulus that activates a cell can provide clues as to what operation needs to be performed for the cells that come later in the chain of events. Third, cell recording assumes that the electrical responses of cells are the correlates of psychological function. However, Bechtel indicated that there burgeoning evidence to suggest that psychological function correlates with a patterned distribution across many cells. In response, researchers are developing methods to obtain data from hundreds of cells simultaneously, although this in itself raises analytical problems. Ultimately single cell recording is seriously constrained anyway, as its use on human subjects precludes a direct understanding of the cognitive processes of humans. Studies of single cells offered enormous advantages but since the brain consists of multiple systems operating in concert, neuroscientists looked for more comprehensive, macro approaches to examining brain activity (Kandel and Squire 2001), like those derived from functional neuroimaging.

Neuroimaging

Neuroimaging provides data that correlate activity of the brain with the cognitive operations performed by a subject. Its obvious advantage lies in the non-invasive approach, although the actual performance of cognitive operations in a loud and unusual chamber raises some questions about the differences between cognition inside and outside the laboratory. The two most useful techniques for mapping function (rather than structure) are PET and fMRI. Both measure blood flow as a proxy for brain activity; a correlation that is intuitive as neural firing requires energy, and energy requires metabolism, which is provided in the form of oxygen via blood. Bechtel (2006) cautioned that one of the most significant mysteries of neuroimaging is that the mechanism behind blood flow is largely unknown.

The major epistemic issue associated with neuroimaging comes in the difficulty of isolated particular cognitive activities. Although it may be intuitive to suspect that increased blood flow denotes new cognitive processing, success in the technique is dependent upon establishing an accurate baseline measurement as blood flow is normal in a conscious brain. However, researchers circumvent the problem by using the subtractive method. Subjects are asked to perform two different cognitive tasks. When the tasks are compared, and the simple tasks removed from the more complex, the unique activation can be seen. However, it is possible that some of the cognitive processes associated with information coding and retrieval
may be concealed during subtractions. It is therefore difficult to be sure that the second task sufficiently differentiated from the focal task (Bechtel 2006).

**Computer Tomography (CT)**

This neuroimaging technique makes it possible to view x-rays of narrow slivers of the brain, the plane of analysis able to be determined by the operator. CT is far more precise than a conventional x-ray, which includes all tissue between the tube and the film. According to Brodal (2004), the technique can also visualise the distribution of a radioactive substance, allowing the examination of blood flow to different parts of the brain. In CT scans, brain X-rays are taken in a series of sections. Rather than a photosensitive plate, the X-ray hits a sensor connected to a computer (Greenfield 2000).

**Positron Emission Tomography (PET)**

X-rays will not reveal which parts of the brain are operational during a specified task. The way around this is to employ a PET scan.

Known mostly by its acronym, PET stands for positron emission tomography. It is a neuroimaging technique that highlights metabolic processes in the brain. The technique is designed to observe brain activity during points in time normally corresponding to specific cognitive activity. In broad terms, PET works through the injection of a harmless radioactive isotope into a subject’s bloodstream. The location of the subsequent radioactive markers is then correlated to brain region activity.

PET developed as a nuclear medicine technique that was based on the unique properties of radioactive atoms which decay by the release of positively charged particles called positrons. In practice, radioactive atoms with short half-lives (decay rates) that are common to the body’s normal functioning such as oxygen, nitrogen and carbon, are incorporated into safe compounds like glucose, and injected into the bloodstream. Images are generated as a consequence of the interaction between a positron and electron within the brain. This is achieved using opposing radiation detectors which are arranged in a circular apparatus configuration. The resulting neuro-images present a representation of the spatial distribution of radioactivity in specific planes of analysis in the brain.
Drawing heavily on the descriptions of Stufflebeam and Bechtel (1997), PET procedures may be summarised as follows:

1. The subject is given precise instructions concerning the task they are to perform.
2. The subject’s head is inserted into the scanner aperture and immobilised.
3. An intravenous tube is inserted into the subject’s arm.
4. A radioactive isotope that has been incorporated into a saline solution is administered through the intravenous tube.
5. Subjects are instructed to perform a specific cognitive task and a scan is taken which lasts for around 40 seconds followed by a 20 minute interval to allow the isotope to dissipate.
6. Step 4-5 are repeated for up to 10 scans.

PET scans can be used to investigate cognitive processes such as attention, memory and language. However, because PET scans need at least 30 seconds to produce an image, the method is imprecise and demands that subjects repeat simple cognitive tasks without distraction or interruption (Matlin 2005). If there are changes in brain activity during this period, then the PET scan will take an average.

