Author/s:
Mason, Robert Joshua

Title:
Examining the knowledge, use, and reception of verbal coach feedback across high performance sport environments

Date:
2020

Persistent Link:
https://hdl.handle.net/11343/249852

Examining the Knowledge, Use, and Reception of Verbal Coach Feedback Across High Performance Sport Environments

Robert Joshua Mason

http://orcid.org/0000-0001-8315-7537

Submitted in total fulfilment of the requirements of the degree of Doctor of Philosophy (Education)

July 2020

Melbourne Graduate School of Education

The University of Melbourne

Produced on archival quality paper

Abstract

An academic interest in the teaching skills of sports coaches emerged in the 1970s, and has since expanded into a sizeable body of coach observation literature in which coach behaviours are recorded and analysed. A consistent finding in these studies is that verbal coach to athlete feedback represents one of the most common coach behaviours observed. Given its prevalence, understanding and harnessing the power of coach feedback to improve athlete outcomes appears an important endeavour in enhancing coach effectiveness. However, there are several gaps in the evidence base related to coach feedback that require further exploration. For example, relatively little is known about the ways in which coaches provide verbal feedback across various settings typical of a high performance sporting environment: during competition, and during video-based feedback meetings. A major criticism of feedback research in other fields is that it considers feedback given, but fails to account for the reception and subsequent action on feedback by a receiver such as a student or athlete. Importantly, in order to influence coach practice, more information is needed about the knowledge and beliefs that coaches hold about the provision, reception, and evaluation of verbal feedback.

This thesis sought to address gaps in the literature related to coaches' knowledge about feedback, the influence of context on the provision of feedback, and athlete reception of feedback, using coaches of team sports working at the high performance level. A mixed-methods approach was adopted to undertake the three studies that make up the thesis.

In Study 1, eight high performance coaches were interviewed about their knowledge and beliefs about feedback provision, reception, and evaluation. Coaches

were able to articulate a range of ideas about feedback, including tailoring their feedback to the individual needs of their athletes, and allowing athletes to self-organise and develop autonomy through finding their own solutions. In Study 2, six coach-athlete dyads were observed in individual video-based feedback meetings. Athlete recall of feedback and athlete characteristics hypothesised to influence the reception of feedback were considered. Major findings included the notion that feedback given does not equal feedback received, with up to 94% of feedback not recalled by athletes at a one-week retention interval. Coach feedback was largely positive, descriptive, and task-focussed. In Study 3, verbal in-game feedback provided to athletes across an entire season of Australian Rules football was observed and analysed. In this context, coach feedback was primarily negative, prescriptive and controlling. Feedback increased in frequency during periods where the score was close, became more positive/less controlling in winning quarters, and more negative/more controlling in losing quarters.

Major conclusions from this thesis include the finding that what coaches know about feedback does not always reflect how they provide feedback; instead, feedback varies widely based on the context in which it is given. This variation between contexts may represent an area for improving coach practice, but may also be seen as a necessity by coaches for adapting to the environment in which feedback is given. A major area for future research and coach education to consider is the notion that feedback given does not equal feedback received, and that methods for evaluating feedback reception should be explored.

Declaration

This is to certify that:

1. This thesis comprises only my original work towards the degree of Doctor of Philosophy (Education) except where indicated in the Preface section of this thesis.

2. Due acknowledgement has been made in the text to all other material used.

3. This thesis is fewer than 100,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Robert J Mason

23 July, 2020

Preface

1. This thesis is comprised of my own original work. I was responsible for the conceptualisation, synthesis of literature, data collection, statistical analyses, and reporting of the research presented in this thesis. My supervisors provided feedback and suggested changes on the contents of the thesis chapters and the published articles included within, as outlined in the tables below. Journal editors and reviewers mandated minor changes to the manuscripts that appear in Chapters 4, 5, and 6 of this thesis.

2. None of the work presented here has been submitted for other qualifications.

3. None of the work towards this thesis was carried out prior to enrolment in the degree.

4. No third party editorial assistance, either paid or voluntary, was used in the preparation of this thesis.

5. Work towards the thesis that was carried out in collaboration with others is reported in the below tables.

Chapter 4.

Mason, R.J., Farrow, D., & Hattie, J.A. (2020b). Sports coaches' knowledge and beliefs about the provision, reception, and evaluation of verbal feedback. *Frontiers in Psychology*, *11,* 2424. https://doi.org/10.3389/fpsyg.2020.571552

The manuscript that makes up Chapter 4 was submitted for publication to the journal *Frontiers in Psychology* on June 11, 2020. At the time of thesis submission, the manuscript was under review and has been resubmitted with minor revisions. At the time of receiving examiner comments on the thesis, the manuscript has been accepted and published. The candidate is the lead and primary author of this article, and the contributions of each author are outlined in the following table.

Chapter 4. Sports coaches' knowledge and beliefs about the provision, reception, and evaluation of verbal feedback.					
Author	*Planning %*	*Lit Review %*	*Research Design %*	*Writing %*	*Overall %*
Mason	80	95	80	95	90
Farrow	10	Comments	10	Comments	5
Hattie	10	Comments	10	Comments	5

Chapter 5.

Mason, R.J., Farrow, D., & Hattie, J.A. (2020c). An exploratory investigation into the reception of verbal and video feedback provided to players in an Australian Football League club. *International Journal of Sport Science and Coaching, x,* 1-11. https://doi.org/10.1177/1747954120951080

The manuscript that makes up Chapter 5 was submitted for publication to the journal *International Journal of Sport Science and Coaching* on April 30, 2020. At the time of thesis submission, the manuscript was under review and has been resubmitted with minor revisions. At the time of receiving examiner revisions, the manuscript has been accepted and published. The candidate is the lead and primary author of this article, and the contributions of each author are outlined in the following table.

Chapter 5. An exploratory investigation into the reception of verbal and video feedback provided to players in an Australian Football League club.					
Author	*Planning %*	*Lit Review %*	*Research Design %*	*Writing %*	*Overall %*
Mason	80	95	80	95	90
Farrow	10	Comments	10	Comments	5
Hattie	10	Comments	10	Comments	5

Chapter 6.

Mason, R.J., Farrow, D., & Hattie, J.A. (2020). An analysis of in-game feedback provided by coaches in an Australian Football League competition. *Physical Education and Sport Pedagogy, 2020,* 1-14. https://doi.org/10.1080/17408989.2020.1734555

The manuscript that makes up Chapter 6 was published by *Physical Education and Sport Pedagogy* on February 27, 2020. The candidate is the lead and primary author of this article, and the contributions of each author are outlined in the following table.

Chapter 6. An analysis of in-game feedback provided by coaches in an Australian Football League competition.					
Author	*Planning %*	*Lit Review %*	*Research Design %*	*Writing %*	*Overall %*
Mason	80	95	80	95	90
Farrow	10	Comments	10	Comments	5
Hattie	10	Comments	10	Comments	5

Acknowledgement of funding.

This thesis was funded through an Australian Government Research Training Program Scholarship (Stipend and Fee Offset), awarded to the PhD candidate. The author was also supported to attend conferences by the Science of Learning Research Centre, a Special Research Initiative of the Australian Research Council.

Acknowledgements

Thank you to my supervisors, Professors John Hattie and Damian Farrow. It isn't often that a research student is able to assemble his "dream team" of academics from two different but complementary fields to conduct research that each brings decades of experience to. Thank you both for the hours of reading drafts, editing and revising, encouraging and supporting, and for allowing me the freedom to follow my curiosity. Thank you also to the chair of my PhD committee, Professor Field Rickards. Field kept me on track through our regular progress meetings with a keen interest in the research.

Thank you to the many coaches, coach developers, athletes, educators, and researchers who I had the pleasure of working with throughout my PhD candidature. In particular, I must pay thanks to Aaron Greaves, Michael Voss, and Chris Davies at the Port Adelaide Football Club. Without their support and belief that the science of learning could make a difference in football, much of this research would not have occurred. Thank you also to the fraternity of South Australian coaching experts for welcoming me mid-way through my candidature with advice and support – Ash Ross, Dave Reynolds, and Shane Pill in particular.

Thank you to my colleagues at the University of Melbourne, for your feedback and camaraderie while also finding your way through your own research projects. It is fitting that I submit this thesis on the same day as Luke Mandouit, who has been a fantastic sounding board and friend since I joined John's research group as a Masters student back in 2016.

Finally, thank you to my personal support network, the original “dream team”. To my younger brother Joel, who led the way with his own PhD and made it through with flying colours despite the circumstances. To my parents, Hels and Wayne, for their unwavering support of my education and my dreams for over 30 years. And to my partner Chelsea, for deciding that it was a good idea to date – and then marry – a PhD student, but also for keeping me sane and reassuring me that the finish line was near.

This is for you!

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

"Sports journalists in Victoria, Australia would have us believe that winning or losing a game of Australian Rules football depends almost entirely on what the coach says to players, and how it is said." (Madden, 1995, p. 525)

Feedback is a concept that is pervasive throughout a vast range of research areas. It appears in computer science, biology, engineering, and management literature, along with literature more familiar to likely readers of this thesis: motor learning, education, and sports coaching. It has technical roots in electrical science, and has been used from the 1910s to describe the looping of a system's output to an input (i.e., 'feeding back' into the system), but was not commonly used to describe information about human performance until the 1960s (Merriam-Webster, n.d.). Feedback, not by name but as a concept, was at the heart of Thorndike and Skinner's work on behaviourism in the early-mid 1900s, where the effects of post-event information on subsequent behaviour was observed (Kulhavy & Wager, 1993). The 1960s saw the emergence of cognitive psychology, where feedback began to be considered not just as motivation but as information to correct errors and alter future actions (Mory, 2004).

The last 50 years has seen the interest in feedback diffuse into a broad assortment of research areas. Management literature evaluates 360° feedback processes in human resource journals (Maurer et al., 2010). Computer science journals consider the role of haptic feedback in the design of virtual reality systems (Stone, 2000). Medical journals lament the gaps between the feedback provided by physicians and what is perceived by interns (Bing-You & Trowbridge, 2009). Motor control scientists discuss the benefits of providing concurrent or terminal feedback for teaching optimal

joint flexion in a skill acquisition task (Swinnen et al., 1993). School teachers contemplate the merits of providing written or symbol-based feedback, and how students might interpret each (Mandouit, 2018). It is clear that feedback is approached from a range of angles across fields; the ways in which it is analysed for its content, timing, tone, quantity, and use varies. An issue in many areas of research is the siloed nature of various sub-fields, such that evidence from one field may be of benefit but is not taken up in other fields (Allan et al., 2018). This is especially true of feedback research in the context of sports coaching, where modern theories of feedback from other fields (e.g., Hattie & Timperley, 2007) are not typically considered. A notion central to this thesis is the idea that feedback theories from fields such as education could be adopted into sport coaching research to provide an alternate lens from which to view feedback. While the sharing of ideas between fields has value, it can also be problematic, particularly given the diverse intended outcomes between the largely cognitive domain of education, and the largely physical domain of sport coaching. For further exploration of this idea, see page 67.

The interest in the use of feedback specifically in an applied sports setting emerged in the mid 1970s, with the first coach observation studies that observed and quantified coach behaviours during training sessions. A considerable amount of research has considered the types and rates of verbal feedback provided by coaches to their athletes (Kahan, 1999). This research has occurred primarily in a training setting (Cope et al., 2017), due to the difficulty of accessing and observing the often intense game-day or competition setting. A major shortcoming of this research area is the use of a narrow scope of feedback coding schemes, excluding important characteristics of feedback that are typically considered in other fields. While nearly every coach observation study provides a measure of positive or negative feedback, very few

consider the autonomy-supportive nature of the feedback (Carpentier & Mageau, 2013) or prominent feedback theories from the field of education (e.g., Hattie & Timperley, 2007). Despite momentum in other fields towards considering not just the provision but the subsequent reception and use of feedback (Bing-You & Trowbridge, 2009; Hattie, 2009), a remarkably small number of studies have considered the reception of coach feedback by athletes. This is perhaps most commonly evidenced through observing the exasperated coach who watches their athletes fail to adopt their feedback in the dying seconds of a game, exclaiming, "… but I *told* them!".

Research aims and scope

The vast scope of feedback research across fields has not been particularly well-adopted into sports coaching research. Coach observation studies consider verbal feedback in a one-dimensional light, and lack the depth of feedback research in other fields. There is strong evidence that feedback, although generally considered effective (Hattie, 2009; Sigrist et al., 2013), is widely variable in its power (van der Kleij et al., 2015), with up to a third of feedback effects found to have a negative impact (Kluger & DeNisi, 1996). While the reasons for this have been explored in other fields, they have yet to receive serious consideration in the sports coaching literature. The broad aim of this thesis is to investigate the knowledge, use, reception, and effectiveness of feedback in high performance sport. More specifically, there are three elements of feedback in high performance sport that form the basis of this thesis.

Coach knowledge and beliefs about the provision, reception, and evaluation of verbal feedback. The first element is the knowledge and beliefs that coaches bring to their practice regarding feedback. Most coach feedback research considers the rates of feedback observed in coach practice, but very little is known

about what coaches believe to be effective feedback practice (Smith & Cushion, 2006). Determining the nature of coach knowledge about feedback may provide a point of intervention to upskill coaches to provide more effective feedback.

The reception of verbal feedback, and factors that influence this. A major theme in feedback research conducted in fields outside of sports coaching has been the reception and use of feedback by the receiver. Feedback research in sports coaching has historically considered feedback from the perspective of the coach, but not the athlete as a receiver of feedback (Chen & Rikli, 2003). Coaching research could benefit from further considering gaps between feedback given and feedback received. Evidence suggests that the working memory capacity (Buszard et al., 2017), self-efficacy (Narciss & Huth, 2004), and feedback orientation (London & Smither, 2002) of the learner may impact feedback effectiveness.

Feedback across various contexts. A criticism of coach observation research is that studies typically examine a training setting (Cope et al., 2017), despite evidence that coaches exhibit changed behaviour between training and competition settings (Cushion, 2010). A small number of coach observation studies investigating a competition setting exist (e.g., Halperin et al., 2016). However, few of these studies examine a high performance sport setting, and most consist of a small number of observation points (Cope et al., 2017). There is also a marked absence of research into the video-based feedback context, in which a coach and athlete review video of performance and the coach provides verbal feedback concurrently (Bertram et al., 2007). A focus of this thesis is on addressing major gaps in the literature regarding the feedback provided by high performance coaches in competition and video-based

feedback settings. A secondary interest relates to the ways that feedback changes within a competition setting; between winning and losing performances, for example.

Scope. In order to achieve these aims, it is necessary to limit the scope of the study. It must first be acknowledged that teaching and coaching consists of far more than the provision of feedback. Feedback has been chosen as the pedagogical intervention of focus in this thesis due to a number of factors. First, verbal coach to athlete instruction and feedback is prevalent at all levels of sport (Kahan, 1999), and does not require large budgets or specialised equipment to administer. Second, feedback is broadly considered to have powerful effects on learning and performance outcomes across a number of settings (Kluger & DeNisi, 1996; Lyster & Saito, 2010; Sigrist et al., 2013). Third, feedback is commonly observed and quantified in studies of coach behaviour, and is included in some form in a wide range of coach observation instruments (Cope et al., 2017). Fourth, there have been few efforts to synthesise evidence on feedback in sports coaching (Mason, 2016).

It is also important to acknowledge that feedback in a sporting context is not limited to that provided verbally by a coach. Feedback can come from a variety of sources, including from technology such as GPS or heart rate monitors (Phillips et al., 2013), and through practice design that aims to allow athletes to 'seek' their own feedback through movement exploration (Woods et al., 2020). While it could be considered a narrow view to explore only verbal feedback in this context, a consistent finding in the coach observation literature is that verbal feedback represents one of the most common coach behaviours across a variety of settings (Cope et al., 2017; Kahan, 1999; Partington & Cushion, 2013), with rates of over 60 feedback messages per game reported recently in a high performance setting (Mason et al., 2020). While it is

acknowledged that there are many other sources of feedback available to an athlete, the prevalence of verbal feedback across all levels of sport (Kahan, 1999) makes it a major element of coach practice, and therefore warrants an investigation specifically into verbal feedback.

This research is positioned as an exploration into the knowledge, beliefs, and observed behaviours of practicing high performance coaches, and is designed to reflect the reality of current coach practice. The justification provided above for focussing on verbal feedback – that it is a common and frequent occurrence at all levels of sport – is important to note given the increasing focus on nonlinear pedagogy in both research and practice (Chow et al., 2016). Nonlinear pedagogy, and its broader field of ecological dynamics, situates verbal instruction and feedback as constraints that can either improve or detract from motor performance, depending on their use (Newell & Ranganathan, 2010). A sizeable body of literature, primarily from lab-based motor control studies, suggests that verbal feedback can detract from performance (Wulf & Weigelt, 1997), particularly when provided in large amounts that could overload the performer's attentional resources and detract from task-intrinsic information (Salmoni et al., 1984). Proponents of nonlinear pedagogy cite this evidence when suggesting that verbal instruction and feedback may not "actually make a real difference to learning" (Chow et al., 2016, p. 123). It is therefore important to position this research, specifically on verbal feedback, as complementary rather than competing with an ecological dynamics framework. As long as verbal feedback continues to be a major part of coach practice (Cope et al., 2017), it is important to examine its characteristics to determine its usefulness to a performer, because it is a current and observable reality of coaching practice. For example, feedback that is highly prescriptive and controlling is not aligned with an ecological dynamics approach, whereas feedback that is

descriptive and autonomy-supportive is considered aligned with ecological dynamics. Discovering more about the types of feedback provided by coaches, and their reception by a learner, represents an opportunity to examine the role of feedback in the learning process.

It is acknowledged throughout this thesis that coaches of all sports function as teachers in their own contexts. While there are many classifications of sport types (Werner & Almond, 1990), the focus of this thesis will be on team invasion sports. Invasion sports, in which a team of athletes move into the opposing team's territory and attack the other team's goal, provide ample opportunity to investigate the role and effects of coach feedback. It should be noted that most coach observation studies focus on a single sport. Rare examples of multi-sport observation studies (e.g., Horton et al., 2005) typically narrow their scope to a homogeneous sub-sample of sports, based on the focus of the study. Although a focus in this thesis is on exploring the role of context in shaping coach feedback, there is a need to hold at least some variables (e.g., team vs individual sports) constant in order to make more reliable conclusions about other contextual variables that may be at play. Team invasion sports have been selected as a focus for this thesis because the emphasis on coordination between team members (tactics and strategies) and countering the coordination of opposition teams (opposition scouting) provide opportunities to investigate the effects of feedback that may not be as prevalent in individual sports or other game types. It is acknowledged that there may be key differences in the types of feedback provided in individual and team sports; for example, the tailoring of messages for individual athletes may be more widely adopted by individual sport coaches. However, due to the many other contextual variables of interest (e.g., training vs competition, phases of competition), individual sports will not be the focus of this thesis.

Additionally, the scope of the thesis has been limited to elite or high performance sport. This is due to three factors. First, the contact time in professional sporting organisations is typically far higher than in amateur or junior settings, allowing for more coach-to-athlete interaction and opportunities to observe teaching, learning and feedback. Second, the learning demands placed on athletes in high performance environments are typically substantial and complex, and include information such as advanced tactics, strategies, technique, and opposition scouting. Third, the expectations placed on the knowledgeability of high performance coaches is likely to have increased alongside the growing professionalisation of the industry in recent decades (Mallett et al., 2009). High performance sport may therefore lend itself more readily to studies of coach knowledge. Lyle (2002) makes a useful distinction between participation and performance coaching, with a wide range of criteria that distinguish the two such as the intensity of participation, participant motives, recruitment, and the emphasis on competition. For the purpose of this thesis, high performance sport will be defined as that which involves high levels of athlete and coach involvement and commitment, with a strong emphasis on competition, and restrictive athlete selection criteria (Lyle, 2002; Rynne & Mallett, 2012). The coaching literature often makes unclear the distinction between performance and participation coaching, with an inherent assumption that the skills and attributes of performance coaches are similar to those required of participation coaches (Mallett et al., 2007). This thesis seeks to draw heavily on the performance coaching literature. Any references to studies involving participation coaches will be noted as such.

Regarding terminology, it should be noted that the term ‘high performance’ is used interchangeably with ‘elite’ throughout the literature. The term ‘high performance’ has emerged more recently to refer broadly to Olympic and non-

Olympic professional sport as well as emerging sports such as surfing or skateboarding (Sotiriadou & De Bosscher, 2018) performed at the highest level. 'High performance' more commonly refers to systems or organisations (e.g., a 'high performance centre'), while 'elite' typically refers to an individual (e.g., an 'elite athlete' or an 'elite coach') or a level of competition (e.g., 'the elite level of the sport in Australia' or 'sub-elite levels'). The two terms should be considered synonymous in terms of their performance connotations; one is not 'higher' or 'more elite' than the other. Throughout this thesis, the two terms are used interchangeably in line with the above conditions, to remain consistent with the wider literature. Some exceptions to these conditions are seen in the manuscripts that form chapters 4-6; these exceptions have been left intact to ensure consistency with the submitted/published manuscripts.

A specific focus on Australian Rules football (ARF; also referred to in the literature as Australian football or AF) and its highest level of competition, the Australian Football League (AFL) will be adopted for studies 2 and 3 of this thesis. The primary reason for this focus is the scarcity of research at the elite level of any sport, along with the availability of Australian Rules football coaches afforded to the author of this thesis (i.e., a convenience sample). A majority of evidence in the field of coaching science is drawn from sub-elite levels; just 20 of 610 studies in a 2004 review of literature adopted a focus on elite sport, with 68% of studies instead drawing on college or high school samples (Gilbert & Trudel, 2004). The AFL is considered to be representative of high performance team sporting environments around the world from a pedagogical perspective.

Limiting the scope of the study is achieved through clear and consistent definitions of terminology. There are a number of key terms used throughout this

thesis that must be positioned from the outset. Firstly, the term 'pedagogy' (used more for child-focussed learning) is used in this thesis in place of 'andragogy' (adult-focussed learning). Despite the focus on adult athletes and coaches in the following series of studies, 'pedagogy' is used because of its widespread use in the sport and coaching literature, for example to refer to 'coaching pedagogy' (e.g., Jones, Morgan, & Harris, 2012). While it is acknowledged that 'coaching andragogy' may be more correct when taken literally, it is also acknowledged that correctness is related to usage (Gordesch & Dretzke, 1998); the importance of consistency with the wider body of literature led to the adoption of 'coaching pedagogy' for this thesis.

A primary interest throughout the thesis is categorising and conceptualising types of coach to athlete feedback. It should be noted, however, that feedback is conceptually intertwined with instruction. More specifically, it has been proposed that instruction and feedback exist along a continuum (Kulhavy, 1977). At one end of the continuum, instruction and feedback are independent; instruction involves the presentation of new information to a learner, and feedback gives information about the learner's performance after it has occurred. At the other end of the continuum, feedback and instruction can become blurred, because feedback that involves information about corrections can sometimes become new instruction itself. The nature of feedback can itself be instructional, because the goal of a coach providing feedback should be to close the gap between the current and goal performance (Ramaprasad, 1983; Sadler, 1989). Throughout the thesis, the term 'feedback' is used with the acknowledgement that an element of instruction may be present. When instruction is discussed in a context where it is independent from feedback, this will be stated.

Just as feedback and instruction can be conceptually intertwined, so too can feedback and questioning. In this thesis, questioning is positioned as a pedagogical tool used by coaches alongside feedback, particularly when the coach is attempting to facilitate a more athlete-centred learning environment (Davis & Sumara, 2003). Many coach observation studies find low rates of questioning (e.g., Cushion & Jones, 2001), and instead show large amounts of verbal feedback given to the athlete, who acts as a passive recipient of information (Cope et al., 2016). The use of questioning to allow athletes to self-regulate and become an active agent in their own feedback process is receiving increasing support in the sport pedagogy literature (García-González et al., 2013; Renshaw et al., 2012). Throughout the empirical work undertaken for this thesis, questioning is considered a tool that coaches can use to facilitate an athlete-centred approach to the provision of feedback.

Significance

This thesis makes unique and substantive contributions to the research area by expanding on existing coach observation research, and by providing novel insights into feedback reception by athletes. There is a large body of literature in which coaches are observed and their behaviours quantified; for reviews, see Kahan (1999), and Cope et al. (2017). In these studies, coaches are commonly observed in a training setting, but are seldom observed in a live competition setting, and even more rarely in a video and verbal feedback setting away from the physical performance environment (Groom & Nelson, 2013). This thesis provides new knowledge about the quality and quantity of verbal feedback provided in these under-researched settings. Additionally, the coding schemes used to categorise feedback in coach observation studies are typically narrow in their focus, and often include only a dichotomous code for positive/negative (or

praise/scold) feedback (e.g., Lacy & Darst, 1984). The research undertaken in this thesis combines several prominent feedback coding schemes found in coaching, motor learning, and education literature, to provide new and more detailed information about the types of verbal feedback provided by coaches.

Another area in which this thesis makes unique contributions to the literature is through the consideration of feedback reception. Most coach feedback research adopts a sole focus on the feedback *provided* by a coach, but few studies consider feedback *received* by an athlete. Recent feedback research emerging from the field of education more thoroughly considers feedback as a two-way interaction involving both the provider and the receiver (Hattie & Clark, 2019). Determining the amounts of feedback that are recalled by athletes appears important for examining feedback effectiveness, at least from a cognitive perspective. Study 2 of this thesis therefore sought to determine rates of feedback recall by athletes. Further, the growing interest in other fields towards moderators of feedback reception, such as working memory or personality variables (Narciss & Huth, 2004), has not been adopted in the coaching science literature. Study 1 of this thesis considers coach knowledge about individual differences in feedback reception capabilities, and Study 2 explicitly tests several athlete characteristics that are hypothesised to impact feedback reception.

Organisation of this thesis

Following this introductory chapter, a literature review is presented which serves to introduce the issues at hand, provide context, and integrate the manuscripts following it into the overall scope of the research question. It should be noted that although care has been taken to expand upon the literature reviews presented in each manuscript when constructing the overarching thesis literature review, some

unavoidable repetition may be present when reading the literature reviews contained within each manuscript. A methods chapter follows this, serving to expand on the truncated method sections presented in each of the three manuscripts, and describing the overall methodological approach of the thesis.

Three standalone manuscripts are presented after the methods chapter. Each manuscript is accompanied by statements of publication to describe the current status of the manuscript including its place of publication, publication or submission date, and the relative contributions of the authors listed. Each of these manuscripts functions as a chapter of the thesis, helping to address the aims of the research as outlined above. The first manuscript examines coach knowledge and beliefs about feedback, providing important evidence about the views that influence subsequent coach behaviour. The second manuscript investigates the impact of off-field coach-athlete feedback meetings on athlete learning and performance, while considering learner characteristics that may mediate the relationship. The third manuscript examines in-game feedback to investigate relationships between types of feedback and game outcomes. Taken together, the manuscripts provide a coherent body of evidence on the current status of feedback knowledge, use, reception and effectiveness in a high performance sporting environment.

Finally, a discussion chapter is presented to tie together the findings of the three manuscripts, and to draw wider conclusions about the practical applications of this research to coaching practice and coach education more broadly. As is often the case, a series of studies such as this raises as many questions as answers; a secondary purpose of the discussion chapter is to explore implications for future research, including the refinement of measures to examine learner characteristics in this

population as well as more robust outcome measures to determine feedback effectiveness.

Chapter 2: Literature Review

The purpose of this chapter is threefold. First, to examine the current state of coach pedagogy research. This includes the teaching skills required of coaches, and the means through which coaches acquire knowledge about teaching. The beliefs and knowledge that coaches possess about pedagogy, and specifically about feedback, are also considered. Second, to provide a broad overview of research on feedback in a sporting context. Evidence is drawn primarily from sports coaching and sport pedagogy research, but supplemented with evidence from the fields of (school-based) education, skill acquisition and motor learning where sport-specific evidence is scarce. Third, to introduce the notion that feedback given is not always feedback received, by considering learner characteristics that may help or hinder the reception of feedback and subsequent change in learning or performance. The purpose of this chapter is to illustrate the gaps in the literature that led to the generation of the research questions guiding this thesis. The literature is then expanded upon in the manuscripts presented in Chapters 4-6.

Coaches as teachers: An overview of coaching pedagogy

The term *coach* emerged from several European languages to describe a carriage with wheels; early carriages were manufactured in the Hungarian town of Kocs (Oxford University Press, n.d.). The term also has early associations with education. Around 1850, *coach* was used as a slang term for a school tutor who carries a student towards and through an examination (Smedley, 1850). An interest in the relationship between teaching and coaching strengthened in the 1930s and 1940s, with the appearance of physical education teachers in public schools (Lyle, 2002). The

1960s and 1970s saw the emergence of a research interest in the teaching skills of coaches; first, the challenges of the dual-role as college coach and teacher (Governali, 1966), and then through the observation and coding of teaching behaviours exhibited by coaches. One particularly famous case study in this area was John Wooden, an English teacher and the coach of 10-time NCAA basketball tournament champions UCLA. Tharp and Gallimore's (1976) observational study set out to analyse Wooden's teaching by coding his dialogue during practice sessions, in an attempt to discover the essence of his coaching success. When articulating his coaching philosophy, Wooden suggested that "running a practice session was almost like teaching an English class... I knew a detailed plan was necessary in teaching English, but it took a while before I understood the same thing was necessary in sport" (Wooden & Jamison, 1997, p. 132). Recent Australian examples focussing on the teaching skills of coaches can be found in the work of Cliff Mallett (e.g., Mallett et al., 2007) along with media coverage of prominent coaches with teaching backgrounds. As an example, recent news headlines from the Australian Football League (AFL) have included "Why AFL clubs with a 'teacher' coach have a lot to learn" (Burke, 2019), "Port Adelaide development coach Aaron Greaves fast tracked to AFL by teaching degree" (Cross, 2017), "Teaching skills proving vital for a new breed of Aussie Rules coaches" (Rollinson, 2016), and "Hawthorn's lesson for the competition" (Niall, 2015).

The link between teaching and coaching is likely highlighted so frequently because of the similarity of the requirements of each profession. Both teaching and coaching involve an expert helping to progress the level of performance or achievement for those in their care, using various interventions and strategies. Like teachers, coaches are expected to be experts in the content knowledge of their area, including a deep understanding of the skills and tactics required for success (Cassidy et

al., 2009). However, it is also argued that coaches must possess the pedagogical skills required to teach these skills and tactics (Nash & Collins, 2006), including the provision of feedback to progress a learner from current to goal performance (Sadler, 1989). An influential text in this area is Jones' (2006) work positioning the sports coach as an educator, and sport coaching as a pedagogical endeavour. Jones asserts that sports coaching as a field can take much from the pedagogical principles that underpin classroom teaching, and vice versa.

The teaching requirements of coaches. There are many settings in a typical high performance sporting environment in which coaches could be considered to be teaching. The facilitation of learning is considered to be a major part of the role of the coach (Nelson et al., 2016). A consistent finding in coach observation studies is that coaches spend a majority of their time in a training setting providing instruction and feedback in a teaching-style role (Cushion & Jones, 2001; Kahan, 1999; O'Connor et al., 2018). An examination of a typical weekly cycle as a coach in an Australian Football League (AFL) club provides a case-study of the on- and off-field teaching roles that coaches engage in.

At the beginning of the week, coaches prepare video footage from the previous game and facilitate a 'line review meeting' in which all players of a particular 'line' or position (e.g., defenders, midfielders, forwards) meet to review their performance as a group. These sessions are referred to in the literature as a video feedback or video-based[1] performance meeting (Groom et al., 2012), but it should be noted that the video

[1] Throughout this thesis, the term 'video-based feedback' is used to refer to the provision of verbal and video feedback by a coach concurrently. However, references to 'video feedback' remain in the manuscripts that make up chapters 4-6 to remain consistent with submitted/published articles.

provided in the session is paired with concurrent verbal coach feedback. This teaching scenario represents a more traditional classroom environment, in which the coach assumes the role of the teacher. They may engage and challenge players with questions, facilitate group discussion, or simply progress through the meeting in a didactic lecture-style manner, providing verbal feedback to athletes with the aid of video (Groom et al., 2011). Typically on the same day, each player will meet one-on-one with their line coach to receive more individualised feedback for approximately 20 minutes on average (Mason et al., 2020c; see Chapter 4). To complete the review process, one coach will lead a 'team review meeting' in which all players and coaches are present.

During the week, coaches design, plan, and implement training sessions. During these sessions, coaches instruct players before the drill occurs, they provide feedback sporadically throughout the drill (O'Connor et al., 2018), and they may also facilitate evaluation or reflection at the completion of the drill (which may be more likely to occur if the coach has a background as a teacher; Partington et al., 2014). Leading into the next game, coaches present another meeting, in which positional groups are prepared for their upcoming game with a combination of information about how the team intends to play, and the challenges the upcoming opposition may present. This is also paired with a team meeting, in which team-level strategy messages are provided by the head coach. On game day, coaches provide instruction and feedback to players as the game progresses. Each 'line' meets as a group during game breaks to discuss progress, and the team typically meets as a group at the completion of the game to evaluate performance.

The development of knowledge about pedagogy. It is apparent that coaches spend a substantial period of time engaged in behaviours that could be considered teaching. Research on coach development has sought to understand the ways in which coaches develop knowledge and beliefs about effective coaching, including pedagogy. This body of literature makes a distinction between *formal* learning, involving formal structures set by a coaching organisation and delivered by a facilitator, and *informal* learning, in which learning occurs in an unguided or incidental manner (Mallett et al., 2009). One consistent finding is that coaches are more likely to be selected into roles at the elite level if they are former elite athletes themselves (Blackett et al., 2017; Kelly, 2008; Mielke, 2007), with playing experience often privileged to the exclusion of other coaching skills (Lyle, 2002). During their playing careers, athletes are exposed to a range of coaching approaches. This has been termed an "apprenticeship of observation" (Cushion et al., 2003, p. 217), in which athletes develop knowledge about what it means to be a coach in an informal manner through observing the coaches they work with. As a result, coaches are likely to adopt a style that is heavily influenced by the approach they have been exposed to as an athlete (Cassidy et al., 2009). The quality of the model being observed is therefore likely to influence the quality of coaching practice that is later reproduced.

Once selected into a high performance coaching role, the learning experiences of early-career coaches may serve to further ingrain the reproduction of coaching behaviours that have been observed in the coach's experience as an athlete at the elite level. The nature of high performance coaching positions is such that the urgent need for on-field success often prevents desirable conditions for learning how to coach (Mallett, Rossi, et al., 2016). In their first two years of employment in a high performance setting, coaches value on-the-job experience and drawing on their

experience as an athlete as the two professional learning sources of greatest value (Mallett, Rynne, et al., 2016). A recent survey of 320 coaches from a variety of contexts found that informal learning was preferred over formal learning by 93% of coaches, with peer discussion and observing other coaches amongst the highest rated activities for acquiring coaching knowledge (Stoszkowski & Collins, 2016). The value placed on informal learning sources is perhaps unsurprising, given the evidence surrounding formal coach accreditation courses and their failure to adequately prepare high performance coaches (Erickson et al., 2008). In Australia, the lack of formalised structure for the preparation and training of high performance coaches has been noted in the literature (Mallett et al., 2009), necessitating further emphasis on informal learning opportunities. Despite this, evidence suggests a positive impact of tertiary qualifications on the teaching skills of coaches, such as critical thinking and delaying instruction to allow player self-organisation (Partington et al., 2014; Rynne & Mallett, 2014). This suggests that university courses may be one way to supplement the training provided by more traditional coach accreditation courses.

One potential side-effect of the informal learning commonly experienced by early-career performance coaches is the adoption of 'folk pedagogies' (Bruner, 1996) into practice. Folk pedagogies are described as beliefs or intuition about how athletes learn best, often based on the personal assumptions of the coach. They are typically held so strongly that they are valued more so than evidence that another approach may be more effective. The concept originated from classroom research, but has more recently been offered as an explanation for the way coaches think about teaching athletes (Armour et al., 2004). Considering the often informal transmission of pedagogical practices appears important when exploring coach knowledge about pedagogy, including feedback.

What coaches know and believe about pedagogy, including feedback.

There are many examples of recent studies investigating the knowledge of high performance coaches. These include knowledge about resistance training (Harden et al., 2019), swimming technique (Morris et al., 2019), and talent identification (Roberts et al., 2019). A major gap in this growing body of evidence about coach knowledge regards the use of pedagogical strategies, including feedback. A review from 2002 suggested that evidence about what coaches know about pedagogy was scarce in the literature (Gilbert, 2002), and it appears that little has been done in the 20 years since this observation was made.

Some studies suggest that 'folk pedagogies' (Bruner, 1996) or myths about teaching and learning are prevalent in coaches across a range of levels. Bailey et al. (2018) surveyed 545 coaches about pseudoscientific ideas and neuromyths, including 118 full-time coaches and 234 volunteers. Among the findings was that 62% of sampled coaches believed that their athletes learn better when information is provided in a manner consistent with their preferred learning style. This is contrasted with a major review (Pashler et al., 2009) which concluded that there is "no adequate evidence base" (p. 105) for the effectiveness of learning styles. However, 57% of coaches in the Bailey et al. study also reported that they had been exposed to the idea of learning styles through formal coaching qualifications, suggesting that formal coach education courses are a likely source of the promotion of pedagogical practices that are not supported by evidence. As of late 2017, before course content was hidden behind a paywall, the AFL's 'Level 1 Youth and Senior Coaching Course' online coaching module still contained information about coaching according to an athlete's preferred learning style. The course material suggests that "it's important that you're able to identify the preferred learning style of each player and adapt your coaching techniques

accordingly" (AFL, 2017). The Bailey et al. study also collected data on formal coaching qualifications, but did not find a significant relationship between the level of qualification attained and the likelihood of belief in pseudoscientific ideas about coaching. Further studies in this area may benefit from the inclusion of a variable pertaining to the current level of performance or experience of each coach, as the demographic information presented in the Bailey et al. paper (age, qualification, employment study) is not sufficient to draw clear conclusions about the effect of experience or current coaching level on the belief in neuromyths. It is important to consider the transmission of neuromyths and other unhelpful beliefs about pedagogy, in order to more carefully target coach development interventions aimed at improving coach practice.

Feedback has been a mainstay as a pedagogical strategy of interest in coach observation studies in both training and performance settings (Cope et al., 2017). These studies will be explored in further depth in a later part of this chapter (see 'Providing feedback to athletes: theory and practice' below). Despite the focus on the provision of feedback in observation studies, an area receiving less attention has been the knowledge and beliefs of coaches about feedback and its use (Smith & Cushion, 2006). This is despite calls more generally for the myriad of coach observation studies to be supplemented with more qualitative investigations of coach practice such as interviews (Potrac et al., 2002) in order to provide greater detail about the contexts and constraints that coaches operate under in reality (Kahan, 1999). Amorose (2007) suggests that a research focus on the beliefs and values that lead to the pedagogical behaviours employed by coaches is lacking, but necessary to supplement the current knowledge base around coach behaviour. An understanding of coach beliefs about

feedback is an important step in ultimately improving coach feedback practices, and coach education in general (Côté et al., 1995).

As with many other concepts related to this thesis, looking to the field of education provides insight into the relevance of practitioner beliefs and the influence that these beliefs have on subsequent practice. A sizeable body of evidence about teacher beliefs suggests that teachers hold varied beliefs about their pedagogical practice, and that these beliefs vary across context and cultures; importantly, beliefs are typically related to the pedagogical strategies adopted by teachers (Fang, 1996; OECD, 2009). As with coach education opportunities in the sporting world, there exists a wealth of teacher professional development opportunities designed to improve the instructional practice of teachers (Darling-Hammond et al., 2017). It is suggested that a vital element of improving teacher practice involves considering the perceptions and beliefs of teachers about pedagogy (Putnam & Borko, 1997). It therefore appears important that coach beliefs about pedagogy, including feedback, are considered when designing coach education and development opportunities (Côté et al., 1995). For this to occur, evidence about what coaches know and believe about feedback is required.

The finding that teachers hold varied beliefs about pedagogy appears to be mirrored in studies investigating coach beliefs about feedback. A wide spectrum of beliefs and philosophies is apparent in the coaching literature, ranging from a highly coach-controlled view of feedback to a more athlete-centred and largely facilitative approach (Côté et al., 1995; Potrac et al., 2002; Smith & Cushion, 2006). A rare example of a coach observation study that is paired with a qualitative investigation into the beliefs underpinning coach practice is seen in a case study of an expert soccer coach (Potrac et al., 2002). Systematic observation data suggested that high levels of

instruction were used by the coach to prescribe individual roles within the team system. Upon reflection, the coach articulated beliefs such as "they've got to be told what is expected of them" (p. 191), and expressed a desire to be in control of his players during training sessions. A major influence on this philosophy appeared to be job security. The coach perceived that his employment as a coach was contingent on competitive success, and so a controlling pedagogical style was believed to be the most effective method of achieving this. In an earlier study investigating coach knowledge, gymnastics coaches reported preferring to provide their athletes with feedback constantly (Côté et al., 1995), reflecting that it was important that their athletes "know where they are regularly" (p. 82).

The high levels of coach control described in the above studies are contrasted with evidence presented elsewhere, suggesting that some coaches adopt a highly athlete-centred approach to feedback. Smith and Cushion (2006) found that expert English soccer coaches used silence strategically during in-game coaching to allow players to make decisions without an overly prescriptive approach. Coaches also reported not wanting to overload athletes with information, preferring to provide a small number of simple prompts. Allowing athletes to experiment without coach intervention, and asking athletes to self-evaluate before providing feedback, were strategies mentioned by the more athlete-centred coaches interviewed in the Côté et al. (1995) study. Across studies, a similar spectrum is seen when coaches are asked to consider feedback valence; some coaches report using up to 90% negative feedback (Côté et al., 1995), while others reported a more balanced approach (Smith & Cushion, 2006). This evidence suggests large variations in coach beliefs about effective feedback practices, which may reflect the unique challenges (Lyle, 2002) represented by the different contexts in which coaches work (Harvey et al., 2013).