Stufflebeam and Bechtel (1997) highlighted some significant interpretive and functional issues associated with PET. Despite the aesthetic appeal of the multi-coloured images it produces of the human brain they cautioned, it can be misleading to assume that the active areas are solely responsible for the cognitive behaviours under examination. Stufflebeam and Bechtel remind us that multicoloured PET images are several steps removed from the phenomenon being studied. Moreover, the production of PET images involves the possibility of artefacts, or inaccuracies, which can be amplified by incomplete assumptions. In their estimation, there are two epistemic aspects to how PET can be appraised. The first involves evaluating whether PET measures the brain activity associated with specific cognitive tasks, and the second addresses how PET results are interpreted in terms of psychological functions; the structure-function problem. Of these two, Stufflebeam and Bechtel viewed the second to be more epistemologically challenging. On the other hand, they argued that the case for establishing that PET measures neural activity is relatively unproblematic.
According to Stufflebeam and Bechtel, five contentions need to be examined in order to determine the epistemic veracity of PET. First is an assumption that has three parts: a) The performance of any task requires certain types of information processing; b) not all regions of the brain process all types of information; and c) discrete regions of the brain are involved in the performance of any given task. Although not universally accepted, these three escalating assumptions were rated as consistent with neuroscientific theories of localisation, in the view of Stufflebeam and Bechtel.

Second is a generalisation: The performance of any given task alters neuronal activity, which in turn alters local blood flow and metabolism. Stufflebeam and Bechtel considered this generalisation to be consistent what is understood about the functioning of neurons.

Third is a hypothesis: With the radio-labelled tracer in a subject’s blood, PET can directly measure changes in local blood flow or metabolism, and indirectly measure changes in neuronal activity. However, even with the tracer, PET does not measure blood flow. Rather, it measures positron annihilation and the subsequent gamma rays. In addition, the blood flow is a proxy for neuronal activity, so PET imagery may be considered twice removed from the actual target of investigation. Nevertheless, Stufflebeam and Bechtel viewed these proxies to be plausible.

Fourth is what Stufflebeam and Bechtel call an antecedent condition: Positron-emitting isotopes can be administered intravenously [or inhaled]. Given that this is true, Stufflebeam and Bechtel accepted this condition.

Fifth is another antecedent condition: The PET scanner detects gamma rays, which are a by-product of positron-emitting isotopes. Paired gamma ray detections are computed into the functional image. Some further explanation of PET physics is required in order to explore this condition adequately. Positron-emitting isotopes are manufactured in a cyclotron by accelerating protons into the nuclei of (say) oxygen, an additional proton in the nucleus tipping the stability of the isotope. In rectifying this stability problem, the proton reduces to a neutron and a positron; only the neutron remains with the nucleus, while the positron travels away a short distance until it collides with an electron. The positron and electron are subsequently annihilated in the process generating two gamma rays travelling in opposite directions. It is these gamma rays that are recorded by the scanner. However, the scanner only
registers a recording when two gamma rays are detected simultaneously, allowing the exact location of the emission to be identified and mapped. In summary, Stufflebeam and Bechtel concluded that an understanding of the above physics of PET scanners reveals that it does detect gamma rays, that gamma rays are a consequence of positron-emitting isotopes, and that the detections are represented by images. They therefore accept condition five and the general contention that PET measures neural activity.

Stufflebeam and Bechtel were less certain about the inferences that can be drawn from PET, in particular the relationship between brain structure and function. Their first concern was that increased blood flow to certain areas of the brain during specific cognitive tasks does not expose the function of that location. While task localisation is helpful in revealing the structure involved in cognitive activity, it is silent on explaining how the activity works. Stufflebeam and Bechtel pointed out that this would demand a disaggregation of the cognitive activity into sub-tasks accompanied by a localisation for each. Furthermore, the difficulty associated with localisation of cognitive functioning in the brain is exacerbated by the generally distributive nature of performance. Functional areas are not necessarily task areas.

Neuroscientists attempt to overcome the localisation of the brain’s distributive functioning through a process known as substraction. Generally speaking, PET subjects are scanned during numerous well-defined cognitive tasks. Assuming that each task differs in a small way, then each PET image should also be different. A comparison of any two images should reveal any unique local activity. The simplest way of going about this is to ensure that a subject performs a control task, the image from which can then be subtracted from the image of an active task. Thus the difference represents a correlation between location and function. Stufflebeam and Bechtel noted that a limitation of the subtraction method is the assumption that cognitive operations are additive, an assumption that may be presumptuous given the possibility of interactive processing in the brain. They also highlighted four additional potential limitations of PET in making attributions to cognitive functioning:

1. PET scans measure blood flow over an extended period of approximately 40 seconds, whereas some cognitive tasks require only milliseconds and will not be detected.
2. The subtraction method sometimes involves taking averages across all the subjects. This can increase the signal-to-noise ratio thereby creating an artificial outcome.
3. The duration of scanning required for the subtraction method to be viable severely constrains the complexity of tasks. As a result, most common cognitive tasks cannot be assessed.

4. Most PET studies utilise small samples from which functional results can be generalised.

Despite these limitations, PET remains a manifestly useful technique. Its boundary is reached, however, when it comes to the assessment of what exactly a specific part of the brain is doing. PET results therefore have to be considered in light of data from other methods and disciplines.

**Magnetic Resonance Imaging (MRI)**

Although known by its acronym, MRI refers to magnetic resonance imaging, another common neuro-imaging technique used to identify active brain structures during cognitive functions. The technique measures the amount of oxygenated blood flowing to different parts of the brain. It is assumed that oxygenated blood in a region is correlated with neural activity in that region because the technique depends on the different magnetic susceptibility of oxygenated versus de-oxygenated blood (FitzGerald and Folan-Curran 2002). In simple terms, protons emit signals when they are placed in a magnetic field. The benefit of this fact is derived from proton concentration in different tissue components which illustrate a greyscale contrast. For example, bone elicits virtually no signal and emerges as black in the signal, but changes in tissue can be noted easily, such as those associated with bleeding or tumour (Brodal 2004).

MRI is based on the behaviour of atomic nuclei when exposed to a combination of a magnetic field and radio waves. For example, the most common atomic nucleus imaged is hydrogen (one proton) because it is plentiful in the body and has high magnetic resonance sensitivity. Being positively charged, hydrogen is affected by magnetic fields. When radio waves are introduced at the same frequency as the hydrogen proton’s movement, its nuclei emit a resonating signal. Resonation creates excess energy, which subsequently needs to dissipate. Since different brain tissue requires different relaxation times, and these relaxation times affect the intensity of the signals created by protons, images of varying shades and compositions are developed. As a generalisation, dark MRI images tend to be associated with decreased activity and brain pathology, while brighter images tend to reflect fat, fluid or metabolic activity.
According to Matlin (2005), functional MRI (fMRI) is generally preferable to a PET scan as it is less invasive, not requiring radioactive injections. In addition, the fMRI can measure brain activity in around half a second, making it a far more precise method for pinpointing the activity associated with a specific cognitive function than PET. On the other hand, fMRI is not sufficiently precise to identify the exact sequence of brain events if a cognitive task is undertaken rapidly.

Kandel and Squire (2001) described fMRI as a technique based on the way in which neural activity changes local oxygen levels in tissue and that oxygenated and deoxygenated haemoglobin have different magnetic properties that can be measured. They specified that it is now possible to image in real time the course of the brain’s response to single stimuli or single events within a spatial resolution of millimetres.

**Single Photon Emission Computer Tomography (SPECT)**

SPECT images are generated by gamma cameras which record photons emitted by tracers in the brain. The strategy for the conduct of neuroimaging analyses revolves around the determination of reaction times for component cognitive operations (Wright and Bechtel 2006). Blood flow is recorded during the performance of one operation is subtracted from that recorded in a different task, revealing the common brain areas involved in both. The subtraction technique does, however, require an initial hypothesis about the component information-processing steps involved in the cognitive operation under investigation. In this way, according to Wright and Bechtel, neuroimaging serves to both localise functional operations to structural components as well as show where additional functional operations might be based.

Functional MRI focuses on changes in cerebral blood flow. The approach assumes legitimately that a brain activity that is activated during a specific task will also undergo a simultaneous increase in blood flow. There are exceptions to the concomitance of brain activity and blood flow, but they are associated with brain dysfunction through pathology or drugs. One advantage of this technique is an excellent spatial resolution that can be ‘co-registered’ with an anatomical MRI during the same session (Newberg 2005), ensuring accurate localisation. The technique also has good temporal resolution. In practice this means that if a subject were asked to perform a sequence of prayers in a row, they could each be differentiated and measured. A final advantage is that it does not use any radioactive
substances. To balance these advantages, Newberg pointed out that fMRI demands that subject are positioned within the restricted space of a scanner. To make matters worse for those subjects attempting to concentrate on meditation or prayer, the scanner itself can make up to 100 decibels of noise. Lazar et al. (2000) cleverly avoided this problem by having their subject practice meditation at home while listening to a recording of the fMRI scanner. Nevertheless, the noise can create unwelcome artefacts as the brain’s auditory cortex is compelled to fire.

Compared to fMRI, PET has good spatial resolution but SPECT is worse. Both can be co-registered with anatomical fMRI but this cannot be undertaken during the same session, making scan-matching troublesome. PET and SPECT need a radioactive tracer in order to work, although the dosage is safe. The great advantage of these techniques is the ability to measure neurotransmitter activity in addition to blood flow and metabolism. Some methods of PET and SPECT allow the radioactive substances to be injected before the subject is placed in the scanner. Because the radioactive marker remains in the brain during the injection period, subjects can perform their religious or spiritual exercises in relative comfort before being shoved in a noisy, claustrophobic scanner. The corresponding limitation is a poor temporal resolution.

The analysis of functional imaging studies is also subject to variable interpretation, the most significant problem being associated with the accurate matching of neurophysiology with subjective reports. As Newberg indicated, it is extremely difficult to pin down which of the scans correspond to which of the subjective accounts. It is also impractical to ask in the middle of the process. Nor are there any definitive benchmarks which specify the degree of change in the brain that may be considered indicative of a change brought about by the religious or spiritual exercise. Furthermore, the analysis of images is statistically problematic. For example, how might multiple images for each subject be consolidated? In what ways can subjects be compared? The conventional use of statistical parametric mapping (SPM) works through the normalisation of images, co-registration and pixel analysis. According to Newberg the method is conservative. As it utilises multiple comparisons it can fail to reveal subtle variations which might be clinically relevant, if not statistically significant.
Recent success in obtaining fMRI images from awake monkeys, combined with single-cell recording, should extend the utility of functional neuroimaging by permitting parallel studies in humans and nonhuman primates.
### APPENDIX B. Summary of Approaches to Progress and the Performance of the Standard Model