When considering the existing research, it appears that the most common method of establishing coach beliefs and knowledge appears to be via interview. A potential challenge for this area may be seen in evidence suggesting that coaches are typically inaccurate when asked to reflect on their behaviours, including their use of feedback. In one study, rowing coaches were observed providing verbal feedback to their athletes during training (Millar et al., 2011). They were later asked to reflect on the types of feedback they provided. Coaches overestimated feedback perceived as desirable by between 5% and 40%. Specifically, coaches typically underestimated their use of highly prescriptive or controlling instruction. Coaches also overestimated their use of questioning to facilitate athlete evaluation of performance. In another study, youth volleyball coaches overestimated their use of tactical feedback and underestimated their use of technical feedback compared to the rates observed in a training session (Pereira et al., 2010). Taken together, these findings suggest that pairing coach interviews with observations of actual coach behaviour may be an important avenue for verifying the beliefs and knowledge that coaches express in interview studies.

The review of coach beliefs about pedagogy presented above reveals a paucity of studies in the area, despite evidence to suggest that beliefs are strongly linked to actual practice. The limited evidence available suggests that coaches can adopt unhelpful beliefs about pedagogy, such as neuromyths, through both formal and informal learning sources. Coaches hold views about feedback that are widely varied, and likely depend on the context in which they work. The lack of work in the area of coach beliefs about pedagogy may partially be explained by the methodological difficulties associated with asking coaches to reflect on their beliefs. Despite this, it is

a worthy area of further investigation, with important implications for improving coach practice.

Providing feedback to athletes: theory and practice

The literature review now shifts from a focus on what coaches know and believe about feedback, to how they actually provide feedback to their athletes. In contrast to the scarcity of research on coach knowledge of feedback, the abundance of studies investigating types, rates, and amounts of feedback provided by coaches makes this a substantial component of the literature review.

Theoretical approaches to feedback. A major focus of this thesis is on the practical application of feedback in the field (i.e., an environment with high ecological validity). However, in order to situate this research in the context of feedback research more broadly, it is important to briefly consider the development of feedback theories across the last century.

The origins of research on feedback likely date back to the work of prominent psychologist E.L. Thorndike. His early work on operant conditioning, which considered the result of post-event information on subsequent behaviour (Kulhavy & Wager, 1993), paved the way for a focus on behaviourism throughout the twentieth century. At this point, feedback was seen as a behavioural reinforcer that could shape learning through reward and punishment. An element of feedback as reinforcement is still seen in modern feedback research; many coach observation instruments include a category for positive or negative feedback (e.g., Cushion et al., 2012).

During the second half of the twentieth century, feedback began to be considered as information, and not just behavioural reinforcement. The 1960s and 70s

saw the development of cognitive psychology, with a focus on an information processing model of feedback (Mory, 2004). Along with this was the notion of the computer metaphor, in which the learner is considered to encode, store, and retrieve information in a similar manner to a computer. One of the major purposes of feedback in this model is error correction (Kulhavy & Stock, 1989). Research on feedback in a range of fields was heavily influenced by the information processing model for decades. A common paradigm for testing the effects of various forms of feedback over the last fifty years has been to provide feedback information from an external source following the completion of a task, particularly in a lab-based setting. This has been a widely-used approach in both education research (Mory, 2004) and in the field of motor learning (Sigrist et al., 2013).

It should be noted that both the behaviourist and information-processing views of feedback described above are primarily objectivist views of feedback, in which objective information and knowledge exists reliably and independently of the learner's experience and social forces (Smith, 2010). Alternative views to this include constructivism, in which the learner must construct their own reality through personal experiences and interpretation (Bodner, 1986). Constructivist views of feedback include the notion that its meaning is generated by the individual's own understanding of the world, and that feedback facilitates knowledge construction.

A prominent modern theory of learning in the context of movement skill acquisition is ecological dynamics (Davids et al., 2013). This approach proposes that an individual learner does not exist independently of the context in which they learn or perform. An emphasis in this approach is the coordination of the interactions between a learner or performer, and their environment. Feedback is therefore seen as a

constraint that interacts with the individual and the task at hand to shape learning; feedback can either improve or degrade learning depending on its usefulness to the learner (Chow et al., 2009).

Contexts for the provision of feedback. Before presenting the feedback coding schemes and evidence on their use, it is important to note the major differences between the contexts in which they are used. A review of coach observation studies between 1975-1997 reported that 65% of coach observations were conducted in a training environment, with just 22% observing a game or competition setting and 13% using a combination of both (Kahan, 1999). Between 1997 and 2016, just 6 of the 26 published coach observation studies investigated a competition setting, with 18 investigating a training environment and 2 studies examining both (Cope et al., 2017). Throughout this review, all available evidence on each type of feedback will be presented under a heading corresponding to the type of feedback rather than the context; however, the context of the observation study will be noted wherever possible. It should not be assumed that feedback types or rates in a training environment are similar to those observed in a competition environment or an off-field environment, as each setting presents unique challenges (Lyle, 2002). It is for this reason that the reader is cautioned against comparing between studies without also considering the different contexts in which the coach was observed.

A concept receiving increasing attention as technology advances is the provision of feedback with the use of video footage of training or competition performances, used in order to aid the coach-athlete feedback process. Early studies considered video feedback to be knowledge-of-performance (KP) feedback given after trials of a typically closed motor skill such as bowling (Rothstein & Arnold, 1976).

Video-based feedback has seen more recent use in a high performance environment in sports such as tennis or golf (Guadagnoli et al., 2002), where a relatively closed skill such as a serve or swing can be analysed and video provided between repetitions. An emerging field is the use of video for the purpose of performance analysis in high performance team sports (Ives et al., 2002). In this context, video is used in reviewing performance in the hours or days following a competition, and involves the coach presenting video clips to one or more athletes while simultaneously providing verbal feedback and questioning the athletes (Groom et al., 2011). A small number of studies have specifically investigated feedback provided in the video-based feedback context (Middlemas & Harwood, 2017; Nelson et al., 2011). Studies typically find that the environment is largely coach-controlled, with limited athlete input, and questioning used as a tool to select turn-takers rather than to aid in the development of new knowledge (Groom et al., 2012). Coding and quantifying feedback types in a video-based feedback setting has not yet occurred in coach observation research. Therefore, video-based feedback does not appear in the following discussion of coach observation studies and the rates of feedback contained within. However, this gap in the literature is a focus of a study presented later in the thesis.

Coach observation studies. Before examining individual feedback codes used in pedagogy research, it is important to first acknowledge the early development of coding schemes used to observe and quantify coach behaviours in a real-world setting. Early coach observation studies were influenced by teacher observation research emerging from the education literature (Flanders, 1970). One of the earliest coach behaviour coding schemes was developed by Tharp and Gallimore (1976) for their seminal study on John Wooden. By their own admission, the authors observed Wooden's training sessions with preconceived notions about what to observe, based on

their previous work with teacher observations. Their final coding scheme appeared strongly aligned with a behaviourist approach to feedback theory. Categories included: instructions, hustles (verbal statements with the intent of intensifying previous instruction), positive and negative modelling of performance, praises, scolds, and nonverbal rewards and punishments. This coding scheme, or a variation of it, was subsequently used in observations of a high school basketball coach (Williams, 1978), a college football coach (Langsdorf, 1979), a field hockey coach (Dodds & Rife, 1981), and a larger study on ten high school football coaches (Lacy, 1983). All of these studies found instruction to be the most commonly employed behaviour, with rates around the 40-50% mark.

A year after Tharp and Gallimore's (1976) influential study, a unique systematic coding scheme for the behaviour of coaches was published by Smith, Smoll and Hunt (1977). The Coaching Behavior Assessment System (CBAS) was developed through content analysis of both training and game settings, consisting of 12 behavioural codes categorised into reactive behaviours (initiated in response to player behaviours) and spontaneous behaviours (initiated by the coach unprompted). The coding scheme includes feedback variables such as positive reinforcement/reward and negative reinforcement/punishment. In contrast to many other schemes, the CBAS also considers coach behaviours following desirable performances or mistakes, including options such as encouragement, technical instruction, and punishment. The CBAS was a popular coding scheme between 1975 and 1997 (Kahan, 1999), with 12 coach observation studies employing it. However, between 1997 and 2016, just one study used the CBAS (Cope et al., 2017).

The Arizona State University Observation Instrument (ASUOI; Lacy & Darst, 1984) was developed to expand upon Tharp and Gallimore's (1976) original coding categories, but seemingly independent of influence from Smith, Smoll and Hunt (1977). Additional categories include pre-instruction, concurrent instruction, and post-instruction, in an attempt to capture the timing of instruction more effectively. Questioning was considered as a pedagogical behaviour, and silence was included to capture instances of observation by the coach. The ASUOI has been the most commonly used coach behaviour coding scheme in research between 1975 and 2016 (Cope et al., 2017; Kahan, 1999). Across these studies, instruction has consistently been the most prominent coach behaviour coded, making up between 30-40% of coach behaviour. Although the comparison of praises/scolds to positive/negative feedback should be made with caution, it is useful to note that praise/scold codes seldom make up more than 10% of total coded behaviours across studies employing the ASUOI.

A coding scheme that has increased in usage in the past decade is the Coach Analysis Intervention System (CAIS; Cushion et al., 2012), a computerised system with validity and reliability data established. The CAIS considers feedback more thoroughly than previous coding schemes, and includes feedback categories such as: specific feedback positive/negative, general feedback positive/negative, and corrective feedback. In addition, historically popular categories such as hustles, praises and scolds are kept in the coding scheme. Between 1997 and 2016, the CAIS was used eight times to observe coach behaviour (Cope et al., 2017).

A major component of Cope et al.'s (2017) analysis of coach observation studies since 1997 was a critique of the field's progress since an earlier review of studies by Kahan (1999). One of the major shortcomings of modern coach observation

studies has been the inconsistent use of coach observation instruments. For example, of the eight studies to use the CAIS since 1997, six of them did not use the original validated version, but instead chose to modify the instrument in some way. The inconsistencies in coding schemes between studies provides challenges for synthesising the literature. In addition, Cope et al. note that the rationales offered in studies where the original instrument has been modified have typically been limited.

With this in mind, the following section will consider some key feedback coding schemes found across coach observation instruments and other coach feedback research. The rationale for the selection of these methods of classifying feedback sits with the idea that existing schemes like those described above typically consider coach feedback valence (i.e., positive/negative), often to the exclusion of other variables found in feedback research outside of coach observation studies. Given the exclusive focus on feedback in this thesis, a custom coding scheme that primarily considers common feedback theories was necessary to obtain a more complete picture of coach feedback.

Methods of classifying coach feedback. This section presents selected feedback coding schemes found in the sports coaching literature, with the education and motor control literature drawn on when relevant to supplement the sometimes one-dimensional focus of coach observation instruments. Within each section, any existing evidence in a sports coaching sample is presented to illustrate the prevalence, frequency or rates of each type of feedback.

Feedback valence. A common method of categorising feedback involves determining the positive or negative nature of the feedback, also known as feedback valence. Categories related to feedback valence have been consistently included in

coach observation studies since the 1970s, but variation is noted in the labels given to categories generally designed to capture the positive or negative nature of the feedback. For the purpose of this review, categories such as praise vs scold (a feature of early instruments such as Tharp & Gallimore [1976] and the ASUOI [Lacy & Darst, 1984]) will be considered a proxy for positive vs negative feedback. Table 1 provides a summary of coach observation studies that have included a code for feedback valence. It should be noted that the rates of positive vs negative feedback have been calculated from frequency (i.e., number of occurrences) rather than interval (i.e., amount of time) data. Any 'neutral' categories have been removed for the purpose of pooling data, to obtain a simple positive-negative ratio.

Table 1

Rates of Positive and Negative Feedback Across 26 Coach Observation Studies

Authors	Year	Sport	Level	Setting	Observation tool	Positive %	Negative %
Tharp & Gallimore	1976	Basketball	College	Training	Tharp & Gallimore	32	68
Langsdorf	1979	Football	College	Training	Tharp & Galilmore	32	68
Model	1983	Football	High school	Training	Tharp & Gallimore (modified)	80	20
Lacy & Darst	1985	Football	High school	Training	Tharp & Gallimore (modified)	68	32
Claxton	1988	Tennis	High school	Training	ASUOI	83	17
Trudel, Côté & Bernard	1996	Ice hockey	Junior	Competition	COSG	24	76
Kahan (review paper)	1999	Various	Various	Various	ASUOI	69	31
Kahan (review paper)	1999	Various	Various	Various	CBAS	77	23
Bloom, Crumpton & Anderson	1999	Basketball	College	Training	Tharp & Gallimore (modified)	69	31
Cushion & Jones	2001	Soccer	Junior	Training	ASUOI	89	11
Massey et al.	2002	Strength coaches	Elite	Training	ASUOI	84	16

Potrac, Jones & Armor	2002	Soccer	Elite	Training	ASUOI	97	3
Horton, Baker & Deakin	2005	Various	Elite	Training	Tharp & Gallimore (modified)	98	2
Smith & Cushion	2006	Soccer	Junior	Competition	ASUOI	94	6
Potrac, Jones & Cushion	2007	Soccer	Elite	Training	ASUOI	96	4
Becker & Wrisberg	2008	Basketball	College	Training	ASUOI	68	32
Mesquita et al.	2008	Volleyball	Junior	Training	ASUOI	75	25
Zetou et al.	2011	Volleyball	Elite	Training	RCBRF	66	34
Guzman & Calpe-Gomez	2012	Handball	Elite	Competition	Custom: CBAS, ASUOI	49	51
Partington & Cushion	2012	Soccer	Junior	Competition	CAIS	65	35
Gomez, Guzman & Grijalbo	2013	Handball	Various	Competition	CAIS	75	25
Harvey et al.	2013	Various	College	Training	CAIS	79	21
Partington & Cushion	2013	Soccer	Junior	Training	CAIS (modified)	65	35
Partington, Cushion & Harvey	2014	Soccer	Junior	Training	CAIS (modified)	58	42
Hall, Gray & Sproule	2016	Rugby	Elite	Both	RCABI	69	31
Halperin et al.	2016	Boxing	Elite	Competition	Custom	69	31

Overall		
Competition (n = 6)	63	37
Training (n = 18)	73	27
High school (n = 3)	77	23
Junior (n = 8)	67	33
College (n = 6)	60	40
Elite (n = 7)	78	22
ASUOI (n = 10)	84	16
CAIS (n = 6)	68	32
Tharp & Gallimore (n = 6)	63	37

Notes: ASUOI = Arizona State University Observation Instrument, COSG = Coaches Observation System for Games, CBAS = Coaching Behaviour Assessment System, RCBRF = Revised Coaching Behaviour Recording Form, CAIS = Coach Analysis and Intervention System, RCABI = Rugby Coach Activities and Behaviours Instrument.

As can be seen in Table 1, rates of positive/negative feedback in the literature are varied, and likely depend on the context in which they are observed. Low amounts of positive feedback are observed in early studies (Langsdorf, 1979; Tharp & Gallimore, 1976), which may reflect the social climate and competitive college environment in which the studies were completed. Overall, feedback appears to be more positive during training than competition, which may reflect the increased pressure of a competitive environment. Some evidence suggests that coaches exhibit increased symptoms of psychophysiological stress, such as an elevated heart rate, during critical game events such as a goal being scored against the team (Kennedy & Knight, 2017). This provides an example of the constraints specific to a competitive setting that may impact feedback patterns, and in particular the valence of the feedback. The observational tool used also appears to influence the observed rates of feedback valence; the praise vs scold categories seen in the ASUOI depict a more positive feedback approach (84% positive/16% negative) than the positive vs negative feedback categories in the CAIS (68% positive/32% negative).

A small number of studies have also investigated rates of feedback valence according to the margin or outcome of the game. For example, in a study of Australian Rules football coaches, Madden (1995) found significantly higher rates of positive feedback were provided by coaches of winning teams than coaches in charge of losing teams. Gomez et al. (2013) found significantly more positive feedback in close games than in large losses when investigating handball coaches. Halperin et al. (2016) found that a statistically significant 18% more positive feedback was given to boxers during a winning bout when compared to a losing bout.

Studies outside of coach observation research show that manipulating feedback valence can impact both emotional/motivational and learning/performance outcomes. For example, Chiviacowsky and Wulf (2007) provided participants with feedback about their performance after either three 'good' trials, or three 'poor' trials of a beanbag tossing task. The group receiving feedback after good trials showed improved performance on a delayed retention test when compared to the group receiving feedback after poor trials. Stoate et al. (2011) extended this research into an applied sporting setting, finding that runners who were given positive feedback displayed improved physical movement efficiency, a perception of greater ease, and positive affect, compared to a control group receiving no feedback. In their study of ringside feedback provided to competitive boxers, Halperin et al. (2016) suggested that positive feedback can enhance athlete expectancies, which has been shown in a range of settings (Hattie, 2009) to be an important factor in determining achievement. This is supported by Mann (2012), who found that lower-skilled athletes exhibited improved decision-making after a time-out in which the coach provided positive rather than negative feedback. Taken together, these findings suggest that positive feedback can have benefits for learning and performance outcomes.

Descriptive vs prescriptive feedback. An important part of a feedback message relates to how it cues the learner; specifically, whether it describes past performance and leaves the learner to search for their own solutions to improve future performances, or whether it explicitly prescribes future actions to improve. Prescriptive feedback may be particularly useful to novices because it assists with correcting the many errors that typify early stages of learning a task, and ultimately guides performance closer to a desired outcome (Schmidt & Wrisberg, 2008). Importantly, the descriptive/prescriptive dichotomy is independent of feedback

valence; descriptive feedback can be either positive (e.g., 'that was a great performance) or negative (e.g., 'that was a poor performance') in nature, as can prescriptive feedback.

Evidence suggests that prescriptive feedback can improve performance of a novel motor task compared to descriptive feedback (Kernodle & Carlton, 1992). It has also recently been shown to improve the learning of a golf putting task in older adults who are novice golfers, when compared with descriptive feedback (Nunes et al., 2020). However, some motor control studies suggest that more advanced learners, who have already mastered the basics of a task, may benefit more from simple descriptive feedback (Magill & Anderson, 2012). This allows the learner to seek ways to correct the error themselves. If feedback is provided too early or too much information is given to the learner, the learner may not develop the skills required to self-regulate performance, as is also found in educational contexts (Bangert-Drowns et al., 1991). There is an absence of studies that have directly compared the effectiveness of descriptive and prescriptive feedback for learning or performance outcomes in a competitive sporting setting, with most studies focussing on complete novices rather than trained athletes. However, an assumption based on the evidence above may be that athletes in a high performance setting, who may be considered expert performers, could benefit more from descriptive feedback. Novice athletes may in turn benefit more from prescriptive feedback. However, it is also possible that expert performers could be novices at certain tasks; for example, consider the scenario of a striker in soccer who is trained as a goalkeeper due to squad injuries.

Aside from learning or performance benefits, descriptive and prescriptive feedback may also have different effects on a learner's expectancy of future success at

a task. Amorose and Smith (2003) found that junior athletes receiving descriptive feedback had higher expectations of success next time they completed a softball hitting task, compared to those who received prescriptive feedback. In a classroom setting, students who are seen to receive explicit help from a teacher (i.e., prescriptive feedback) can be perceived as having lower ability (Graham & Barker, 1990). It is possible that lower athlete expectancies as a result of prescriptive coach feedback could subsequently reduce performance.

Autonomy-supportive vs controlling feedback. Another feedback classification method involves the nature of the feedback's delivery; regardless of content, feedback can be delivered in a way that allows athlete autonomy, or in a controlling manner. Heavily influenced by self-determination theory (Deci & Ryan, 2000), autonomy supportive feedback is considered to be: empathic, paired with choices of potential solutions, based on objectives that the learner sees as clear and attainable, avoids person-related statements, includes tips on how to improve next time, and is delivered in a considerate tone of voice (Carpentier & Mageau, 2013). The interplay between autonomy-supportive feedback and feedback valence appears complex and important; it is suggested that autonomy-supportive feedback can preserve learner motivation when receiving negative (corrective) feedback, when compared to receiving negative feedback in a controlling manner (Mouratidis et al., 2010). This is because the focus of the feedback becomes about the task at hand and possible solutions, which guides the learner's attention to the learning process rather than possible threats to the self.

Despite the appeal of the theory at face value, there is limited evidence to suggest that autonomy-supportive feedback is associated with improved learning or performance when compared to controlling or neutral feedback. Links between an

autonomy-supportive coaching approach and athlete performance outcomes have been shown indirectly (Gillet et al., 2010). A sample of 101 judo players were asked to rate the extent to which their coach adopted an autonomy-supportive approach. Athlete contextual and situational self-determined motivational variables were also included in a structural equation model, with a final variable included for athlete performance. While no direct effect of coach autonomy support on athlete performance was found, self-determined motivation was a significant predictor of performance, which was in turn predicted by coach autonomy support. Despite the indirect nature of the relationship, the study is currently the strongest evidence that an autonomy-supportive approach can positively impact performance.

Webster et al. (2013) explicitly tested the hypothesis that more successful college soccer coaches would provide more autonomy-supportive feedback than less successful coaches in training and competition, adopting a systematic coach observation study design. Observed rates of autonomy-supportive feedback indicated small differences between groups overall, but that less-successful coaches provided more autonomy-supportive feedback in a competition setting. In the previously-mentioned boxing study (Halperin et al., 2016), coach ring-side feedback was coded according to an autonomy-supportive/controlling/neutral scheme. A striking finding was that 53% of coach feedback was seen as controlling, with just 6% considered autonomy-supportive and 42% considered neutral. In winning bouts, autonomy-supportive feedback increased to nearly 7%, but dropped to 4% during losing bouts. Lyle (2002) contends that many coaches believe they must maintain control over as much as possible to coach successful performances, and do not see the value of providing the athlete autonomy. This observation, along with the remarkably low rates of autonomy-supportive feedback reported in the literature, suggests that a major area

for improving current coach performance may be found in increasing rates of autonomy-supportive feedback. However, stronger evidence for the benefits of autonomy-supportive feedback for performance is also required, along with further examination of the interplay between autonomy-supportive feedback and feedback valence.

Hattie & Timperley's feedback model. A four-level model of feedback was proposed by Hattie and Timperley (2007), who suggested that the effectiveness of feedback is related to its level of focus. Feedback about the learner as a person (self-level feedback) is considered to be the least effective for influencing achievement, because it contains little to no task-specific information. Evidence from several meta-analyses (Kluger & DeNisi, 1998; Wilkinson, 1981) illustrated that praising the learner has a negligible effect on improving outcomes in a classroom setting. However, it is also important to note that praise related to effort, processes, or in relation to the task itself can enhance self-efficacy; the authors take issue primarily with praise directed to the learner as a person (e.g., "you are fantastic"). The second level of feedback relates to the completion of the task at hand (task feedback), and is analogous with the 'knowledge of results' or 'corrective feedback' categorisations commonly seen in motor control literature (Schmidt & Wrisberg, 2008). In a classroom setting, task feedback is the most commonly presented form of feedback (Harris et al., 2014). Presented alone, task feedback can impact learning positively (Tenebaum & Goldring, 1989), particularly for early stages of learning (Heubusch & Lloyd, 1998). However, Hattie and Timperley argued that task feedback is most effective when it is used as a foundation to then provide other levels of feedback: process and self-regulation. Process feedback is about the skills or processes needed to understand and perform tasks. Receiving feedback about processes can function as a way of cueing the learner

to select appropriate strategies to complete a task. Process-level feedback may also be more effective than task-level feedback in developing a deeper understanding of the learning (Balzer et al., 1989). Finally, self-regulation feedback helps the learner to develop an ability to self-assess, seek help, monitor and direct future actions. This level of feedback is aimed at helping the learner to reduce a dependency on external sources of feedback (a teacher or coach, for example) and gain greater control over the learning process. Hattie and Timperley consider learners with lower self-regulatory abilities to be less effective learners.

In addition, Hattie and Timperley's model proposes three questions that effective feedback answers: Where am I going? How am I going? Where to next? The latter two questions are analogous to the descriptive/prescriptive dichotomy described elsewhere in this review; 'How am I going?' describes performance, while 'Where to next?' prescribes future actions to bridge the gap between current and goal performance. Hattie and Timperley's feedback model has seen limited use in school-based observational studies (Harris et al., 2014), and no use at the time of writing in coach observation studies outside of those included in this thesis.

Hattie and Timperley's (2007) model of feedback in turn drew influence from a meta-analysis conducted by Kluger and DeNisi (1996), which they considered to be "the most systematic study addressing the effects of various types of feedback" (Hattie & Timperley, 2007, p. 84). From the data collected through meta-analysing 131 studies on feedback, Kluger and DeNisi proposed feedback intervention theory, which suggests that feedback interventions become less effective as they move more towards drawing attention to the learner (e.g., praise), and away from the task. They further propose that three main types of variables impact on feedback's effectiveness: cues

contained in the feedback message, the nature of the learning task, and personality or situational variables.

Group vs individual feedback. A general feedback variable of interest, particularly in team sport settings, is whether the feedback is delivered to specific individuals or directed to the team or particular playing positions (e.g., forwards, defenders) as a whole. While not derived from any particular feedback theory, gaining a sense of the feedback's intended audience provides another angle from which to view feedback, particularly during competition; feedback targeted towards the group may indicate it is focussed on group dynamics or strategy involving multiple team members, whereas individual feedback may be assumed to relate to one athlete's individual performance independent of the team's performance. Rates of individual and team feedback are not commonly included in coach observation studies, but a small sample of studies generally indicate that group feedback is more frequent in a team sport setting than individual feedback. Rates of group feedback between 61% (Moreno et al., 2005) and 80% (Madden, 1995) have been reported during game breaks, and 55% during training activities (Becker & Wrisberg, 2008). There is limited evidence on the effectiveness of group vs individual feedback on team performance outcomes, but evidence from educational psychology literature suggests that feedback effect sizes are similar in both individual and group settings (Tannenbaum & Cerasoli, 2013).

The role of questioning. Although this thesis focusses primarily on the feedback given by coaches to their athletes, a related concept is the use of questioning that often accompanies the provision of feedback by coaches. Questioning is considered to be a pedagogical tool that promotes an athlete-centred environment

(Davis & Sumara, 2003), and can assist athletes to develop problem-solving and decision-making skills (Chambers & Vickers, 2006; García-González et al., 2013) or attune their focus to task-relevant information in their environments (Renshaw et al., 2012). However, many coach observation studies suggest that coaches ask very few questions (Cushion & Jones, 2001; Potrac et al., 2007), which suggests the positioning of the coach as an expert and the athlete as a passive recipient of information (Cope et al., 2016). Additionally, coaches primarily ask closed or convergent questions, at a rate of more than two to one when open or divergent questions are also coded (Partington & Cushion, 2013). Convergent questions allow for little athlete autonomy and force athletes into choosing from a limited number of options; conversely, divergent questions allow for greater athlete 'talk' and agency. The convergent/divergent rates found in coach observation studies mirror rates found in a traditional classroom setting (Kim, 2015; Martin & Hand, 2009). Further evidence on the quality of questions asked by coaches is provided by Groom et al. (2012), who observed that questioning is used by coaches as a tool to select turn-takers, rather than to aid in the development of new knowledge. Coaches also do not vary their questioning depending on the athlete, exhibiting similar questioning methods regardless of the individual abilities or dispositions of their athletes (Cope et al., 2016). This is of particular importance when considering the below section on evaluating feedback reception, given the importance of questioning for gathering evidence of learner knowledge.

Considering the reception of feedback

So far, this review has focussed on feedback from the coach's perspective. As the provider of the feedback, it is important to know what coaches know and believe about feedback, as well as the types of feedback they provide to athletes. However, a

common criticism of feedback research is that it typically considers the feedback provided to a learner without considering the factors that the learner brings to the interaction (Butler & Winne, 1995; Chen & Rikli, 2003). A necessary consideration when evaluating the overall state of feedback in sport therefore concerns the receiver of the feedback. How do athletes listen to, interpret, and use feedback? Do athletes hear every feedback message? Are they able to interpret and make meaning from each? How much is too much?

Athletes must be able to attend to, interpret, remember, and act upon feedback messages in order for the feedback to influence performance (Hattie, 2009), but there is often a discrepancy between feedback given and feedback received. An illustration of this in practice comes from a study of judo players and their coaches, which found that an average of 31% of coach-to-athlete instruction provided before a competition was not recalled by players when interviewed immediately after the competition (Mesquita et al., 2008). In the medical field, a striking finding was that 91% of surgeons reported that they were successful at providing effective feedback, but just 17% of the residents receiving this feedback agreed (Liberman et al., 2005). In the classroom, 70% of teachers claimed to provide helpful and detailed feedback, but only 45% of students agreed (Carless, 2006). In a sporting setting, some authors suggest that an absence of coach awareness about how athletes process and respond to feedback can have negative implications for player performance (Pensgaard & Duda, 2002). It is acknowledged that a related topic receiving much attention in both research (Brower et al., 2001; González-Haro et al., 2010) and practice (Bailey et al., 2018) is the idea of tailoring coach instruction to different learning styles such as visual, auditory and kinaesthetic. However, learning styles show poor construct validity, cannot be measured reliably, and do not improve learning outcomes (Pashler et al.,

2009). The following section instead considers factors with more substantial empirical support that may be important in the reception of feedback by an athlete. They include the quantity of feedback provided, and athlete characteristics such as working memory and dispositions towards receiving feedback.

Feedback quantity and the role of working memory. Evidence from coach observation studies suggests that athletes do not recall every piece of feedback given to them by a coach during training or competition. A series of studies conducted in Portugal and Spain tested athletes on their ability to recall feedback provided to them in a training session by a coach. Rates of recall ranged between 57% (Januario et al., 2015) and 69% (Mesquita et al., 2008). A study conducted by the same research group revealed that high school physical education students recalled 69% of information provided by a teacher on average, finding an inverse relationship between the quantity of information provided and subsequent recall of the information (Januario et al., 2015).

The amount (or rate) of feedback provided to athletes can impact its effectiveness, and perhaps differentially according to the athlete's attentional and memory resources. Magill and Anderson (2012) suggested that feedback provided by an athlete should be the minimum amount of information required to convey the intended message. Based on Miller's (1956) classic study on working memory capacity, Magill and Anderson proposed a guideline that coaches should provide feedback about only one error observed during the athlete's performance. The authors considered this to be of particular importance for novices, who can experience issues in determining which errors to correct. There is some empirical support for the idea that limiting feedback can improve performance. In a sample of 30 junior gymnasts,

Sadowski et al. (2013) found that limiting feedback to a few key elements of technique resulted in higher scores on a difficult gymnastics manoeuvre than providing feedback on every error made. Although this result suggests that a reduction in feedback information can result in improved performance, it is not known from this study whether working memory was the mechanism for this to occur, although the authors suggest that limiting feedback may prevent the athlete from becoming overwhelmed.

The limited generalisability of findings is a noted shortcoming of research investigating working memory capacity (WMC) in sport (Buszard et al., 2017), because many studies use a contrived lab-based experimental protocol. A recent paper investigating the role of WMC in a basketball shooting task provided some evidence from an applied setting. Buszard et al. (2017) found that children in a high WMC group showed consistent improvements in basketball shooting compared to children in a low WMC group, with both groups given five identical explicit instructions about shooting a basketball. The low WMC group displayed reduced performance across the experiment, suggesting that explicit instruction can in fact hinder performance with athletes who do not possess the attentional capacity needed to process such instruction. This finding provides ecologically valid evidence that WMC can play an important role in an athlete's ability to use instruction or feedback to improve performance.

A number of studies focussing on the attentional limits of athletes employ dual-task paradigms, where the performer executes a motor task (the primary task) at the same time as processing cognitively demanding material (the secondary task). Performance in the motor task typically degrades as the cognitive load from the secondary task increases, unless the performer has achieved a degree of automaticity in the motor task and can therefore devote cognitive processes to the secondary task (for

a review, see Huang & Mercer, 2001). The implication for the provision of feedback is that providing cognitively demanding feedback to an athlete who has not achieved automaticity with the task in question may be detrimental to performance because of the limits to attentional capacity. When providing feedback away from the performance environment, as is the case in post-competition video-based feedback reviews employed by many high-performance sporting organisations, there may also be factors other than feedback competing for athlete attention. A study of player and coach perceptions of video-based feedback sessions found that players reported losing focus when they personally appeared in a video clip (Middlemas & Harwood, 2017). One participant reflected on their attentional focus during sessions: "I'm listening to the coach talk about the team shape, but I'm watching myself, whether I have a good touch if I get the ball, or whether I look OK on screen" (p. 8).

Wrisberg (2007) summarised the literature on motor learning and games-based approaches to teaching sport, with two general conclusions: less feedback is generally better, and feedback amount should decrease as the experience levels of the athlete increase. Providing large amounts of feedback can also be associated with the athlete developing a reliance on the feedback, which can later degrade performance once feedback is removed (Salmoni et al., 1984). Given the suggestion that less feedback can result in superior performance, the responsibility falls to coaches to be able to identify instances where external feedback is needed to augment any intrinsic feedback from the athlete themselves, and also to select the most salient piece of feedback to deliver when there may be a need for several (Leas & Chi, 1993). As noted above, a major gap in the literature is the paucity of direct evidence from applied sporting contexts about optimal amounts of feedback.

How do athletes interpret feedback? Once feedback is attended to, it must be interpreted by the athlete to determine its meaning before it can be used. In classroom research, many teachers claim to give sufficient feedback to students, but the reception and interpretation of feedback by students is less tested (Hattie, 2009). There are a number of reasons that may explain why athletes interpret feedback in a different way to that intended by the coach. To be able to be interpreted, feedback must be provided in language that is clear and meaningful to the learner (Magill, 2010), but this is not always the case. Teachers and students can often report different interpretations of the same piece of feedback, which is known as the 'problem of shared meaning' (Boud & Molloy, 2013). When feedback is not clear and specific, the learner can experience frustration or believe the feedback is useless and then not act on it (Williams, 1997). Feedback that lacks clarity can also require greater information processing from the learner in order to interpret and extract meaning, adding to cognitive load and potentially reducing learning or performance outcomes (Bangert-Drowns et al., 1991), especially in those with lower working memory capacity (Stevenson, 2017). In the motor learning literature, Shea (1977) provided evidence that meaningfulness of information can positively impact learning. Learners who were asked to remember limb positions using labels that refer to a clock face (e.g., 12 o'clock) exhibited superior recall compared to learners who used random three-letter syllables to remember the same limb positions. These findings, taken together, demonstrate the importance of checking for feedback reception to ensure 'shared meaning' between coach and athlete.

Another reason for gaps between the coach's intended meaning and an athlete's interpretation of feedback may be the motivation of the athlete. Each athlete enters a learning environment with an individual history of experiencing success or failure with

previous learning tasks (Zanone & Kelso, 1997), and this can impact attitudes towards future learning. An influential framework for understanding the role of motivation in the reception of feedback is self-determination theory (SDT; Deci & Ryan, 2000). SDT is centred around three intrinsic needs that are proposed to be vital to a learner's functioning: competence, relatedness, and autonomy. Competence refers to a learner's feelings of effectiveness or mastery. Relatedness is a learner's desire to feel connected to others. Autonomy is considered an ability to self-organise and experience freedom of choice. Certain types of feedback may challenge these needs, leading to differences in interpretation among learners. Complementing this approach is Boekaerts' dual pathway theory (2006), which posits that a learner's appraisal of feedback results in attention being directed to either a growth pathway, or a well-being pathway. The growth pathway leads to the learner attempting to increase competence or improve performance as a result of the feedback provided. Attention is directed to the well-being pathway when there is perceived to be a threat of harm to the learner's feelings of competence which needs minimising.

Related to the above concept of self-determination, the way in which feedback is delivered can have effects on its interpretation by the learner. Autonomy-supportive feedback was described earlier in this review as feedback which is empathic, paired with choices of potential solutions, and avoiding person-related statements (Carpentier & Mageau, 2013). It is contrasted with controlling feedback, which forces the athlete to think or behave in a way the coach prescribes. Feedback that is corrective or negative in nature can be seen as a threat to competence, potentially harming a learner's motivation; however, motivation can be preserved when corrective feedback is delivered in an autonomy-supportive manner (Mouratidis et al., 2010). A focus on the task and not the learner themselves is proposed to reduce the likelihood of

feedback being interpreted as a threat to competence. This view is supported by the views of athletes; when coaches focus on providing performance-based feedback and not feedback directed towards the athlete as a person, athletes report improved affective, motivational and learning outcomes (Sagar & Jowett, 2012). Conversely, aggressive or hostile coach reactions lead to negative affective outcomes for athletes (Chen & Rikli, 2003; Sagar & Jowett, 2012). Athletes in Sagar and Jowett's study also expressed views that overly controlling feedback could reduce motivation and learning outcomes. Regardless of whether the negative feedback is provided in an autonomy-supportive or controlling manner, it is also possible that it may be attributed externally by the learner (i.e., it was not my fault), while positive feedback will be attributed to the learner's own enduring traits (i.e., self-serving bias; Hughes et al., 1997).

The significance of the body of research on athlete interpretation of feedback lies in the notion that feedback reception is not frequently considered in coach education, nor is a great deal known about feedback reception in areas outside of classroom research. Feedback reception represents a potential avenue for improving coach practice; if coaches can more carefully consider the factors that may help or hinder an athlete's ability to receive feedback, their ability to communicate effectively may be enhanced.

An important caveat to note at this point of the literature review is that classroom research can provide a useful angle from which to consider the reception of information by a learner, but may be limited in its effectiveness in explaining athlete learning because of differences in the intended outcome of the feedback. Providing feedback to a student on an essay or a maths problem, for example, involves feedback on cognition and subsequent action by a learner in the cognitive domain. However, in a

sporting context, verbal feedback provided by a coach is received and processed from a cognitive standpoint, but must then be physically implemented in order to change performance. A relevant paradigm in cognitive psychology is the distinction between declarative and procedural knowledge; declarative knowledge is considered to be 'knowing what to do', while procedural knowledge is 'doing it' (Magill, 1993). A key difference between the two categories is that declarative knowledge is widely considered easy for the athlete to access and verbalise, while the accessibility of procedural knowledge is more contentious, and considered by some to be mostly subconscious or implicit (Abernethy et al., 1993). Some authors believe that physical performance involves both declarative and procedural knowledge simultaneously (McPherson & Kernodle, 2003). Others consider cognition to be less important and instead emphasise the interaction of the performer and their environment (Travassos et al., 2012). Concurrent verbal instruction can even degrade performance (Wulf & Weigelt, 1997), especially if it is provided in large amounts that overload the performer (Salmoni et al., 1984). This is contrasted with education research that typically finds positive effects for feedback (Hattie & Timperley, 2007). Taken together, this evidence suggests that the nature of transforming verbal feedback into physical performance appears different to the process of transforming verbal feedback into cognitive outputs, as is the case in a classroom. However, given the prevalence of verbal feedback in high performance sport (Kahan, 1999; Cope et al., 2017), and the privileging of cognitive knowledge about performance observed in the use of video-based feedback sessions (Groom et al., 2011), an examination into education research that may be applied in a sporting setting appears warranted.

Individual athlete characteristics. One particularly thorough syntheses of feedback research (Kluger & Denisi, 1996), along with several more recent papers

(Narciss & Huth, 2004), consider learner personality factors such as self-efficacy to be an important influence on feedback effectiveness. Much of the feedback self-efficacy literature concerns the effect of feedback on learner self-efficacy, but self-efficacy of the learner receiving the feedback may also influence how the feedback is interpreted. It is possible that learner self-efficacy is related to the likelihood of the learner processing feedback along the growth pathway rather than the well-being pathway of Boekaerts' dual pathways (2006). This is because a high self-efficacy learner may possess the belief that they can succeed at using the feedback to improve performance, rather than seeing it as a threat to competence. Learners with low self-efficacy for using feedback may not have experienced as much success with using feedback previously, and therefore process feedback along the well-being pathway to minimise threats to competence. In contrast to this hypothesis, learners with high self-efficacy may be less likely to seek out feedback from external sources, and may not act on negative feedback as readily as they do with positive feedback (Ilgen et al., 1979). Additionally, allowing a learner to select when they receive feedback (known as a self-controlled feedback schedule) may promote self-efficacy, particularly as learners tend to request feedback after trials in which they believe they have been successful (Chiviacowsky & Wulf, 2005). However, further research is required to elucidate the role of self-efficacy in interpreting and using feedback.

Another related characteristic of the learner that may influence interpretation of feedback is a construct known as feedback orientation (London & Smither, 2002). Typical instruments for measuring a learner's feedback orientation include a number of sub-scales (Linderbaum & Levy, 2010). Utility refers to the learner's beliefs about how useful feedback is for their performance. Accountability is the learner's belief about their responsibility to use feedback. Social awareness refers to the learner's

beliefs about how feedback influences the impressions of others about the learner. Feedback self-efficacy is the learner's beliefs about their competence in using feedback. Evidence from a study of hospital staff found that each of these subscales was related to a measure of job performance, with correlation coefficients as high as *r* = .67 for the feedback self-efficacy sub-scale (Rasheed et al., 2015). Feedback orientation scales have been proposed for classroom use (see King et al., 2009), but are yet to be tested in a sporting environment.

In summary, there are a number of factors that can influence an athlete's interpretation of feedback provided by a coach. These factors may include the clarity and meaningfulness of the coach's language, attentional factors and the working memory capacity of the athlete, the degree to which feedback is autonomy-supportive, the self-efficacy of the athlete, and the athlete's feedback orientation. Understanding more about these factors can help to explain the discrepancies sometimes seen between the feedback given by the coach, and the feedback received by the athlete.

Conclusion and research questions

This chapter has focussed on three major areas in feedback research: the beliefs and knowledge of coaches about the role, power, focus, and reception of feedback; major categories of feedback and their use in both training and competitive environments; and factors related to the reception of feedback. It is apparent that the role of the coach involves the provision of feedback across training, competitive, and off-field settings. Coaches initially learn about providing feedback through informal sources, such as through their own experience as an athlete and from on-the-job experience once they begin their coaching careers, while formal coaching courses can fail to meet the needs of high performance coaches and may indeed promote myths

about ineffective pedagogical practices. It may be for this reason that coach beliefs about feedback vary so widely. The paucity of research into coach knowledge and beliefs about feedback is contrasted with the myriad of coach observation instruments and studies that describe the types and rates of coach feedback provided across various contexts. The inconsistent use of observation tools, along with a tendency of researchers to observe sub-elite levels of sport, means that little is known about the feedback patterns of high performance coaches, especially in competition settings. Additionally, feedback coding schemes are typically one-dimensional in nature (e.g., praise vs scold, positive vs negative only) and fail to account for modern feedback theories. Very few coach observation studies tie feedback to a performance measure or outcome. Further, despite the growing interest in other fields regarding factors that influence the reception of feedback, little is known about the ways in which athlete characteristics can influence the reception of feedback in an applied sporting setting.