<table>
<thead>
<tr>
<th>Proponent</th>
<th>Emphasis</th>
<th>Standard Model Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abrahamsen; Bechtel; Cramer; Darden; Machamer</td>
<td>Cognitive phenomena are explained by identifying their specific <strong>mechanisms</strong> of operation. Contrary to deductive methods that derive behaviour from laws and theories, mechanistic approaches disaggregate phenomena into their constituent operations localised in parts.</td>
<td>This approach has great potential for the description of cognitive operations because it combines the explanatory power of disaggregation without the limitations of strict reductionism. This also means that analyses can move across levels. A mechanistic approach has not been employed on the Standard Model.</td>
</tr>
<tr>
<td>Bird</td>
<td>Progress is demonstrated by the accumulation of scientific knowledge; an episode in science is progressive when it displays more knowledge at the end than there was at the beginning.</td>
<td>Despite my suite of reservations, appeals to caution and general uncertainties, I conclude that on this simple measure, progress is being made in the cognitive understanding of religion through the Standard Model.</td>
</tr>
<tr>
<td>Carnap; Morris; Nagel; Neurath</td>
<td><strong>Logical positivism</strong> holds that propositions in science should objectively describe observable phenomena which can be summarised by a set of fundamental physical premises. Logical positivism is unitary in its outlook in that it assumes science progressively reduces all of reality to its most basic theoretical elements. In the end, progress will be revealed by fewer, unifying theories.</td>
<td>The Standard Model sets out a progressive framework for the definition and explanation of physical phenomena associated with religious cognition. However, there is no evidence that the Standard Model will head towards progress by unification accompanied by fewer theories.</td>
</tr>
<tr>
<td>Churchland</td>
<td>The early <strong>eliminative materialist</strong> position held that mental interpretations will be eliminated in favour of physical explanations. Psychological theories fall away in the face of superior neuroscientific approaches and will also be totally incommensurate with the new, prevailing physical theories.</td>
<td>No evidence of elimination of psychological theories, but the Standard Model is weak when it comes to fitting in with neuroscientific evidence. Although I do not predict elimination, I think it is likely that physical, neuroscientific theories will play a much more substantive role in the understanding of religious thought.</td>
</tr>
<tr>
<td>Darden and Maull</td>
<td><strong>Interfield theories</strong> are likely to be generated when two fields share the imperative of explaining the same phenomenon. Interfield theories explain how relations between theories can be explained. Progress may be seen where a common heuristic connected to one set of phenomena can stimulate hypotheses concerning another.</td>
<td>Progress can be demonstrated in the Standard Model when seen in terms of the generation of interfield theories. Equally, interfield theories are a useful analytical lens because they explain demonstrable occurrences of progress in the Standard Model where I noted instances when: • the interfield theory offers answers to questions posed in one field but cannot be answered by it without drawing on another field. • domain items that were not previously important become salient. • interfield theories predict new domain items for one or both fields.</td>
</tr>
<tr>
<td>De Jong</td>
<td><strong>Heuristic interlevel relations</strong> provide connections between concepts within two or more theories covering overlapping classes of phenomena. Progress is seen in pluralistic terms in the form of domain-specific, multi-level explanatory account, rather than a reductionistic one.</td>
<td>I have argued that treating interlevel relations as heuristics is particularly advantageous in scientific programs such as the Standard Model. On this approach, progress is evidenced through: • the interpretation of micro-level phenomena in terms of concepts consistent with a higher level theory, • specification of the composition of higher level theories in terms described by lower theories. I have shown in the Standard Model that the development of both higher and lower level theories are bolstered by heuristic interlevel relations, making them an extension of existing theories rather than a reduction.</td>
</tr>
<tr>
<td>Dennett</td>
<td><strong>Reductionism</strong> is acceptable, desirable and indicative of progress until it provides no further explanation of the original phenomena.</td>
<td>I have argued that the Standard Model shows interconnections rather than reductions. It is plausible that the mechanistic model might be applicable here to satisfy Dennett’s avoidance of greedy reductionism, but it is too early to say.</td>
</tr>
<tr>
<td>Dupre</td>
<td><strong>Disunity</strong> is the reality leading to the denial that science constitutes, or could</td>
<td>'The case of the Standard Model neither confirms nor undermines the disunity position. If anything,</td>
</tr>
<tr>
<td>Player</td>
<td>Statement</td>
<td>Interpretation</td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Feyerabend</td>
<td>All methodologies have their limitations and that the only rule that survives is ‘anything goes’. Progress is therefore unpredictable and cannot be forced through a contained framework.</td>
<td>While there is some evidence that a wide variety of fields associated with religious cognition are offering useful contributions, this is become achieved under the Standard Model’s framework. As a result, there are rules and ‘anything does not go’. I have also concluded that the Standard Model framework constitutes a progressive contribution on a number of accounts.</td>
</tr>
<tr>
<td>Fodor</td>
<td>Scientific consilience is horizontal in nature; the joining of threads of different scientific disciplines at a common explanatory level. For these inter-disciplinary connections, there is no need to invoke any form of reduction.</td>
<td>The Standard Model is a case study showing how interlevel connections can occur through a common explanatory level. There has been little evidence of reduction.</td>
</tr>
<tr>
<td>Grantham</td>
<td>Fields are unified to the extent that they are densely connected. The density of connections therefore becomes a proxy for theoretical progress to be measured.</td>
<td>In that the Standard Model reveals more connections—and particularly novel connections—it may be considered to progressively generate unity when measured as density.</td>
</tr>
<tr>
<td>Hacking</td>
<td>Contingency in science may be found in the framing of research questions, but once framed the answers or the contents of science are non-contingent.</td>
<td>To some extent social constructionism in the form of concepts overlaid upon other concepts occurs in the Standard Model and in religion in general. However, the Standard Model does not leave room for interpretations of cognition which are not consistent with the representational-computational approach.</td>
</tr>
<tr>
<td>Hardcastle</td>
<td>The pivotal issue in progress is the heuristic role of theoretical principles and the utility of explanatory extensions between promising, but unconnected theories.</td>
<td>I have noted the relevance of the heuristic approach to the Standard Model, which in a manner consistent with Hardcastle, has generated general principles and a set of loosely linked models that are able to operate over several levels</td>
</tr>
</tbody>
</table>
of description and analyses. As a result, the Standard Model operates to establish explanatory extensions that modify the understanding of starting theories but is not enough to warrant the theory’s replacement or of its reduction. The result is a “fairly messy set of connections”, as Hardcastle predicted.

<table>
<thead>
<tr>
<th>Source</th>
<th>Description</th>
</tr>
</thead>
</table>
| Harman; Thagard | Inductive inference is **inference to the best explanation**. It is appropriate to argue for a hypothesis or a theory on the basis that it is the best explanation of the evidence. Better explanations show more progress than inferior explanations. On the basis of Thagard’s criteria of inference to best explanation, my evaluation of the Standard Model reveals some degree of progressiveness in that:
- it shows consilience by explaining more about religious cognition than previous attempts (although I have not considered the Standard Model against other classes of theories about religion);
- it shows a degree of simplicity because it leads to empirical predictions from a definitive set of propositions (although I have suggested that these proposition are not all compelling);
- it shows a form of analogy in highlighting connections to other fields and theories. |
<p>| Hempel | Theories and laws cannot be conclusively verified, but can be more or less <strong>probable</strong> on the basis of evidence. Probability comes from available evidence in the form of quantity and variety, simplicity, and support from other theories. Greater probability is a proxy for progressivity. While these probability determinants are logical conditions for progress, they do not capture the complexity of multi-disciplinary theoretical models operating over numerous levels. The Standard Model operates across numerous fundamental assumptions and theoretical premises which all need independent examination. Such as approach requires a review of evidence in all aspects of the Standard Model’s predictions. I have reported on the results with help from Thagard’s organising structure with a generally positive but cautious conclusion. Probability is therefore moving in |</p>
<table>
<thead>
<tr>
<th>Author</th>
<th>Statement</th>
<th>Counterpart</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hintikka</td>
<td>The utility of information is measured by its ability to <strong>eliminate uncertainty</strong>. The more possibilities that a theoretical statement excludes the more informative it is. Progress accompanies greater informativeness.</td>
<td>While the Standard Model decreases some uncertainty through the application of its propositions, there is no case to make that it eliminates uncertainty. In fact, I claim that some of the propositions lead to greater uncertainty because they fail to account for some salient streams of evidence. Overall, however, I argue that the Standard Model improves informational content.</td>
</tr>
<tr>
<td>Holton</td>
<td>Progressive programs of research are demonstrated through clear <strong>themes of science</strong>. The accumulation of thematic ideas about a domain is revealed through its unique methodological approaches and expressed in categorical structures, principles and facts.</td>
<td>Although in a burgeoning phase, I propose that the Standard Model represents an emerging theme of science. I have also expressed some reservations about the ‘unique’ methodological approach the Standard Model encourages. I think its categorical structures, principles and facts are prematurely categorical.</td>
</tr>
<tr>
<td>Hooker</td>
<td>Scientific fields or a <strong>theoretical worldview</strong>, impose an influence upon the conditions of observation, instrumentation and interpretation. The primary business of a theory is to make assertions at the observational level and to provide in general terms the conditions, features and measureability of observations.</td>
<td>The Standard Model reveals some limitations accompanying its commitment to a specific theoretical worldview I have noted as the representational-computational approach to cognition. On the other hand, deploying this worldview has successfully introduced observational assertions of which some are robust while others remain uncertain.</td>
</tr>
<tr>
<td>Huber</td>
<td>Good theories are <strong>informative theories</strong> (along the lines of Popper) in that a highly informative theory is unlikely to be accompanied by a high probability of accuracy.</td>
<td>Predictive novelty is essential to corroboration, but I have noted for the Standard Model that probability and informativeness are not casually linked for any given proposition. I also argued that the Standard Model is informative but unconvincingly corroborated in parts. While it might be true to suggest that a more</td>
</tr>
<tr>
<td>Kincaid</td>
<td><strong>Unification is a matter of degree</strong> and two theories become more unified as they become more interdependent. More connections are better than fewer.</td>
<td>The strength of the Standard Model is its contribution to revealing interconnections between theories, particularly at different analytical levels.</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Kinoshita</td>
<td>Different fields which share the study of a single phenomenon may be considered members of a cluster. The <strong>identification of cluster relations</strong> is pivotal to progressive science.</td>
<td>The Standard Model excels from a cluster relations viewpoint as it emphasises the importance of connecting different approaches to religious cognition via a common framework.</td>
</tr>
<tr>
<td>Kitcher</td>
<td>Successful theories unify empirical content from different domains; progress is not only about expansion, but also <strong>synthesis and integration</strong>. Better theories are 1) unified, in that a single set of problem-solving strategies resolves a large set of problems, 2) fecund, in that it opens up new lines of inquiry and stimulates productivity, and 3) contains auxiliary hypotheses that can be tested independently of the problem it was devised to resolve. Scientific progress is achieved insofar as conceptual and explanatory progress is made. Practical progress comes through the design and use of scientific instrumentation. <strong>Conceptual progress</strong> is weighed carefully in light of Hardcastle’s version of explanatory extensions.</td>
<td>‘Practical progress’ is achieved in the form of the scientific instrumentation and methods cognitive scientists have devised for studying religious cognition, although this form of progress is far less robust than conceptual and explanatory progress. ‘Conceptual progress’ is present but limited as boundaries are adjusted in order to provide more adequate specifications of phenomenon. ‘Explanatory progress’ can be seen as it involves improvement in patterns of explanation, especially at multiple levels of analysis. My assessment of the Standard Model’s prospects for theoretical progress is weighed carefully in light of Hardcastle’s version of explanatory extensions.</td>
</tr>
</tbody>
</table>
acquired through the development and upgrading of categories that represent the contents and relations of physical systems. Explanatory progress is achieved with improved or alternative patterns of explanation.