Research questions. The research questions that guide the rest of this thesis have been generated from the gaps in the literature presented thus far. They are:

(1) What knowledge and beliefs do high performance sports coaches currently possess about the provision, reception, and evaluation of feedback?
(2) What is the nature of feedback provided to athletes in video-based feedback and competition settings?
(3) How does in-game feedback vary based on the state of the game?
(4) What is the impact of coach video-based feedback on athlete learning?
(5) What is the impact of athlete characteristics on feedback reception?

Chapter 3: Research Design and Methodology

The purpose of this chapter is to provide a brief orientation to, and justification of, the methodological approach and design of the research presented in this thesis. Chapters 4 through 6, representing the three studies undertaken for this thesis, include a method section specific to each study respectively. The participants, data collection instruments, procedures and data analyses are described in these individual chapters. This chapter is instead focussed more globally on the overall approach adopted in the thesis.

Research design

To address the research questions posed at the conclusion of the literature review chapter (Chapter 2), a mixed methods approach has been employed. Mixed methods research is an approach that combines both quantitative and qualitative data. This combination of data is subsequently interpreted as a collective body of evidence. An assumed strength of the mixed methods approach is that the respective strengths of qualitative and quantitative research are able to provide a more complete understanding of the research problems than a single approach to data collection (Creswell, 2015). In the case of this thesis, it was important to collect quantitative data for the purpose of comparison to previous coach observation studies, and to determine the relationship between feedback recall and athlete characteristics. It was also necessary to collect qualitative data to determine coach knowledge and beliefs about feedback, and in the recall interviews in Study 2. Given the paucity of existing work in these areas, it was decided that a more exploratory qualitative approach could allow initial themes to emerge, from which subsequent future studies could build more

quantitative data collection instruments. There have been several calls in the coaching science literature for research to combine both qualitative and quantitative investigations into the behaviours and knowledge of expert coaches (Greenwood et al., 2014; Potrac et al., 2002), so that the large body of quantitative coach observation studies can be supplemented with important information about coaches' experiential knowledge.

Figure 1 below provides an overview of the three studies that make up this thesis, and their individual methods of data collection. It should be noted that these three studies were not conducted sequentially; several of the studies had temporal overlap. While it is acknowledged that it may be 'best practice' to allow one study's results to inform the next, the nature of data collection in a high performance environment meant that adhering to the team's schedules took priority.

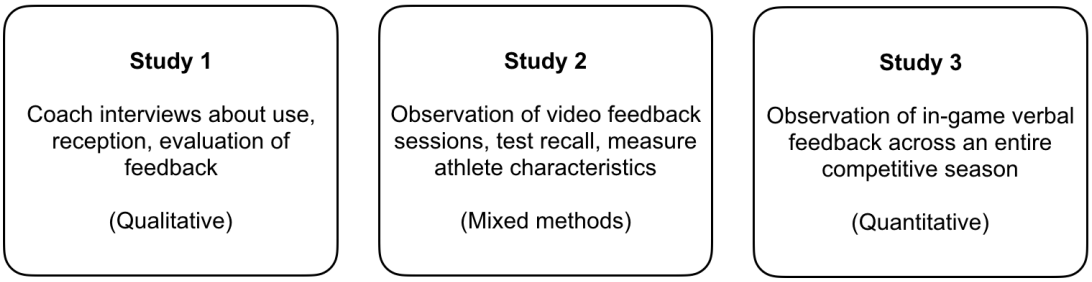

Figure 1. *Design of the Research Project*

Additionally, Table 2 provides a crosswalk table commonly seen in evaluation research (O'Sullivan, 2004), which provides an overview of each research question and the studies in which they are addressed.

Table 2.

Crosswalk Table Depicting Alignment Between Research Questions and Study Design

Research question	Study 1 (interviews)	Study 2 (video feedback)	Study 3 (in-game feedback)
(1) What knowledge and beliefs do elite sports coaches currently possess about the provision, reception, and evaluation of feedback?	x		
(2) What is the nature of feedback provided to athletes in video feedback and competition settings?		x	x
(3) How does in-game feedback vary based on the state of the game?			x
(4) What is the impact of coach video feedback on athlete learning?		x	
(5) What is the impact of athlete characteristics on feedback reception?		x	

Methodology

The overall aim of this thesis is to explore the ways in which coaches provide verbal feedback to athletes in a range of contexts, while also considering related concepts such as the reception of feedback by athletes and the knowledge that coaches possess about feedback. The research is inherently underpinned by epistemological assumptions. As is the case with much research in the broader area of sport science, a lens of scientific empiricism is assumed for the more quantitative components of this thesis. This approach values observable and measurable phenomena. In addition, the coach interviews conducted as part of Study 1 assume a more constructivist epistemology, in which the experiences and ideas of coaches about feedback were of interest. Rather than testing coaches against a 'gold standard' or 'correct' view of feedback provision, as might be done through lens of scientific empiricism, it was important to acknowledge that coach knowledge about feedback has developed through a complex interaction of prior experiences. Despite this, a potential bias held by the author of this thesis toward a positivist, scientific empiricist epistemology may have been adopted throughout the thesis, including the qualitative study reported on in Chapter 4. A positivist approach was also encouraged by comments provided by reviewers on the manuscript for Chapter 4 of this thesis; despite being qualitative in nature, the reviewer considered adding thresholds such as 'four or more authors mention this concept in their interviews' to be necessary in improving the manuscript. Therefore, despite making efforts to acknowledge the strengths of a constructivist approach, the dominant epistemology adopted throughout the thesis was one of scientific empiricism.

Ethics approvals

All studies presented in this thesis were approved by the Melbourne Graduate School of Education's Human Ethics Advisory Group. An ethics application was approved for each of the three studies individually; ethics application numbers are as follows: Study 1 - 1851890.1, Study 2 – 1741579.1, Study 3 – 1851346.1. No data collection was undertaken prior to ethics approval being obtained.

Chapter 4: Sports Coaches' Knowledge and Beliefs about the Provision, Reception, and Evaluation of Verbal Feedback (Study 1)

This manuscript was submitted to the journal *Frontiers in Psychology* in June 2020. It was published by the journal in September 2020. It sets the scene for the following studies in the thesis by outlining the current knowledge and beliefs held by coaches about feedback provision, reception, and evaluation.

Abstract

Coach observation studies conducted since the 1970s have sought to determine the quantity and quality of verbal feedback provided by coaches to their athletes. Relatively few studies, however, have sought to determine the knowledge and beliefs of coaches that underpin this provision of feedback. The purpose of the current study was to identify the beliefs and knowledge that elite team sports coaches hold about providing, receiving and evaluating feedback in their training and competition environments. Semi-structured interviews conducted with 8 coaches were inductively analysed, revealing three broad themes: thinking and learning about feedback, providing feedback, and evaluating feedback. Findings revealed a detailed array of knowledge about feedback across a wide range of sub-topics. Coaches saw feedback as a tool to improve performance, build athlete confidence, help athletes to monitor progress, and as a tool to improve their own performance. Novel insights about evaluating an athlete's reception of feedback, and tailoring feedback for individual athletes, were provided by coaches. The findings also highlight areas

in which future coach education offerings can better support coaches to provide effective feedback.

Keywords: feedback; feedback reception; sports coaching; pedagogy; instruction

Introduction

Coaches are thought to require strong procedural knowledge about the pedagogical strategies required to help athletes learn effectively (Nash & Collins, 2006) in addition to possessing specific knowledge about their sport. Recent studies have investigated the knowledge of coaches regarding sport-specific topics such as resistance training (Harden et al., 2019), swimming technique (Morris et al., 2019), and talent identification (Roberts et al., 2019). However, a major gap in this growing body of literature about coach knowledge concerns the use of pedagogical techniques such as feedback in coach practice. Therefore, the research question for consideration in this paper concerns what coaches know and believe about the provision, reception, and evaluation of coach-athlete verbal feedback. It is acknowledged that feedback in an elite sporting setting is not limited to that provided verbally by a coach. Although important in the overall context of learning design in an elite sporting setting, the role of the coach as a practice designer and facilitator of athletes seeking their own feedback (Woods et al., 2020) is not the primary focus of the current paper. A large body of coach observation literature consistently finds that verbal feedback represents one of the most common coach behaviours observed (Partington & Cushion, 2013), with rates of over 60 feedback messages per game reported recently in an elite setting (Mason et al., 2020). As such, an investigation into verbal feedback appears important to determine the knowledge that coaches hold about this major element of their practice.

Feedback is widely regarded as a frequently used and high-impact strategy to progress a learner from current to goal performance (Hattie, 2009; Kluger & DeNisi, 1996). Many studies have quantified and analysed coach feedback in both training and performance settings (e.g., Halperin et al., 2016; Partington et al., 2015). However, an area receiving less attention is the investigation of coach knowledge and beliefs underpinning the feedback they provide (Smith & Cushion, 2006). Supplementing the large body of empirical evidence on coach feedback in practice with an investigation of the experiential knowledge of expert coaches is considered to be an important direction for improving pedagogical practice (Greenwood et al., 2014). Qualitative investigations of coach practice such as interviews (Potrac et al., 2002; Tinning, 1982) may assist in providing greater detail about the contexts and constraints that coaches operate under in reality. Recent studies examining coach knowledge (e.g., Roberts et al., 2019) have not yet filled the gap in the area of pedagogical strategies such as feedback.

In education, a large body of evidence exists on teacher beliefs and links to their subsequent practice. Reviews of this literature suggest that teachers hold a variety of beliefs about their pedagogical practice that vary across context and cultures, and that these beliefs are usually related to the pedagogical practices they adopt (Fang, 1996; OECD, 2009). Importantly, it is suggested that efforts to improve teacher practice must take into account the perceptions and beliefs of teachers (Putnam & Borko, 1997). Similarly, an understanding of coach beliefs about feedback is an important step in ultimately improving coach feedback practices, and coach education in general (Côté et al., 1995). There is evidence that myths from the field of education have been adopted by sports coaches; 62% of surveyed coaches in the United Kingdom believed that individuals learn better when they receive information in their

preferred learning style (Bailey et al., 2018). This is contrasted with many major reviews (e.g., Pashler et al., 2009) which concluded that there is "no adequate evidence base" (p. 105) for the effectiveness of learning styles. More broadly, several authors have lamented the absence of a belief in evidence-based approaches to pedagogy in high performance coaching (Davids et al., 2016; Rushall, 2003).

Current evidence on coach knowledge about feedback suggests a wide spectrum of philosophies, ranging from the highly coach-controlled to a more facilitative and athlete-centred approach (Côté et al., 1995; Potrac et al., 2002; Smith & Cushion, 2006). In the former category is a case study of an expert English soccer coach, who reported beliefs towards providing feedback such as "they've got to be told what is expected of them" (Potrac et al., 2002, p. 191). The coach expressed a desire to be in control of his players during training because his job security ultimately depended on game-day success, and this was reflected in the feedback he provided. In another study, gymnastics coaches reported preferring to provide their athletes with feedback constantly (Côté et al., 1995), reflecting that it was important that their athletes "know where they are regularly" (p. 82). These high levels of coach control are contrasted with evidence that some coaches adopt a highly athlete-centred approach to feedback. Smith and Cushion (2006) found that expert English soccer coaches used silence strategically during in-game coaching to allow players to make decisions without an overly prescriptive approach. Coaches also reported not wanting to overload athletes with information, preferring to provide a small number of simple prompts. Allowing the athletes to experiment without coach intervention, and asking an athlete to self-evaluate before providing feedback, were strategies mentioned by the more athlete-centred coaches interviewed in the Côté et al. (1995) study. Across studies, a similar spectrum is seen when coaches are asked to consider feedback

valence; some coaches report using up to 90% negative feedback (Côté et al., 1995), while others reported a more balanced approach (Smith & Cushion, 2006). This evidence suggests large variations in coach beliefs about effective feedback practices, which may reflect the unique challenges (Lyle, 2002) represented by the different contexts in which coaches work. For example, and of interest to the current study, is the differences in feedback between team and individual sports coaches. It appears that determining the gap between current coach practice and 'best practice' for feedback as reported in the literature is an important task in improving the feedback that coaches give.

A potential challenge for this area of research is evidence to suggest that coaches can be inaccurate when reflecting on their use of feedback. For example, rowing coaches were observed providing verbal feedback to their athletes during training, and then an hour later they were asked about the feedback they provided (Millar et al., 2011). It was found that coaches overestimated desirable feedback patterns by between 5% and 40%; coaches tended to underestimate their use of highly prescriptive instruction, and overestimate their use of questioning to allow athletes to evaluate performance or describe affective feeling about performance. Coaches also appear to over-report the provision of tactical information over technical information compared to actual rates observed in the feedback they provided to athletes (Millar et al., 2011; Pereira et al., 2010). Additionally, coaches and athletes show low agreement when asked to recall the types of feedback provided by the coach, with the highest correlation in one study $r = .26$ between athlete and coach perceptions (Smoll & Smith, 1980). These findings highlight the importance of triangulating coach interview data with observational data where possible.

An area not commonly considered in feedback research is the reception of feedback (Anderson, 2010); much time and effort has been spent on determining the quality and quantity of feedback provided, without considering its reception and subsequent action by a receiver. Little is known about the ways in which coaches evaluate their feedback to determine its reception and use by their athletes. Barriers to the successful reception of feedback by athletes include discrepancies in interpretations of feedback between the provider and the receiver (Adcroft, 2011; Liberman et al., 2005). Other barriers include variations in the characteristics of the feedback receiver such as working memory capacity (Buszard et al., 2017), or the receiver's self-efficacy to receive and act on feedback (Narciss & Huth, 2004). There have been numerous calls in the literature (Langley, 1997; Potrac et al., 2000) for research designs to consider the athlete's ability to receive feedback, but relatively few studies have done so. Despite the importance of considering individual athlete factors, there is evidence to suggest that coaches may have high confidence but low accuracy when judging their athletes' mental skills (Leslie-Toogood & Martin, 2003).

Present study. The literature on coach beliefs and knowledge about verbal feedback is still in its infancy. The variation observed in what coaches know and believe regarding the provision of feedback may be caused by factors such as experience, context, or perceived job pressure. Additionally, a major gap in the area is an understanding of how coaches consider athlete factors such as the capacity and disposition to receive verbal feedback from a coach. Supplementing the large body of empirical evidence on coach feedback in practice with an investigation of the experiential knowledge of expert coaches is considered to be an important direction for improving pedagogical practice (Greenwood et al., 2014).

The purpose of this study was to qualitatively determine the knowledge and beliefs currently held by elite sports coaches with regard to the provision, reception, and evaluation of verbal feedback in training and competition environments. Given the proposition that coaches must possess a strong understanding of the pedagogical strategies required to help athletes learn effectively (Nash & Collins, 2006), along with evidence that coaches may hold some misconceptions about pedagogy (Bailey et al., 2018), it was hypothesised that there would be much variance in the beliefs and knowledge about feedback, with varying degrees of support from academic evidence.

Method

Participants. Eight coaches currently employed in a high performance team sport setting were recruited for the study. Recruitment was limited to coaches who had at least five years of experience coaching in a high performance setting. For the purpose of the study, this was defined as a professional national-level league or international representative (i.e., national team) setting. This definition is broadly consistent with similar previous studies that have sought to investigate high performance coaches (Morris et al., 2019; Rynne & Mallett, 2012). The sampling procedure was aligned with a purposeful sampling approach (Creswell, 2012), to ensure that expert coaches who have experience with a high-performance team sport environment could provide insight into the research questions. Coaches were aged between 32 and 52 years (M = 42.63, SD = 6.55), and had a mean experience level of 9.75 years (SD = 3.20) in a high performance setting. Coaches represented the sports of Australian Rules football (2), rugby (2), basketball (2), soccer (1) and field hockey (1). Five coaches were involved in elite national-level competitions with senior athletes, two were involved with elite youth national representative teams (under 18

age group), and one was involved with a senior national representative team. Six of the coaches had participated as athletes in the sport they coached to a high performance level, while two had not. Demographic information about the participating coaches is provided in Table 3.

Table 3.

Coach Demographic Information.

Coach	Gender	Sport	Gender of athletes	Level
Coach 1	M	Basketball	M	Senior
Coach 2	F	Basketball	F	Elite youth
Coach 3	M	Australian football	M	Senior
Coach 4	M	Australian football	M	Senior
Coach 5	M	Soccer	F	Senior
Coach 6	M	Field hockey	M/F	Elite youth
Coach 7	M	Rugby	M	Senior
Coach 8	M	Rugby	M	Senior

Participants were recruited via email or phone. At the time of the interview, participants were provided with a plain language statement and consent form, and were given the chance to answer questions about the study before enrolling. All participants were assured of anonymity and informed that participation was entirely voluntary.

Ethics approval was obtained from the Melbourne Graduate School of Education's Human Ethics Advisory Group (Ethics ID: 1851890.1).

Interview guide. To assist with consistency between interviews, a semi-structured interview guide was constructed. General information sought from the participant at the beginning of the interview included current role, time in current role, total years of experience coaching in a high performance setting, and any relevant experience as an athlete. These questions served to provide important demographic information, and were also used as rapport-building opening conversations to introduce a relaxed, conversational style to the interview (Côté et al., 1995). Researchers are encouraged "to keep uppermost in one's mind the fact that the interview is a social, interpersonal encounter, not merely a data collection exercise" (Cohen et al., 2011, p. 421), so care was taken to develop this rapport initially.

Questions from the main part of the interview focussed specifically on the research question; a list of questions can be found in Table 4. Consistent with a semi-structured interview approach, probes (e.g., "Are there any other ways you know the feedback has been received?") were used when participants provided relevant but incomplete information, to seek a deeper response, or to ensure the clarity of the response. Any new topics that emerged during the course of the interview were explored by the interviewer, consistent with methods adopted in similar semi-structured interview research in sport (Potrac, Jones, & Armour, 2002).

Table 4.

Interview Questions

1	How important is providing feedback to your players in your role?
2	How often do you give feedback to your players? In what settings?
3	For what purpose do you typically use feedback?
4	How much of your feedback is positive vs negative/constructive?
5	Do you tailor your feedback based on the individual athlete? If so, how?
6	Do some players respond better to feedback than others? If so, how?
7	How do you know when an athlete has received the feedback?
8	Do you think it's best to provide feedback to the athlete or let them solve performance problems by themselves?
9	Do you give good feedback? If not, what prevents you from giving better feedback?

Procedure. The study protocol was explained to participants, who were then offered an opportunity to ask questions about their involvement in the study and assured of the confidentiality of their identity and responses. Informed consent was then obtained from the participant via a hard-copy form. All interviews were recorded on an Apple iPhone 6S, and an Apple MacBook Pro internal microphone was used as a second backup recorder. All interviews were conducted by the first author, who has undertaken undergraduate and postgraduate training in qualitative and quantitative

research methodology. Interviews were conducted primarily in person (n = 5), with a further 3 interviews conducted via phone or Skype; research suggests that Skype and phone interviews can be an appropriate replacement for in-person interviews where geography is a limiting factor (Deakin & Wakefield, 2013). Interview duration was between 14 and 46 minutes (M = 27.25, SD = 10.42). Within 24 hours of the interview, the interviewer transcribed the interviews verbatim into a Microsoft Word document. All participants were provided with a copy of the interview transcript within one week of the interview, and asked to check the transcript for accuracy and clarity.

Data analysis. Transcripts were uploaded into NVivo for analysis. Given the precedent in coaching literature for an inductive approach to qualitative interview data (Potrac et al., 2002; Rynne & Mallett, 2012), data analysis in the current study also adopted an inductive approach. The process of inductively coding data followed the methods outlined by Côté et al. (1993). First, interview transcripts were read and assigned a label to begin the general process of categorising the data. At this stage, the primary focus of coding was to organise rather than to interpret. Following a first round of coding, all labels were compared and assigned a broader category, a process known as *creating categories* (Côté et al., 1993). For example, any text tagged with 'positive feedback' or 'descriptive feedback' was assigned to a category called 'types of feedback'. In completing a similar procedure, Rynne and Mallett (2012) acknowledged that categories remained flexible due to the need for adjustment as coding took place; in the current study, many instances of re-coding took place as themes emerged and developed. The final step in the analysis process involved the naming of final themes, along with the generation of a narrative to accompany each theme in the context of the research question for presentation in this article (Braun &

Clark, 2006). Categories discussed by at least half of coaches (i.e., 4 or more), or that were considered theoretically important for the research area, were included in the final themes.

Results

The three higher-order categories that emerged throughout the inductive analysis procedures were *thinking and learning about feedback, providing feedback,* and *evaluating feedback*. The major sub-themes of each category are presented in Table 5 below. The following section will detail the major findings within each category and sub-theme with respect to the range of knowledge and beliefs held by the high performance coaches interviewed. Where relevant, quotes from interviewees are included with the pseudonyms Coach 1 through to Coach 8. The gender-neutral pronoun 'they' has been used throughout to conceal the gender of the coach.

Table 5.