Explanatory extensions work where one theory provides an addition to a second theory if it can derive some of the second theory’s premises. Abrahamsen described extensions in terms of ‘bridging boundaries’ instead of ‘breaking boundaries’.

| Kuhn | Normal scientific activity thrives under conditions where puzzles are tackled through an existing paradigm, at least until anomalous observations accumulate sufficiently to bring about a revolutionary change. The decisive factor determining the success of a new paradigm is its capacity to retain the puzzle-solving power of its predecessor while simultaneously solving as many outstanding anomalies as possible.  

Theoretical knowledge is marked by: 1) exactness of a theory (theory consequences must be in accord with experiments and observations); 2) consistency; 3) a broadening field of application (the consequences of theory must venture beyond the limits of the facts that the theory originally intended to explain; and 4) fruitfulness (the theory’s ability to uncover new events and correlations not previously anticipated). |
| From a Kuhnian perspective, the Standard Model is a problematic case. There is no absence of anomalous data but at present it is not presenting a challenge to the model’s key assumptions. There is little reason to expect a crisis, as the Standard Model’s advocates appear reasonably happy to continue operating within their own paradigm. In any case, one researcher’s anomaly is another’s expectation.  

I have addressed Kuhn’s four specific markers of theoretical performance within chapters 5-11. In general, I have suggested that the propositions central to the Standard Model perform in a range from low to moderate on exactness; moderate on consistency; moderate on broadening application; and high on fruitfulness. I do note, however, that these measures are arbitrary given that there is no competing framework for religious cognition. |
| **Kuipers** | A new theory should allow fewer **anomalies** than its predecessor. Progress or success criteria may be summarised under the notions of 1) truth approximation, 2) explanatory success, 3) predictive success, and 4) external success. | While my examination of the Standard Model has placed greater emphasis on the progress potential of the overarching program, I have reviewed the performance of the central criteria against empirical observation. The Standard Model is, by default, superior by virtue of the fact that it is the first coherent framework for the study of religious cognition. I have indicated that the Standard Model performs best on explanatory success while it predictive success does not satisfy more rigorous standards of novelty. |
| **Lakatos** | Research programs demonstrate empirical success where a superseding theory is capable of explaining the content of its predecessor whilst providing some evidence that the earlier theory failed to explain. | The previous two chapters speak at length about the relevance of Lakatos’ position of research programs. I have argued that his designation of hard core and protective belt is useful in articulating the propositions and principles being wielded. My conclusion is that the Standard Model is usefully described as a neo-Lakatosian research program. On this specification, the Standard Model is progressive. I have noted, however, some reservations about the efficacy of some predictions generated by the framework and their lack of novelty. Beyond obvious differences between strong and weak predictions, Lakatos is less useful when it comes to fine-tuning judgments about degrees of novelty. |
| **Laudan** | Progress is measured by the **problem-solving ability** of a research program and its theories. | The suggestions that theories have malleable hard cores and that making ad hoc modifications to a theory is both acceptable and progressive so long as there is no other explanation available, are useful contributions in the case of the Standard Model. However, Laudan’s general approach to specifying solutions to problems is too generous and permissive; any theory can be regarded as having solved an empirical problem if it |
functions in any schema of inference whose conclusion is a statement of the problem. Laudan’s problem-solving approach is only partly helpful given that it cannot yield immediate assessments of any given theory case.