Emerging Themes and Sub-Categories Following the Process of Inductive Analysis

Thinking and learning about feedback	*Providing feedback*	*Evaluating feedback*
Roles for feedback (8) - To improve performance (6) - To monitor progress (2) - To help coaches improve (2) - To build confidence (5) Learning about giving feedback (5) - Mentors (2) - Peer learning (3) - Shortcomings of formal coach ed. (2)	Feedback valence (7) Feedback quantity (8) Allowing athletes to problem-solve (5) Structures/frameworks (3) - Goal setting (2) - Individual Performance Plan (1) - "Shit sandwich" (1) Timing of feedback (3) Barriers to giving better feedback (8)	Methods of evaluating feedback reception (8) - Observing change in performance (7) - Questioning (4) - Statistics (2) Factors influencing feedback reception (8) - Personality variables (4) - Overloading the athlete (5) - Amount of feedback (6) - Terminology (2)

Thinking and learning about feedback. One of the major categories identified through the collation of sub-themes was the way in which coaches conceptualise, learn about, and reflect on their use of feedback. Sub-themes under this category include: coach beliefs about the roles of feedback, and sources of learning about providing feedback.

Roles of feedback. Coaches held varying beliefs about the role and purpose of feedback in their coaching practice that fell into four main themes: improving performance, monitoring progress, helping coaches to improve, and building athlete confidence. A strongly-held belief was that coaches see feedback as a major tool for improving individual and team performance. Coach 7 reflected on the importance of feedback for improvement, stating that "if you don't get feedback, you don't really know how you're tracking and how you're developing". Coach 7 went on to clarify that they saw feedback as a tool to help both athletes and coaches grow, suggesting that feedback is conceptualised not only as something to be given by coaches, but also received and used to improve coaching practice.

Aside from the role of feedback as a means for improving performance, 5 interviewees also discussed the importance of feedback for building confidence and providing reassurance when both individual and team performance was not ideal. Coach 4 spoke of the importance of showing positive video feedback to their team following a loss in order to re-motivate the group. This was also discussed by Coach 1, who said that they would often ask video analysts in their organisation to just cut up some positive footage because a player's "confidence is so bad right now". The role of feedback as reassurance also extended to a competition setting, with Coach 2 reflecting

that “I think 50% of my job on game day is to tell them [the athletes] that everything is okay, and that they’re going okay”. Coach 3 took a different approach to the motivational role of feedback, sharing that they often provided overly positive feedback to one athlete with the hope that it may induce competitiveness and prompt other athletes to “strive for similar feedback”.

Learning about giving feedback. Coach 5 believed that having a mentor was an effective method for improving their use of feedback, stating that “the best thing that any new coach could do is partner up”. A common theme was that coaches trusted advice from experienced peers, with Coach 6 explaining that “I’d probably like to go from experience and what’s worked for them [another coach] rather than going for something completely drastic and new”. Coach 8 reflected critically on formal coach education courses, stating that “I enjoy doing them, just the piece of paper doesn’t do much for me”, while also speaking of the importance of informal learning for their improvement as a coach. It appears that coaches already working at the high performance level see limited benefit in obtaining formal accreditation, instead valuing the informal learning opportunities presented by collaborating with peers or mentors.

Providing feedback. A second major category emerging from the interview data relates to beliefs and knowledge about the practicalities involved with providing feedback. In this section, sub-themes include: feedback valence, feedback quantity, providing feedback vs allowing athletes to problem-solve, structures and frameworks, timing, and barriers to giving better feedback.

Feedback valence. One of the most commonly discussed beliefs amongst the interviewed coaches was the ideal ratio of positive to negative (also referred to by the coaches as ‘constructive’, ‘growth’ and ‘room for improvement’) feedback. There was

a common acknowledgement from interviewed coaches that rates of positive to negative feedback vary according to the coach's personal style and the context in which they operate. Coach 1 recalled an experience of working under a head coach who was "a little more old school" and "doesn't think much about being more positive… if he has something to say about it [a video clip], he's going to say it", while also acknowledging their own style to be more "modern" and responsive to the needs of the athlete. Half of the coaches articulated the belief that providing too much negative feedback was detrimental to athlete performance. For example, Coach 8 reported striving to show athletes positive examples to guide them towards desired behaviour, rather than negative examples that show an athlete performing poorly. Coach 3 believed that mostly positive feedback should be used during competition, with "constructive" feedback left for breaks in competition or during training. Like many other coaches, Coach 3 believed that the motivational benefits of positive feedback could enhance performance during competition, with negative feedback believed to cause doubt or impact the concentration of the athlete.

Feedback quantity and 'overloading' athletes. All coaches spoke about feedback quantity, with over half discussing their struggle find the right balance between providing enough feedback to ensure the most salient points were covered, but also keeping feedback quantity within a range that was manageable for athletes to use. Coach 7 used an analogy to describe their approach to deciding on feedback quantity: "If I tried to throw you 10 tennis balls, you'd probably catch 2-3… If I throw you 2-3 tennis balls, you'll probably catch 2-3… Players can only retain a certain amount of information, and chunking up that information from smaller bits is really important". The philosophy of Coach 2 was similar: "2-3 [pieces of feedback] tops". Coach 4 reported taking an individualised approach to deciding on the amount of

feedback provided to athletes, considering motivation to be an important factor in determining how much feedback athletes prefer: "[My approach is] if you want the info I'll give it to you, but I'm not going to chase you either. If I'm chasing them they're probably not going to look at it anyway. They've got to drive it and want it themselves".

Providing feedback vs allowing athletes to problem-solve. The influence of training design frameworks such as the constraints-led approach, where coaches are encouraged to design environments in which athletes are able to solve problems rather than simply being told by a coach (Renshaw et al., 2016), was clearly seen in coach responses. This was summarised by Coach 8, who observed the following:

> They're the ones out there on the field in the heat of the battle. For me to come in and tell them everything… well, I'm not out there to solve their problems on game day, on the field. I just want to steer them and guide them to come up with the answers.

Coach 5 was stronger in their phrasing, believing that "you're not winning the game from the coaches' box". Coach 3 took this philosophy into their training design, reporting that they often manipulated the amount of feedback provided during a training session to encourage athletes to problem-solve without coach intervention: "I'll say to the coaching staff, we're not holding their hands through any of the session, don't say anything to them… they have to find their own way". When reflecting on their work with less experienced coaches, Coach 2 believed that a novice coach is more likely to adopt an "I tell" coaching mentality, in which coaches will "tell them [the athletes] what they see without giving the student/player an opportunity to think of their own answers". Coach 4 believed that this led to negative outcomes for both coach

and athlete, whereby the coach "can easily get frustrated when they give advice and then they don't see that change in behaviour from the player".

Structures and frameworks. Three of the eight coaches discussed a more formal approach to providing feedback, detailing the frameworks they have in place for providing regular feedback to their athletes. This was most common in coaches who worked with a national squad, where athletes typically train in their local environments when not with the national team. For example, Coach 6 reported providing regular feedback in the context of an individual performance plan (IPP), in which 3-4 goals are set in consultation between the athlete and coach before a tournament begins. Coach 6 then works with athletes during the course of a tournament to provide feedback against the goals outlined in the IPP. After tournament completion, Coach 6 triangulates feedback from themselves as head coach, their assistant coaches, and self-assessment from the athlete themselves before generating a new IPP for their local context.

Other coaches reported less formal structures for providing feedback. Coach 7 reported their use of the colloquial "shit sandwich" method of providing feedback: "Start with a positive, then a negative, then finish with a positive. I was taught that way back when. In some ways when I do my game reviews, I structure it a bit like that. Here's some things we did really well, here are some things we need to fix up, look at efforts where we did really well off the ball. I still haven't gone too far away from that".

Timing of feedback. Three coaches explicitly mentioned the importance of timing feedback for maximum impact on their athletes. Coach 3 believed that feedback was often most effective if provided before an opportunity to implement it in

performance, choosing to provide feedback directly before training when practical, in order to see immediate change in performance. Coach 3 suggested that:

> Feedback at the end of the session is good, just general feedback or how they performed or whatever, but if there is a particular thing that you need them to try and get, I have found it's gotta be right before the next session so it's fresh.

Coach 8 relayed similar sentiments, believing that feedback "on-the-run" during training or competition was more easily implemented than feedback given in a video feedback setting away from the performance environment.

Perceived barriers to giving better feedback. All coaches reflected on challenges they faced in their day-to-day roles that may not be conducive to providing feedback that is in line with their views of 'best practice'. One of the most commonly reported barriers was time. Coaches 3 and 6 both worked with national representative squads, where intensive tournament play at international level is often interspersed with months away from athletes while they train and play with their local teams. Coach 3 reflected that "you might only see them [athletes] for a few days at a pre-tournament camp, and then it's another two months until another camp". Coach 6 spoke of the importance of checking in on individual athletes in their local environments, to ensure continuity and consistency of feedback across the course of a year. Coach 8 mentioned the difficulty associated with having up to 15 players under their care during a season, admitting that some players don't sit down with a coach to review footage and receive feedback for "a couple of weeks". To circumvent this, the coach provides feedback in a group setting more regularly.

Evaluating feedback. A major focus of this paper is on determining the beliefs, knowledge and reported approaches taken by coaches with regard to feedback reception. Coach 6, a former school teacher, was a particularly strong advocate for more closely considering the reception of feedback by athletes:

> I think athletes, or kids in school, they almost need to be trained or given methods of what is feedback and how to receive feedback. We think about how we deliver it a lot, and we put a lot of effort into ourselves – hopefully – in that area, but it's actually a skill to receive feedback.

The following section presents coach reflections on: methods for evaluating feedback reception, and factors influencing the reception of feedback by an athlete.

Methods for evaluating feedback reception. Coaches were varied in the extent of their responses to questions relating to the reception of feedback by athletes, and typically fell into one of two groups: one group of coaches appeared to prefer a practical approach to evaluating feedback reception by way of observing physical performance, while another group reported using pedagogical tools such as questioning for assessing player knowledge and retention of feedback.

The most common response from coaches was that performance in competition is a reliable measure of the effectiveness of feedback; for example, Coach 1 reflected that "the way you know if it's been 100% effective is if they do what you told them, at the end of the day, on the court". However, two coaches also believed that this method of evaluating feedback was not completely reliable, citing extraneous variables such as skill errors or athletes choosing not to buy in to the coach's strategic changes as

possible reasons that observing performance may not accurately reflect the reception of feedback.

Another commonly reported method for seeking evidence that feedback has been received by athletes is through questioning or otherwise designing a learning environment where athletes can provide verbal evidence of understanding to the coach. Coach 5 explained their approach to providing video feedback, stating that they believed the feedback had been received "… if they can take you through a different piece of vision or a different scenario from the one where we first might have unearthed an issue or whatever it was, and they can talk it back to you". Coach 8 believed that an athlete-centred approach to video feedback meetings was needed in order to evaluate feedback reception:

> If I'm doing all the talking, I don't know if they're understanding what they're saying. I ask a lot of questions, or I put up a clip and get them to tell me what they're thinking. That way we can sort of find somewhere in between where we can meet.

Other reported methods for evaluating feedback reception include reading non-verbal markers such as body language, and analysing in-game statistics.

Athlete characteristics influencing feedback reception. Coaches were asked to report any characteristics of their athletes that are perceived to act as facilitators or barriers to the athletes receiving feedback. Four coaches described attitude or entitlement problems observed in their athletes. This reportedly led to a reluctance to receive and accept feedback, particularly negative or constructive feedback. Coaches suggested that ego and previous experience with overly positive feedback were the

main contributors. For example, Coach 2 shared their experience with athletes who are "overwhelmed by positive feedback from people around them, and they believe the hype". Coach 3 reflected that the most difficult athletes to coach are:

> … the ones that have coaches back home that have told them what they've wanted to hear all of the time. They haven't had a coach who has been constructive with them, and they haven't got family that say 'you still need to work on this'. They have surrounded themselves with 'yes' people.

Other coaches spoke of the "participation trophy era" (Coach 5), alluding to a phenomenon whereby junior athletes receive trophies for simply entering an event, not just for winning. It appears that a major challenge for coaches is adjusting the approach they take when providing feedback to athletes who exhibit a reluctance to receive feedback.

Another belief frequently mentioned by coaches in this area related to knowing the athlete as an individual and acknowledging the ways in which they prefer to receive feedback. Coaches alluded to this being the 'art' of coaching; for example, Coach 8 reflected, "that's coaching, isn't it? Knowing who wants what". The importance of differentiating feedback for individuals was acknowledged by Coach 7, who ran pre-season surveys with all their athletes to determine their preferences for receiving feedback.

The most commonly reported methods of differentiating feedback for players involved tailoring the amount or the valence of the feedback. Coach 1 reported that their assistant coaches were mindful of the amount of video feedback that athletes preferred. For example, "[this athlete] doesn't like watching film, so let's just keep it

short, 3-4 clips". Coach 6 believed that certain athletes had a natural feel for the game and didn't benefit as greatly as others from video feedback: "To some guys the footage can just become a drag for them. Some of those natural players, you start showing them all that and putting them into a box – well that's not what they're good at". Coach 6 believed that giving these types of athletes feedback in a training environment may be more productive than in a video feedback session. Similarly, coaches believed that certain athletes benefited more from either positive or negative feedback, differentiating based on preference. Coach 3 spoke of their experience working with athletes who varied in their need for feedback: "[player], you just had to tell her how great she was all the time… others, you could be a lot harder on". Coach 4 believed that most of their athletes preferred hearing positive feedback, but observed that some athletes in their squad have "an ability to have a bit more of a 'dressing down' type of feedback".

Discussion

The aim of the study was to determine the knowledge and beliefs currently held by high performance sports coaches with regard to the provision, reception, and evaluation of feedback. The findings presented above illustrate the multifaceted and complex nature of current coach knowledge about feedback. The notion that coaches must possess knowledge of pedagogical strategies required to help athletes learn effectively (Nash & Collins, 2006) was supported by a rich array of information collected about the many strategies that coaches use for providing and evaluating feedback in their roles. As predicted, there were also some areas in which coach knowledge about feedback did not align with current evidence.

A number of ideas emerging from the interview data align with prior research. The most fundamental of these was the belief that feedback is a useful tool for improving both individual and team performance. Coaches considered feedback to be a vital part of their role and a commonly used pedagogical tool, implemented with the intention to improve player performance. Links between feedback and performance are reflected throughout a range of feedback literature (Hattie & Timperley, 2007; Kluger & DeNisi, 1996; Randell et al., 2011). Importantly, the notion of receiving feedback as a coach in order to improve coaching practice was also mentioned, reflecting Hattie and Clarke's (2018) emphasis on feedback being a two-way process between receiving and giving. The idea of using student assessments as feedback on teaching is not new in education (Nicol & MacFarlane-Dick, 2006), but the current study also shows that coaches seek feedback from athletes to evaluate their impact in much the same way.

Coaches articulated preferences for informal learning sources when asked about how they might upskill themselves in the area of feedback, with five coaches referring to learning from peers or a more experienced coach as a preferred way to seek improvement. One coach reflected critically on formal learning sources such as accredited coach education courses. These sentiments align with evidence from previous studies on coach education, where typical findings are that informal learning sources such as discussions with peers are preferred over formal courses (Erickson et al., 2008; Stoszkowski & Collins, 2016). One reason for this preference, with particular relevance to the interview data, is that formal coach education courses often do not allow for substantial participant interaction (Demers et al., 2006). Striking a balance between allowing for the sharing of experiences between coaches, while also advocating for evidence-based feedback practices that do not promote neuromyths

(Bailey et al., 2018) or folk pedagogy (Bruner, 1996), appears an important endeavour for future coach education offerings. Working with a mentor (McQuade et al., 2015) or coach developer (North, 2010) may be an avenue for further exploration, given the learning preferences articulated by coaches in the current study.

An area yielding novel data in the current study relates to the use of questioning by coaches to check for feedback reception. Previous studies suggest that coaches ask few questions (Potrac et al., 2002), and that coaches tend to overestimate their use of questioning when asked to self-report (Millar et al., 2011). Coaches in previous studies also report not wanting to ask too many questions due to a desire to avoid appearing indecisive or lacking expertise (Potrac et al., 2002). Despite this, evidence suggests that questioning paired with feedback can have a positive effect on performance (Chambers & Vickers, 2006). A commonly reported method for evaluating feedback reception in the current study was through questioning, with five coaches suggesting that they check for player understanding of feedback through using open-ended questions. Coaches also reported creating athlete-centred learning environments in which athletes were encouraged to show evidence of their understanding through analysing video with coach feedback withheld. Athlete-centred coaching has been noted in the literature as an effective method for improving performance and motivation of athletes (Light & Harvey, 2017). An important avenue for future research appears to be matching self-reports of teaching behaviours with observations to verify their accuracy. However, the data collected in the current study provides evidence of commonly-held knowledge that there are a number of ways to check for feedback reception.

An emerging topic in sport psychology research relates to entitlement attitudes displayed by some athletes (Dorsch & Etheredge, 2017). This theme presented clearly in the coach interviews, particularly when coaches were asked to discuss barriers experienced when providing negative feedback to athletes. Four coaches discussed the 'participation trophy era', referred to by others as 'the selfie age' (Gilbert, 2016), as a potential influence on the reluctance of a certain generation of elite athletes to receive negative feedback. One potential recommendation from this finding is that coaches may need more support in overcoming particular athlete personality characteristics when providing negative feedback. Managing egos and expectations about the nature of feedback (particularly with respect to valence) appears important for ensuring that athletes are willing to receive feedback. Prominent theories on attribution (e.g., Boekaerts, 2006; Dweck, 2000) may provide some value in assisting coaches to provide feedback that is less likely to be interpreted as a threat to perceived competence, and more likely to be seen as an opportunity for growth by the athlete. This may be an avenue for future coach education offerings.

One area in which reported coach knowledge was at odds with evidence concerns the strategies or frameworks that coaches use to deliver feedback, particularly with regard to feedback valence. While coaches generally gave their views on an ideal ratio of positive to negative feedback, some coaches mentioned the notion of a feedback sandwich or "shit sandwich", in which a piece of negative feedback is "sandwiched" between two pieces of positive feedback. Although it is claimed the feedback sandwich technique can have affective benefits such as building rapport with the feedback receiver (Dohrenwend, 2002), evidence suggests that the feedback sandwich does not impact post-feedback performance (Parkes et al., 2013) in a sample of medical students, and can encourage the feedback receiver to overlook negative

feedback and reach artificially positive conclusions (Shute, 2008). While the generalisation of these findings into the sporting context should be made with caution, it provides a viable avenue for future research.

Limitations. The evidence presented in the current study provides an insight in to the current knowledge and beliefs of high performance coaches about verbal feedback. However, the use of coaches working at the highest level limits the generalisability of findings to coaches working at other levels. To determine the ways in which knowledge about feedback develops over time, a comparison between novice and expert coaches may be beneficial. Widening the scope to investigate differences between individual and team sports coaches would also provide additional information about how coaches use feedback in different contexts. An acknowledged limitation of the sample used in the current study is the small number of coaches recruited overall, and the brevity of some of the interviews. This represents a major challenge associated with working alongside high performance coaches while in-season. Several barriers with recruitment and retainment of participants were experienced throughout the data collection phase of the study, which may be alleviated in future work by collecting data early in pre-season when competition is not intense. Crucially, it should be recognised that verbal feedback is just one source of feedback available to athletes; future studies could consider the interaction between verbal and other sources of feedback. Finally, future research should further investigate the relationship between what coaches say they do in interview studies, and what they actually do while coaching. This is especially important given evidence that coaches can be inaccurate when reflecting on the feedback they provide (Millar et al., 2011; Pereira et al., 2010).

Practical applications. The findings of this study provide information about what expert high performance coaches know and believe about feedback. As such, this information may be useful as a model to coaches working at other levels, as it represents the current 'best practices' that are adopted by these expert coaches. Below are some potential practical applications arising from this study:

- Coaches should consider that feedback has various roles: to improve performance, to monitor progress, to help coaches improve, and to build athlete confidence.
- Coaches prefer to learn about feedback from peers and mentors; this should be reflected when designing future coach development opportunities.
- Coaches should consider feedback quantity, and try to avoid 'overloading' athletes with many feedback messages.
- Coaches should consider ways of evaluating the reception of feedback by their athletes. These include observing performance changes, and pedagogical tools such as questioning or allowing athletes to teach or explain a concept.
- Coaches should consider various athlete characteristics that may help or hinder feedback reception. These may include athlete attitudes and preferences.

Conclusions. This study provides insight into the knowledge and beliefs of high performance coaches with regard to the provision, reception, and evaluation of feedback in training and competition environments. It adds important qualitative detail to the myriad of observational studies of coaches providing feedback, filling a gap commonly identified in previous research. The findings suggest that coaches possess a

highly nuanced understanding of the ways in which the power of feedback can be harnessed in their individual contexts and, importantly, evaluated for reception and effectiveness. The findings also highlight areas in which future coach education offerings can better support coaches to provide effective feedback.

Chapter 5: An Exploratory Investigation into the Reception of Verbal and Video Feedback Provided to Players in an Australian Football League Club (Study 2)

This manuscript was submitted to the journal *International Journal of Sport Science and Coaching* in April 2020. It was published by the journal in August 2020.

Abstract

Background: Coach observation studies commonly examine training and competition environments, with little attention paid to the ways in which coaches provide video feedback in a performance analysis setting. In addition, few studies have considered the reception of feedback by an athlete, or the characteristics of the athlete that may support or hinder feedback reception.

Purpose: The purposes of this study were threefold. First, to examine the characteristics of feedback provided by a coach during a typical video feedback meeting. Secondly, to measure the impact of this feedback on athlete learning. Third, to consider a range of learner characteristics that may impact feedback reception.

Method: Six coaches and six players affiliated with an Australian Football League (AFL) club were recruited. Coach-player dyads were observed in one-to-one video feedback meetings following a game played in the 2017 season. Players were interviewed to test feedback recall. Players also completed a series of tests designed to

measure learner characteristics, with the intention of discovering moderating factors of the relationship between feedback and learning outcomes.

Results: Rates of feedback generally mirrored those found in previous studies. Coaches provided nearly 30 feedback messages during each meeting. Players recalled 50% of summarised feedback messages but just 6% of all feedback a week later. A ceiling effect on learner characteristics was observed.

Conclusions: The paper presents a novel design for examining feedback effectiveness while considering learner characteristics. Given the findings on feedback quantity and recall, coaches are encouraged to adopt a 'less is more' approach to providing feedback.

Introduction

Coach observation studies emerged in the mid-1970s (Tharp & Gallimore, 1976) as a method for exploring the behaviours of expert coaches. A major interest of these studies has been the quantification of instruction and feedback provided from coach to athlete. Approximately 75% of recent studies observe coaches in a training environment, while the remaining 25% examine a competition environment (Cope et al.. Another trend emerging in recent years, particularly as technology has developed in elite sporting settings, is the use of video to supplement verbal coach feedback when analysing athlete performance (Pain & Harwood, 2007). Video feedback sessions typically involve the coach presenting video clips to one or more athletes while simultaneously providing verbal feedback and questioning athletes (Groom et al., 2011). However, there is little evidence about how coaches deliver video feedback to improve athlete learning and performance (Bertram et al., 2007), particularly in a

classroom or lecture-style setting away from the performance environment. Given the similarities between a video feedback session and a school-based classroom, it has been suggested that looking to the field of education may provide insights into novel approaches toward studying the pedagogical interactions between coaches and athletes (Groom & Nelson, 2013). The current study aims to investigate the feedback provided in a video feedback setting and its effect on athlete learning, drawing on evidence from the coaching science literature while also looking to the field of education.

Examining the evidence provided by coach observation studies in training and competition environments provides a basis from which to make predictions about the types and rates of feedback that might be found in a video feedback setting. Feedback valence is a commonly-researched feedback variable, and considers the degree to which feedback is positive or negative in nature. Rates in observation studies range from a 24/76% split of positive and negative feedback (Trudel et al., 1996) found in a junior ice hockey competition setting, to a 98/2% split found across training environments in various sports (Horton et al., 2005). Feedback is generally found to be more positive in a training environment than in a competition environment (Hall et al., 2016) suggesting that rates of feedback are likely to be context-dependent.

Another feedback classification involves its delivery; regardless of content, feedback can be delivered in a manner that is controlling, or that allows for athlete autonomy. Autonomy-supportive feedback is considered to be empathic, paired with choices of potential solutions, based on objectives that the learner sees as clear and attainable, avoids person-related statements, includes tips on how to improve next time, and delivered in a considerate tone of voice (Carpentier & Mageau, 2013). In a competitive boxing setting, 53% of coach feedback was seen as controlling, with just

6% considered autonomy-supportive and 42% considered neutral (Halperin et al., 2016). In a study that compared more and less successful soccer coaches in a competition setting, results revealed that the less successful coaches provided a slightly greater amount of autonomy-supportive feedback (Webster et al., 2013).

Two further theoretically important feedback models have received limited attention in coach observation studies, and are included here with the intention of expanding the narrow band of feedback variables typically considered. A descriptive/prescriptive dichotomy is proposed in a number of motor learning texts (Magill & Anderson, 2012; Schmidt & Wrisberg, 2008), and considers feedback to either describe past performance, or prescribe future performance. Prescriptive feedback is considered to be beneficial to novice performers (Kernodle & Carlton, 1992; Nunes et al., 2020). However, an overly prescriptive approach may not be beneficial to elite athletes, who may have already developed the skills necessary to self-regulate performance (Magill & Anderson, 2012). In a live competition setting, coaches of an elite Australian Rules football team provided 81% prescriptive feedback, with 19% considered descriptive (Mason et al., 2020).

A second model that may have particular relevance to the video feedback setting is Hattie and Timperley's (2007) four-level model. This model proposes that feedback is differentially effective depending on the level at which it is directed; at the learner themselves, at the task, at the processes underlying the task, or at the self-regulation level. Feedback at the task level is considered similar to the 'knowledge of results' category commonly referenced in motor control research, whereas process-level feedback is synonymous with 'knowledge of performance'. Coaches in the elite Australian Rules football setting described above provided overwhelmingly task (58%)

and process (37%) level feedback. Approximately 2% of feedback was directed to the athlete themselves, and a further 3% provided at the self-regulation level (Mason et al., 2020).

Evidence from the field of education may assist in initial efforts to explore the environment in which coaches provide video feedback to athletes, particularly in the off-field classroom-based setting in which video feedback often occurs (Nelson et al., 2011). While coach and teaching share many similarities (Côté & Gilbert, 2009), there are also some key differences between coaches in a video feedback setting and teachers in a classroom that should serve as a caveat to any comparisons between fields. These may include the age of the learner, the intensity of the coach-athlete (teacher-student) relationship, and the role of money and the learner's status as either a student or a professional.

A common criticism of feedback research in education is that it too often considers the provider of feedback, and too infrequently considers the role of the feedback receiver and the factors that they bring to the interaction (Butler & Winne, 1995). Recent feedback research emerging from education more thoroughly considers feedback as a two-way interaction involving both the provider and the receiver (Hattie & Clark, 2019). Several studies illustrate a discrepancy between feedback provided and feedback received. For example, 70% of teachers claimed to provide helpful and detailed feedback, but only 45% of students agreed (Carless, 2006). In a sporting setting, an absence of coach awareness about how athletes process and respond to feedback can have negative implications for player performance (Pensgaard & Duda, 2002). An illustration of this in practice comes from a study of judo players and their coaches, which found that an average of 31% of coach-to-athlete instruction provided

before a competition was not recalled by players when interviewed immediately after the competition (Mesquita et al., 2008). The following section considers factors that may influence the reception of feedback by an athlete.

One factor that may impact feedback reception is likely to be working memory capacity (WMC), defined as the ability to focus attentional resources on task goals despite interference (Engle, 2002). Given the finding that coaches can provide up to 8 feedback messages in a 3-minute boxing bout (Halperin et al., 2016), considering an athlete's WMC when deciding how much feedback to provide may improve feedback effectiveness. A recent study found working memory to be important in using instruction and feedback to learn a basketball shooting task (Buszard et al., 2017), whereby children in high and low WMC groups were provided with 5 identical explicit instructions about performance. The high WMC capacity group showed consistent improvements on the task while the low WMC group became slightly worse. Attentional capacity can also be a factor in video feedback sessions; athletes' ability to receive feedback can be reduced when they personally appear in a video clip (Middlemas & Harwood, 2018). One participant reflected on their attentional focus during video feedback sessions: "I'm listening to the coach talk about the team shape, but I'm watching myself, whether I have a good touch if I get the ball, or whether I look OK on screen" (p. 8).

In meta-analyses (Kluger & DeNisi, 1996) and reviews (Narciss & Huth, 2002) of feedback research, learner factors such as self-efficacy and feedback orientation were also identified as important in the process of interpreting and understanding feedback. It is possible that learners with high self-efficacy may be less likely to seek out feedback from external sources, and may not act on negative feedback as readily as

they do with positive feedback (Ilgen et al., 1979). Feedback orientation (London & Smither, 2002) is a learner's disposition towards receiving feedback, and is typically quantified using a number of sub-scales such as accountability, social awareness, and utility (Linderbaum & Levy, 2010). Feedback self-efficacy, another common sub-scale, is the learner's beliefs about their competence in using feedback. Evidence from a study of hospital staff found that each of these subscales was related to a measure of job performance (Rasheed et al., 2015). Feedback orientation scales have been proposed for classroom use (King et al., 2009), but are yet to be tested in a sporting environment. They represent a possible avenue for testing athlete characteristics that act as moderators for the feedback-learning relationship.

There is a clear need to further investigate the reception of verbal feedback in a sporting setting, along with factors that may impact feedback recall. The present study sought to categorise and quantify the feedback provided from coaches to athletes in a video feedback setting, and the impact of this feedback on athlete learning outcomes. Additionally, the study sought to explore athlete characteristics that could act as moderators of the feedback-learning relationship, by including a number of additional instruments designed to measure proposed moderators of feedback effectiveness identified in the literature.

In line with the findings presented in the literature review, it was predicted that the elite athletes in the current study would receive feedback from their coaches that is primarily descriptive, controlling, task-oriented and positive. It was further predicted that feedback recall was likely to be moderated by athlete characteristics (e.g., working memory, self-efficacy) and the amount of feedback provided by the coach, such that

improved recall would be seen in players receiving less feedback, possessing greater working memory capacity, and with greater self-efficacy for receiving feedback.

Method

Participants. Participants were a convenience sample drawn from one elite Australian Rules football (ARF) club. All six coaches responsible for a positional group (forwards, midfielders, backs) within the club were recruited, with two coaches recruited from each positional group. Coaches reported spending approximately five years working at the elite level (M = 5.33, SD = 2.34). It should be noted that all six coaches were assistant coaches, particularly due to findings that head and assistant coaches differ in their provision of feedback (Solomon et al., 1996). The head coach was not recruited for the study because this coach does not provide regular 1:1 feedback to any players. It is also of note that all coaches included in the study played the sport at the highest level for multiple seasons. This pattern of experience is typical of coaching groups in elite ARF teams.

One player assigned to each of the coaches' positional groups was also recruited (six total; elite league games played: M = 50.33, SD = 80.12). To ensure a relatively homogeneous sample, players were selected for the study only if they had reported completing compulsory (Year 12 or equivalent) education and did not self-report any conditions that may influence learning outcomes (e.g., hearing or vision loss likely to impact daily living, working memory difficulties, other diagnosed learning difficulties). No other selection criteria were stipulated. Of the six players selected, five players reported normal hearing and vision. One player reported minor hearing loss in one ear that did not affect daily tasks. All players had previously completed

compulsory education (Year 12 or equivalent) and all were engaged in post-compulsory courses at the time of testing.

Materials. To measure the working memory capacity (WMC) of the players involved in the study, two versions of the shortened complex span tasks developed by Foster et al. (2015) were administered using a 13-inch MacBook Pro. Complex span tasks involve providing the participant with a sequence of items to remember (such as letters, numbers, or positions on a grid). Participants also complete a distractor task between each presentation of an item, such as judging the symmetry of an image or completing a simple mathematics equation. The number of items to be remembered for each trial ranges from two to seven. Two versions of the shortened complex span tasks were used to provide a measure of verbal and spatial WMC. The symmetry span task provided a measure of spatial WMC. In this task, participants are asked to remember the location of a highlighted square in a 4x4 grid, while judging the symmetry of an image between presentations of the grid. The operation span task, in which participants must remember a sequence of randomly generated letters while solving mathematics problems between each presentation of a letter, measured verbal WMC. Due to time constraints, participants were presented with one block of each task. It is acknowledged that this may have impacted on the accuracy of the data, but it also represents the challenging nature of working with elite athletes in-season. For full task specifications and validity/reliability information, see Foster et al. (Foster et al., 2015).

Participants were also asked to complete the Feedback Orientation Scale developed by Linderbaum and Levy (2010) in an attempt to determine each individual's disposition towards receiving feedback. The scale consists of 20 statements requiring a response on a 5-point Likert scale where 1 = strongly disagree

and 5 = strongly agree. Where required, the original wording of the instrument was adjusted to reflect the sporting context; statements such as "feedback contributes to my success at work" were modified to "feedback contributes to my success with football".

A scale intended to measure participants' self-efficacy for understanding and using feedback was developed by the researchers, in accordance with guidelines for self-efficacy scale design proposed by Bandura (2006). Participants were asked to respond to seven statements on a scale from 0-100, where 0 = cannot do at all to 100 = highly certain can do. The statements were:

- I can understand the feedback given to me by the coach
- I can ask questions to the coach to help clarify the feedback they give
- I can ask questions to my peers to help clarify the feedback the coach gives
- I can use the coach's feedback to plan or set goals for my performance in the next game
- I can remember the coach's feedback on game day
- I can change my game day performance based on the coach's feedback, and
- I can judge how successful I was at using the coach's feedback to change my in-game performance.

All coach-player meetings and player interviews were recorded using a standard Apple iPhone 6. Verbal interactions (i.e., feedback, questioning) between player and coach during meetings were coded using the scheme depicted in Table 6 below. The scheme was developed using the feedback coding systems and models presented in the literature review, and has been established in previous studies (Mason et al., 2020). Player interviews were conducted by the first author, and were intended to assess recall of feedback provided by the coach in a similar manner to previous

studies (Januario et al., 2015). Interviews were semi-structured in nature; each was based around the following questions: 1) What did your coach tell you about your performance in the meeting following last week's game against [opponent]? Recall as many messages as possible. 2) [Once Q1 had been exhausted] Can you summarise your coach's feedback into a few key points? 3) How well could you recall the coach's feedback during the next game? 4) Were you able to successfully change your performance in the next game as a result of the coach's feedback? Players were prompted for more information where required, particularly when vague or truncated answers were provided. Players were also asked basic demographic questions: age, self-reported hearing or vision issues, any known learning difficulties, and educational attainment.

Procedure. Written consent was obtained from all participating coaches and players, along with the General Manager of Football, prior to participation. The study was approved by the University of Melbourne Human Ethics Advisory Group (HEAG) at the Melbourne Graduate School of Education. Ethics ID: 1749578.1, granted 6/7/2017.

Each coach-player pair was filmed during one individual video feedback meeting on the Monday following a Saturday game held in July 2017, in which the team won. Six meetings were filmed in total. Meetings took the form of a review of the previous game, with coaches providing video of the player's performance on a laptop computer while narrating the vision with their own verbal feedback to the player. All verbal interactions between coach and player were transcribed verbatim.

Seven days after each meeting, following the next game but before the next feedback meeting, the first author administered a series of data collection instruments

to the player. First, the player was interviewed about their recollection of the feedback provided to them in the previous week's feedback meeting. Following the interview, the player was administered the Feedback Orientation Scale (Linderbaum & Levy, 2010) and the Sport Feedback Self-Efficacy Scale (Bandura, 2006) in counterbalanced order. Following this, the player was administered the working memory capacity task, with the symmetry span and operation span tasks (Foster et al., 2015) presented in counterbalanced order.

Following data collection, verbal interactions between player and coach were coded using the scheme in Table 6. To ensure reliability, data was dual-coded by a second coder who was blind to the first coder's responses; reliability data is presented in the Results section. Coders were asked to score each category once; for example, in the autonomy-supportive/controlling category, each feedback message was coded as either: autonomy supportive, neutral, or controlling. A description of each type of code and a representative example (not taken from the current sample) was provided to assist with coding.

Table 6.

Coding Scheme Used to Categorise Coach-Player Dialogue During Meetings

Code	Description	Reference
Coach FB	When the coach provides the player with any kind of feedback	
Coach question	When the coach asks the player a question	
Coach summary	When the coach provides a summary of feedback for the player	
Player talk	When the player talks (response, question, statement - any speech)	
Player question	When the player asks the coach a question	
Player self-FB	When the player makes an evaluative statement about their own performance	
Player summary	When the player provides a summary of feedback they have been given	
Descriptive FB	Describes performance and/or errors made	Magill & Anderson (2012)
Prescriptive FB	Provides information on how to change action next time	Ibid.
Self FB	Personal evaluations and affective (usually positive) about the learner	Hattie & Timperley (2007)
Task FB	How well tasks are understood/performed	Ibid.
Process FB	The main process needed to understand/perform tasks	Ibid.

Self-regulation	Self-monitoring, directing, and regulating of actions	Ibid.
Positive FB	Feedback that evaluates performance positively	Halperin et al., (2016)
Negative FB	Feedback that evaluates performance negatively	Ibid.
Controlling FB	Pressures the player into thinking, feeling or being in specific ways	Carpentier & Mageau (2013)
Autonomy-supportive FB	Empathic, paired with choices of solutions, free from person-related statements, paired with tips, etc.	Ibid.
Group FB	Feedback that refers to a whole team or line performance	
Individual FB	Feedback that refers to the individual's performance only	
Closed question	Questions that can be answered finitely by a 'yes' or 'no'	
Open question	Questions that solicit additional information	

Note: FB = feedback.

All verbal interactions were also coded into idea units, a concept introduced in human communication research (Stafford et al., 1987) and later adapted for use in sport (Januario et al., 2015). An idea unit represents the smallest unit of meaning in an interaction that carries information or affective value (Stafford et al., 1987). Idea units are contrasted with reproductions, which are the units recalled by a conversational participant that preserve the original meaning of the idea unit. These figures can be compared to obtain an overall percentage of information recalled from an interaction,

in this case a coach-player video feedback meeting. In an early study employing idea units to measure conversational recall during a 7-minute conversation, between 132-253 idea units (Stafford et al., 1987) were coded. In a sporting context, the number of idea units exchanged between soccer players and their coach ranged from 1-39 (Januario et al., 2015) during a single training session; however, the coding protocol for this study suggests that idea units were much larger than originally defined by Stafford et al., with idea units reportedly between 1 and 250 words. When asked to reproduce idea units during a free recall interview, players reproduced 34.5% of the original idea units. However, given the large chunks (up to 250 words) that make up idea units in this study, it is possible that the true rate of reproduction was much lower. It is acknowledged that the context of a video feedback meeting is not the same as a casual conversation; however, a precedent for this type of analysis in existing coaching science research (Januario et al., 2015; Mesquita et al., 2008; Rosado et al., 2008) suggests that this may be an appropriate avenue for analysing feedback recall.

Results

Coach feedback coding. Each coach-player feedback meeting was timed, with a mean meeting time of 19min 58sec (*SD* = 9min 4sec). Meetings ranged between 10min 33sec, and 27min 15sec. To allow for comparison across meetings of differing durations, raw frequencies for each code were also converted into a rate per 10mins of meeting time. The Kappa statistic (k) was used as an indicator of inter-rater reliability, with agreement levels ranging between "moderate" (k = 0.41) and "substantial" (k = 0.79). Mean and per 10min frequencies for coach feedback coding categories are shown in Table 7 below.

Table 7.

Mean, Percentage, and Per 10min Frequencies for Coach-Athlete Dialogue Coding

Code	Mean (SD)	% of coding cat.	Per 10min
Coach feedback	29.33 (9.46)		16.11 (6.33)
Coach question	18.67 (16.50)		9.94 (7.91)
Coach summary	1.00 (0.61)		0.61 (0.37)
Player talk	27.00 (15.50)		13.97 (7.32)
Player question	1.17 (1.17)		0.70 (0.86)
Player self-feedback	12.33 (6.56)		6.30 (2.59)
Player summary	0.67 (0.82)		0.33 (0.39)
Feedback types			
Descriptive	19.33 (7.17)	63.37%	10.55 (3.98)
Prescriptive	11.17 (3.76)	36.63%	6.31 (2.93)
Self	0 (0)	0%	0 (0)
Task	18.00 (6.57)	60.69%	9.85 (4.38)
Process	9.83 (3.76)	33.14%	5.32 (2.53)
Self-regulation	1.83 (0.75)	6.17%	0.99 (0.38)
Positive	17.33 (6.95)	59.08%	9.46 (3.95)
Neutral	7.67 (4.41)	26.15%	3.82 (1.95)
Negative	4.33 (1.75)	14.76%	2.82 (1.90)

Controlling	5.17 (2.99)	17.63%	3.21 (2.65)
Neutral	18.83 (7.17)	64.20%	10.11 (3.68)
Autonomy-supportive	5.33 (2.94)	18.17%	2.77 (1.25)
Group	3.00 (2.83)	10.46%	1.61 (1.40)
Individual	25.67 (8.80)	89.54%	13.67 (5.48)
Question types			
Closed	8.83 (6.08)	48.62%	5.05 (3.81)
Open	9.33 (9.58)	51.38%	4.65 (4.30)

Table 7 also provides an overview of the types of feedback and other interactions observed during the coach-player feedback meetings. An unexpected finding was that for every question asked by the player (M = 1.17 per meeting), the coach asked nearly 19 questions (M = 18.67 per meeting).

Learner characteristics. Player results on the instruments designed to measure moderators of feedback recall (working memory capacity, feedback self-efficacy, feedback orientation) are presented in Table 8.

Table 8.

Player Demographic and Moderator Variables

Variable	*M*	*SD*
Age	22.67	3.14
Games played (AFL level)	50.33	80.12
Working memory capacity		
Operation span Ospan score (max = 27)	9.80	8.98
Operation span total score (max = 27)	18.80	4.27
Symmetry span Symspan score (max = 14)	4.17	3.60
Symmetry span total score (max = 14)	8.00	2.83
Feedback Orientation Scale (ranges from 1-5)		
Utility	4.63	0.45
Accountability	4.30	0.35
Social awareness	3.97	0.79
Feedback self-efficacy	4.17	0.79
Sport Feedback Self-Efficacy Scale (ranges from 0-100)		
Understand feedback given by coach	95.00	8.37
Ask clarifying questions to coach	91.67	11.69
Ask clarifying questions to peers	98.33	10.33
Use coach feedback to set performance goals	93.33	10.33
Remember coach feedback on game day	81.67	17.22
Change performance based on feedback	83.33	10.33
Evaluate success of changing performance	86.67	8.17

Note: Ospan/symspan = total number of items recalled in correct order.