Several of Laudan’s observations about the way science ‘works’ are noticeable in the Standard Model case including that:

- theories are not discarded because of anomalies nor accepted because of confirmation;
- theories are changed due to conceptual reasons as much as empirical support;
- there is broad array of approaches to science fitting in the middle ground between acceptance and rejection of a given theory;
- there is also a broad middle ground between laws and conceptual frameworks.

<table>
<thead>
<tr>
<th>Leplin</th>
<th>Theories should be capable of <strong>novel predictions</strong>, particularly in an environment where the assessment of interlevel progress is prioritised.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Losee</td>
<td>Science is progressive, containing an inherent <em>goodness</em> about the process that increases over time. Attempts to establish necessary or sufficient conditions governing either progressive incorporation or progressive revolution have been unsuccessful largely due to the availability of counter-cases that may be applied to each proposed condition. The corroboration of</td>
</tr>
<tr>
<td></td>
<td>Leplin’s position is particularly salient to the Standard Model which has, in my estimation, been more successful in generating interconnections between analytical levels than it has been in specifying novel predictions at any level.</td>
</tr>
<tr>
<td></td>
<td>The case of the Standard Model shows an attempt to maximise diversity of evidence, although some areas are relatively overlooked. The attempt to establish a convergence of diverse experimental results around a single phenomenon is an implicit part of the Standard Model’s structure as a mutildisciplinary framework. I have suggested that the pursuit of empirical diversity is advantageous in a case such as this because it can lead to support for the framework irrespective of whether the</td>
</tr>
<tr>
<td>Author</td>
<td>Theory/Statement</td>
</tr>
<tr>
<td>--------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mayo</td>
<td>Novel predictions can be reframed in terms of the severity of novelty tests. Some predictions are reliable while others are more severe.</td>
</tr>
<tr>
<td>McCauley</td>
<td>Every discussion about theory development has to overtly or tacitly presuppose <strong>distinctions between levels</strong> of analysis or context, and between levels of continuity.</td>
</tr>
<tr>
<td>Musgrave</td>
<td>Novelty is relative to a background theory in that a new theory is novel if it predicts something that is <strong>not predicted by its background theory</strong>.</td>
</tr>
<tr>
<td>Nagel</td>
<td>Theories can be articulated as explicit sets of statements. Deductively, <strong>one theory can be reduced to another if the fundamental laws of the first can be derived from the second</strong>. If this is</td>
</tr>
</tbody>
</table>
to hold, the two theories in question must be logically consistent and share a common vocabulary and meaning.

| Niiniluoto | Progress can even be viewed as the development of theories which demonstrate **greater explanatory power within simpler structural complexity**.

10 basic virtues of a theory: 1) **consistency** in that it contains no internal contradictions; 2) **truth** in that there is a correspondence between reality and its interpretation; 3) **probability** in that there is a low likelihood that the empirical content represented by the theory was the result of chance, and that there can be a rational degree of belief in the truth of a given hypothesis on the basis of the available empirical evidence; 4) **information content** in that a large content is needed to defend hypotheses that are falsifiable; 5) **empirical content and empirical success** in that the theory should contain some empirical claims that can be validated by observation leading to empirical success; 6) **explanatory and predictive power** in that the statements and laws provided by a theory explain phenomena and make correct, new predictions about phenomena without the aid of empirical content; 7) **problem-solving capacity** in that practical scientific problems are resolved as a consequence of a theory; 8) **simplicity** in that the theory is economical and parsimonious; 9) **accuracy** in that the predictions made |

I have argued that the Standard Model is progressive on this interpretation because it offers a cohesive framework that generates a significant range of explanatory outcomes. In addition, I address Niiniluoto’s 10 virtues on a micro level for each chapter’s propositions. Each proposition performs differently, ranging from weak to strong. While most of the 10 virtues are implicit within other accounts of theoretical choice, it is the most comprehensive approach. However, it is worth acknowledging that the Standard Model’s propositions perform variably but collectively may remain a progressive research program.
<table>
<thead>
<tr>
<th>Source</th>
<th>Statement</th>
<th>Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nowakowa and Nowak</td>
<td>A new theory should provide greater approximate explanation by correcting flawed consequences of an earlier theory.</td>
<td>The Standard Model focuses on correcting the claimed ‘flawed’ consequences of other theories that do not employ a cognitive interpretation. Examples include exclusively social and cultural views of religious belief transmission. I conclude that some of this ‘correction’ is overzealous given the evidence, but that the introduction of an explanation for religious thought that is consistent with evolutionary pressures is a strengthening factor.</td>
</tr>
<tr>
<td>Olsen</td>
<td>Theoretical statements <strong>cohere or ‘hang together’ if they are true together or false together.</strong></td>
<td>I have suggested that the coherency of the Standard Model is relevant in that its propositions do hang together. However, I caution that this coherency could work against the Standard Model if its soft core is undermined.</td>
</tr>
<tr>
<td>Oppenheim and Putnam</td>
<td>Not only are theories <strong>reducible from higher to lower levels</strong>, but there is also a structural relationship between different levels, like a kind of theoretical architecture.</td>
<td>The case of the Standard Model reveals interconnections between theories at different levels but there is little sign of reduction or of a hierarchical theoretical architecture.</td>
</tr>
<tr>
<td>Popper</td>
<td>Progress comes with <strong>truthlikeness, or verisimilitude</strong>, focused on a reflection of the proximity to a comprehensive truth. Competing theories can be distinguished on the basis of the degree of corroboration they achieve, and a higher level of corroboration indicates that a theory is a superior approximation to the truth than a competitor.</td>
<td>I have expressed some uncertainty about the correspondence between the Standard Model’s propositions and empirical content that has been generated by other fields. The propositions central to the Standard Model are vulnerable to falsification, but it is too early in the program’s development to conclude that it should be abandoned. In fact, I have suggested that it is yielding more rather than less empirical content.</td>
</tr>
<tr>
<td>Rosenberg</td>
<td>Newer theories treat older ones as approximations that <strong>require correction or clarification.</strong></td>
<td>Standard Model advocates accept a set of common principles and propositions and work towards their fuller elucidation. It is for this reason that the approaches to research program development conceived by Lakatos in general, and Hardcastle in cognitive science, are consequential.</td>
</tr>
<tr>
<td>----------</td>
<td>----------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Shapere</td>
<td>Theories are assessed in terms of how well they <strong>account for problems within their own domains.</strong></td>
<td>The Standard Model fares better in the contained domain of cognitive science than in others.</td>
</tr>
<tr>
<td>Stepin</td>
<td>Scientific programs operate as <strong>complex systems where paradigmatic ‘grafting’ leads to messy interactions.</strong> Progress can occur when emergent properties of the research system come to the fore.</td>
<td>There is some potential in the complexity metaphor to describe the development of the Standard Model in that some advantageous findings have occurred emergently. However, the metaphor does not apply to the research framework the Standard Model employs, which is too prescriptive to meet complexity theory criteria. There is nevertheless some appeal to the notion that scientific programs like the cognitive science of religion can be messy. One of my chief arguments is that progress in an interdisciplinary field such as cognitive science must include attention to interlevel connections.</td>
</tr>
<tr>
<td>Swanson</td>
<td>Complementary refers to the relationship between two separate scientific arguments, which when combined yield substantive insights that remain covert or unclear when considered independently. Disjoint literatures hold no content in common, and do not reference each other. When two literatures are complementary but disjoint, they might collectively contain important inferences that have not been made explicit anywhere else before. <strong>Progress occurs when</strong></td>
<td>Flawed though I argue it is, the Standard Model demonstrates the ability to connect complementary content. I have also shown instances where it has led to complementary and disjoint connections.</td>
</tr>
<tr>
<td>Author</td>
<td>Statement</td>
<td>Commentary</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>van Fraassen</td>
<td>Theoretical statements about observations should be true in that they are confirmed, but say nothing about truth in the larger, theoretical sense.</td>
<td>Advocates of the Standard Model claim that its central propositions have been confirmed. I have reservations because I do not believe that the statements included sufficient tests of novelty.</td>
</tr>
<tr>
<td>Watkins</td>
<td>The aim of science is to develop theories that are deeper, more unified, and have more predictive power than their rivals.</td>
<td>Depth of theory is difficult to operationalise and hard to compare. The Standard Model does not excel at traditional unification but is gathering additional empirical content.</td>
</tr>
<tr>
<td>Whewell</td>
<td>A theory is more compelling when it explains evidence associated with a phenomenon for which it was not composed to explain.</td>
<td>There are complications about what constitutes a new class or a new ‘kind’ of phenomenon. However, if theoretical connections should be viewed as loose heuristics, then the Standard Model has shown some a limited capacity to make associations.</td>
</tr>
<tr>
<td>Worral</td>
<td>Heuristic novelty proposed by Lakatos and Zahar and elaborated upon by Worral, considers whether the fact being used to bolster a theory played a role in that theory’s original construction. Worral argued that the same fact cannot be used twice.</td>
<td>The development and deployment of the Standard Model shows no signs of acknowledging Worral’s rule. In fact, there are numerous examples of a circuitous relationship between inductive and deductive evidence.</td>
</tr>
<tr>
<td>Wylie</td>
<td>Localised relations between research fields are the markers of progress.</td>
<td>On the basis of localised relations, the Standard Model would be seen as progressive.</td>
</tr>
</tbody>
</table>
Minerva Access is the Institutional Repository of The University of Melbourne

Author/s:
Smith, Aaron Colin Thomas

Title:
Thinking about religion: scientific progress and the cognitive science of religion

Date:
2012

Citation:

Persistent Link:
http://hdl.handle.net/11343/37175

File Description:
Thinking about religion: scientific progress and the cognitive science of religion

Terms and Conditions:
Terms and Conditions: Copyright in works deposited in Minerva Access is retained by the copyright owner. The work may not be altered without permission from the copyright owner. Readers may only download, print and save electronic copies of whole works for their own personal non-commercial use. Any use that exceeds these limits requires permission from the copyright owner. Attribution is essential when quoting or paraphrasing from these works.