Table 8 shows large variance in playing experience within the sample, but consistently high scores across a range of measures of attitudes towards feedback. Working memory capacity results suggest that players performed at a higher level on average on the operation span task (where $M = 18.80$ or 69.6% of the total possible score) than the symmetry span task (where $M = 8.00$ or 57.1% of the total possible score). It should be noted that while some players performed at or close to the maximum score, no player was excluded from the study due to a poor score on either of the working memory tasks. A strong positive correlation was observed between the two working memory tasks, $r = .95$, $p = .003$.

Player recall of feedback. An idea unit analysis revealed that meetings contained a mean of 116.17 (SD = 51.27) idea units. Transcripts of player recall revealed that players were able to provide a mean of 6.33 (SD = 2.42) reproductions of the original feedback meeting, which represents 6.43% (SD = 3.56%) of total idea units. Representative examples of an idea unit, and the player's recall of it, is provided below:

Idea unit: "I thought your aerial defending has improved"

Reproduction by player: "He said that my aerial defending was pretty strong"

Idea unit: "When you [run in] from an angle rather than come straight you're better"

Reproduction by player: "He talked about coming in on those different angles"

*Idea unit: "*Put some work into getting those ground balls right"

Reproduction by player: "Most of my feedback was about my ground ball work… just to get repetition at training"

A qualitative examination of the types of feedback messages that players recalled revealed that players appear to summarise feedback messages into broad themes, omitting the level of detail in the feedback provided by the coach. To illustrate this, the first author grouped each coach's feedback into categories, which were agreed upon by a secondary coder blind to the first author's categorisation. These categories were then matched up with the themes that athletes recalled. Results are presented in Table 9 below, indicating that player recall of key feedback themes sat consistently at around 50% across the six participants.

Table 9.

Estimated Feedback Categories Present in Each Player's Feedback Meeting

Player	Total FB messages	FB categories	Recalled	%
1	31	7	3	42.86%
2	38	11	6	54.55%
3	37	15	7	46.67%
4	25	11	5	45.45%
5	13	8	4	50.00%
6	28	13	6	46.15%
Mean	28.67	10.83	5.17	47.61%

Interactions between recall and moderators. Moderators of interest were examined against recall of feedback measures. It should be noted that the correlations presented below are underpowered and are included as an indicator of general trends only.

An expected strong positive relationship (r = .93, p = .008) was found between meeting length and the number of idea units present. A strong negative relationship (r = -.83, p = .042) was found between meeting length and the percentage of idea units recalled by players, such that longer meetings were associated with lower rates of recall.

No relationships were found between recall and working memory measures (r = .31, p = .553 and r = .46, p = .35 for verbal and spatial WMC respectively), playing experience (p = -.64, p = .175), feedback self-efficacy (r = .05, p = .924), or feedback orientation (r = .34, p = .516).

Discussion

The aim of the current study was to categorise and quantify the feedback provided from coaches to athletes in a video feedback setting, and the impact of this feedback on athlete learning outcomes. Additionally, the study sought to explore athlete characteristics that could act as moderators of the feedback-learning relationship.

Rates and types of feedback generally followed those found in the literature. The largely task-focussed nature of feedback mirrors rates found in previous studies (Mason et al., 2020). Approximately half as much process as task-based feedback was provided in the current study, with even less self-regulation level feedback observed.

Lower rates of process-level feedback were found in the current study than in a live competition setting (Mason et al., 2020). Hattie and Timperley (2007) argue that task-level feedback can be effective when feedback about the task can subsequently be used for strategy selection or improving self-regulation, but that this is often not the case. Rates of process and self-regulation feedback did not appear to vary based on athlete experience or from coach to coach. While it may be expected that coaches should provide more higher-level (process or self-regulation) feedback to athletes who are more experienced, given the notion that higher levels of feedback help to reduce a dependency on external sources, it is also possible that the experienced athletes in the sample were receiving feedback on a new concept or skill for which they could be considered novices.

Feedback was primarily descriptive rather than prescriptive. This likely reflects the expert nature of the athletes in the sample (Magill & Anderson, 2012), and may be aligned with best-practice given the proposition that prescriptive feedback does not allow for athlete self-regulation (Bangert-Drowns et al., 1991). This represents a contrast to the high levels of prescriptive feedback found in a live competition setting (Mason et al., 2020), providing evidence that context is likely to have an effect on observed rates of feedback. Coaches in the current sample provided mostly positive feedback rather than neutral or negative; a pattern which is more closely aligned with rates found in observational studies of training than with feedback provided in competition (Horton et al., 2005). Levels of controlling feedback were similar to previous studies, while autonomy-supportive feedback levels were well above those found previously (Halperin et al., 2016). However, this may again reflect the setting in which the feedback was provided; previous studies have observed a live competitive setting, where time pressure and the intensity of competition may impact the coach's

ability to provide autonomy-supportive feedback compared to a setting in an office away from the competition environment.

A clear message from the general coding categories was that coaches ask approximately 16 questions for every player question, at a rate of nearly one per minute. Further analysis revealed that slightly less than half (48.6%) of coach questions were closed (requiring a yes/no answer; e.g., "Is that what we're after?"). Previous research has suggested that coaches working at a higher level ask more questions than coaches working at lower levels (Cushion & Jones, 2001), and that questioning is used as a tool to prompt athletes to take turns, rather than to aid in the development of new knowledge (Groom et al., 2012). The finding that approximately half of coach questions are closed suggests room for improvement. Walsh and Sattes (2005) suggest that teachers should create more opportunities for students to ask questions, because a rapid-fire closed questioning approach can minimise student engagement. Coaching practice may be improved by encouraging coaches to ask deeper, open-ended questions, and to create more opportunities for athletes to ask questions themselves.

Athlete recall of coach feedback, as measured at a follow up interview one week after the video feedback meeting, was low. This provides further evidence that feedback given is not always feedback received (Hattie & Clark, 2019). The finding that just 6% of idea units from a video feedback meeting were recalled at a one-week retention interval should be treated with caution, given the absence of an immediate recall test for comparison. Despite its use in various coaching science studies (Januario et al., 2015; Mesquita et al., 2008; Rosado et al., 2008), the idea unit analysis may be too sensitive a method of analysis to reflect accurate rates of recall; asking an athlete to

recite individual conversational items from a video feedback meeting held a week prior may not be an ecologically valid method of assessing recall. A recall rate of approximately 50% of major themes from the video feedback is more in line with rates found in prior research (Mesquita et al., 2008), and is perhaps more practically viable as a future method for evaluating feedback recall.

A general trend observed in the recall data was that the number of idea units successfully recalled by participants appeared to be related to the overall number of idea units coded in the meeting transcript. The two meetings with under 100 idea units resulted in recall rates above 10%, while the four meetings with over 100 idea units resulted in recall rates below 10%. While this is an unsurprising finding, given that recall is likely related to the overall number of items to be recalled (Ward et al., 2010), the outcome has practical implications. The message for coaches may be to either simplify their messages and adopt a 'less is more' approach, to reduce the overall length of their meetings, or identify memory and learning strategies they can employ in their teaching practices to enable athletes to recall more of their feedback.

The absence of any significant findings related to the learner characteristic variables should be interpreted with caution, given the small sample size in the current study. However, some general trends among all six athlete-coach pairs can be observed. Results of the Feedback Orientation Scale (Linderbaum & Levy, 2010) and feedback self-efficacy questionnaire (Bandura, 2006) reveal a ceiling effect. All four subscales of the Feedback Orientation Scale (utility, accountability, social awareness and feedback self-efficacy) resulted in a mean score of 4 out of 5 or above, with little variation between participants. Similarly, the feedback self-efficacy questionnaire revealed homogeneous responses across items and participants, with mean scores in

the range of 82-95 out of 100 for all questionnaire items. These findings may be the result of a social desirability effect (Krumpal, 2013), whereby participants feel pressured to respond in a way they believe their coach may wish them to (i.e., that they enjoy receiving feedback and are skilled at using it) despite reassurance from the researcher that their responses are confidential. However, given the high-stakes environment of professional sport (Calmeiro et al., 2014), it is also possible that the athletes genuinely highly value the feedback provided to them, as it helps them to improve their performance.

Limitations and future directions. A fundamental limitation of the current study is that it focuses solely on one source of feedback throughout a typical week in an elite sporting environment: the video feedback meeting. As a result, it ignores the myriad of other sources of feedback that athletes receive each week: during competition, during training, from peers, and feedback generated internally by the athlete during self-regulatory processes. There is a major gap in the coaching science literature regarding the types of feedback provided during video feedback meetings (Bertram et al., 2007), which has been addressed in the current study. However, future studies should seek to more closely examine the feedback that occurs over an entire weekly cycle to obtain a more accurate depiction of feedback recall.

A weakness of the feedback coding scheme was found when coding autonomy-supportive and controlling feedback. While Carpentier and Mageau (2013) suggest that there are up to eight criteria that indicate feedback is autonomy-supportive, later studies that coded autonomy-supportive feedback in a competition setting accepted as few as one of these criteria (feedback posed as a question that provides the athlete with choice; (Halperin et al., 2016). The current study adopted the approach of Halperin et

al. in coding autonomy-supportive feedback, but it should be acknowledged that this may be a superficial treatment of the notion of autonomy. On the other hand, Halperin et al.'s approach may be the most practically meaningful method of coding autonomy-supportive feedback, since no feedback statement will likely contain all eight criteria proposed by Carpentier and Mageau (2013), and earlier authors.

Future studies may also benefit from interviewing players about their interpretation of the feedback provided by the coach. Evidence suggests that feedback lacking clarity can negatively impact working memory and subsequent retention of information (Bangert-Drowns et al., 1991), so any variation in feedback recall could be further investigated by determining inconsistencies between the coach and player's interpretations of the same piece of feedback.

Finally, it should be acknowledged that one feedback meeting from six coach-athlete dyads is a small sample size. Although the coaches and players recruited for the current study are typical of the coaches and players at the elite level of Australian Rules football in terms of age and experience, the size of the sample may bring into question its representativeness. Future research would benefit from expanding the number of participants or the number of observations for a similar number of participants. Additionally, observing feedback meetings following both a win and a loss would enable an examination into the ways in which video feedback changes as a result of game outcome.

Practical implications for coaches. A number of practical implications can be drawn from the results of the current study. First, given the finding that longer video feedback meetings led to lower athlete recall, coaches should adopt a 'less is more' approach to feedback in this context. Second, coaches should be encouraged to alter

their approach to questioning, such that more athlete questions and less coach questions are asked in an interaction. Moving towards fewer, but deeper and more open-ended, questions appears to be an avenue for improving coach practice. Finally, despite the absence of significant findings regarding athlete characteristics, it can do no harm for coaches to consider the dispositions and skills that an athlete brings to a learning situation when planning a video feedback meeting.

Conclusions. This study provides novel insight into the ways that feedback reception, and the factors that influence reception, can be studied in an applied sporting setting. The results provide new detail about the types of verbal feedback that coaches provide in video feedback meetings. While the exact method of measuring feedback recall may need refinement, recall rates found in the current study provide a useful starting point from which to further consider the reception of feedback in an applied sporting setting.

Acknowledgements

The authors wish to Aaron Greaves for his assistance with organising data collection and Chris Davies for his willingness to allow access to the Football Department. The authors also wish to acknowledge Kieran Hattie for his assistance with coding.

Disclosure statement

No potential conflict of interest was disclosed by the authors.

Funding

This work was supported by an Australian Government Research Training Program Scholarship, awarded to the first author.

Chapter 6: An Analysis of In-Game Feedback Provided by Coaches in an Australian Football League Competition (Study 3)

This manuscript was submitted to the journal *Physical Education and Sport Pedagogy* in November 2019. It was published by the journal in February 2020.

Abstract

Background. Coach observation studies have been a mainstay of coaching science research for decades, with a major focus on the use of instruction and feedback by coaches. However, relatively few studies have investigated feedback provided in a live competition setting, with a majority focussing on the training environment. As such, little is known about the way that feedback changes as the status of the game fluctuates (win/loss, narrow/wide margin). Additionally, feedback variables of interest are featured inconsistently between studies.

Purpose. The purpose of the current study was to investigate the quantity and nature of feedback from coach to player in an Australian Rules football context, specifically the elite-level Australian Football League competition. An entire season worth of coach-player feedback was recorded and coded against a wide range of feedback variables most commonly found in the literature. A secondary aim of the study was to examine changes in feedback against various game metrics (winning/losing quarter, margin).

Method. Five coaches from one AFL team, all with several years of experience at the elite level, were recorded across 21 games from the regular 2018 season.

Feedback quantity, along with several feedback variables of interest (valence, autonomy-support, descriptive/prescriptive, individual/group, etc.), were coded during each quarter of play. Game information (game outcome, quarter outcome, margin at start of quarter, point differential for quarter) was also recorded.

Results. Across 84 quarters of football, 1301 coach-player feedback instances were observed. Mean values across all quarters revealed that more negative (20%) than positive (13%) feedback was provided, more prescriptive (81%) than descriptive (19%) feedback, more controlling (58%) than autonomy-supportive (8%), and more individual (70%) than group (30%) feedback was provided. Task-related feedback (60%) was more common than process-related (37%), self-regulation feedback (3%) or self-level feedback i.e., praise (2%). More positive feedback was provided in winning quarters than in losing quarters, while more controlling feedback was present during losing quarters than during winning quarters. Coaches provided significantly more feedback overall when the game was in the balance than when the team was 95% likely to win or lose.

Conclusions. The paper presents novel findings about feedback use in an elite competitive team sport setting. Areas where the use of feedback does not align with current theory and evidence are highlighted, particularly regarding feedback valence and autonomy support. Feedback variables more commonly associated with improved learning and performance in the literature appear to generally be provided more frequently during winning quarters, but a causal relationship is yet to be determined.

Keywords: feedback; Australian Rules football; Australian Football League.

Introduction

Growing interest in the behaviour and decisions of sports coaches has seen an emergence of coach observation studies in recent decades (Gilbert & Trudel, 2004). A common research paradigm involves the observation of coaches in a training environment, with various behaviours categorised and quantified as a measure of coaching effectiveness (Ford et al., 2010). Many studies focus on instruction and feedback provided by coaches, but few have examined these in a live competition setting (Cope et al., 2017). In most team sports, the coach is able to provide instruction and feedback to their players during game breaks, timeouts, and to players resting while not in the field of play. This can serve to instruct players on strategies or tactics to adopt, to provide feedback on individual performance, and to motivate. However, little is known about the nature of coach feedback during competition, or the way in which feedback varies according to the stage of the game or the margin. The term 'feedback' will be used throughout this paper, but it is acknowledged that feedback and instruction are inextricably intertwined (Kulhavy, 1977). Feedback can sometimes take the form of instruction if it prescribes future performance, just as instruction could be considered feedback if it relates to previous instruction.

A small number of studies have investigated in-game feedback from coach to player. However, a major limitation of these studies is the absence of a comprehensive framework for evaluating feedback. This may be due to the popularity of coach observation instruments such as the Arizona State University Observation Instrument (ASUOI; Lacy & Darst, 1984) and the Coach Analysis Intervention System (CAIS; Cushion et al., 2012), which appear to value a narrow band of particular feedback characteristics (such as positive vs negative reinforcement) over others. Strikingly, few

studies use these tools in their original or validated form, instead opting for modified and adapted versions with little consistency between studies (Cope et al., 2017).

Studies including a simple positive and negative feedback dichotomy generally reveal that coaches provide more positive than negative feedback during games, with the gap widening in favour of positive feedback when coaching a winning performance. For example, French rugby coaches were found to provide large amounts of positive feedback in-game (Mouchet et al., 2014). Rates of positive feedback ranged between 63% and 100%, with the exception of one team where the coaches provided around 25% positive feedback; the authors noted that this game was characterised by many errors and a close margin. In another study, coaches of elite youth soccer teams provided up to 95% positive feedback throughout a game, with 0.96 instances of praise per minute compared to 0.06 scolds per minute (Smith & Cushion, 2006). Praise accounted for up to 18% of total coach actions. Calpe et al. (2013) examined feedback valence in the context of close games, large wins, and large losses, finding that significantly more negative feedback was provided by handball coaches in large losses than in close games or large wins. In a study of ringside feedback provided during a boxing bout, coaches provided positive feedback more frequently in winning bouts (36%) than in losing bouts (18%; Halperin et al., 2016). Positive feedback was provided more than negative feedback overall (29% and 13% respectively, with 58% considered neutral). In a sample of amateur Canadian ice hockey coaches, more than twice as much negative feedback as positive feedback was provided to their 14 year old athletes (Trudel et al., 1996). De Muynck et al. (2017) argued that the age of this study may reflect a different social climate where the effects of positive or autonomy-supportive feedback on motivation were less well-known. Finally, in a study linking type of feedback to performance improvement in volleyball setters, Mann (2012)

found that lower-skilled athletes exhibited improved decision-making after a time-out in which the coach provided positive rather than negative feedback. This finding is one of few studies to show causal effects of positive feedback on performance. It provides a sense of ecological validity to support lab-based studies, including a finding of improved movement efficiency in treadmill runners who receive positive feedback (Stoate et al., 2011).

Aside from feedback valence, other feedback characteristics of interest are featured sporadically throughout the literature. Studies investigating team sports may include a measurement of feedback delivered to individuals compared to feedback delivered to the group as a whole. Madden (1995) reported rates of 80% group and 20% individual feedback during game-break messaging in Australian Rules football. Questionnaires provided to 25 elite volleyball coaches revealed that 61% of feedback during game breaks was group-oriented, but that this changed to 37% (i.e., 63% individual feedback) for instruction provided during play (Moreno et al., 2005). Another feedback characteristic of interest relates to whether the feedback is autonomy-supportive or controlling. Autonomy-supportive feedback is empathic, delivered in a considerate tone of voice, provides choices of potential solutions, and is based on clear and attainable objectives (Carpentier & Mageau, 2013). Conversely, controlling feedback forces the athlete to think and behave in certain ways, conforming to the coach's views and allowing little room for autonomy. Autonomy-supportive feedback is typically found to enhance learning and performance outcomes (Teixeira et al., 2012). A sample of boxing coaches (Halperin et al., 2016) was found to provide controlling feedback approximately 53% of the time during a bout, compared to 6% autonomy-supportive and 42% neutral. However, the amount of autonomy-supportive

feedback rises to nearly 7% during winning bouts, and drops below 5% for losing bouts.

Despite its prevalence in motor control literature and experimental research (e.g., Kernodle & Carlton, 1992), there is a clear absence of research into in-game sports coaching that considers a descriptive vs prescriptive approach to feedback coding. Madden (1995) observed game-break messaging in Australian Rules football, finding that 53% of coach feedback prescribed solutions to what was occurring in the game, whereas 47% of feedback simply described performance with no prescription regarding future actions. This approach to feedback coding is of particular interest in the field of non-linear pedagogy, as proponents of this approach believe that feedback should function as facilitative rather than being overly prescriptive in nature (Chow et al., 2016, p. 122).

Another area for further exploration is the focus of the feedback, using a model such as Hattie and Timperley's (2007). The model suggests that feedback is differentially effective depending on the level at which it is provided (at the learner themselves, at the task, at the processes underlying the task, or at the self-regulation level), and the stage of the learning process. This model has only been explored in an off-field sporting environment (Mason et al., 2020c) and in educational research. Adopting a coding scheme such as this would help to elucidate the function of the feedback provided during performance: is it largely praise directed at the individual? Information about the task or how to perform it? Information that helps the athlete to self-regulate and correct future performances? Additionally, Hattie and Timperley's model proposes three questions that effective feedback answers: Where am I going? How am I going? Where to next? The latter two questions are analogous to the

descriptive/prescriptive dichotomy described above; ‘How am I going?’ describes performance, while ‘Where to next?’ prescribes future actions to bridge the gap between current and goal performance, and could even be considered instruction in some cases.

Along with the content of feedback provided to players, another important consideration is the overall quantity of feedback. Retention of coach feedback has been shown to be less than ideal in both competition settings (Mesquita et al., 2008) and for feedback provided post-competition in a video review session (Mason et al., 2020c). Boxing coaches were found to provide up to 8 feedback messages during each 3-minute round (Halperin et al., 2016). This rate did not differ according to the bout’s outcome (win/loss). In a competition setting, the amount of feedback provided to players is of particular importance because of the detrimental impact of cognitive load on physical performance (Smith et al., 2014) and decision-making (Smith et al., 2016). In many of the studies cited throughout this review, the conclusion is that coaches should limit their instruction to a small number of salient points rather than overload their players (Madden, 1995; Mouchet et al., 2014; Smith & Cushion, 2006).

Australian Rules Football. Australian Rules football represents a unique environment for the provision of feedback from coaches to players in a live competition setting. Matches consist of four quarters, each with 20 minutes of playing time; the clock is stopped in certain situations (e.g., out of bounds, after a goal, free kicks) so that the actual elapsed time of each quarter is around 28-30 minutes. Coaches are permitted to address players during 6 minute breaks after the first and third quarters, and during the 20 minute half-time break. Coaches are unable to call a ‘time-out’ or otherwise stop play to instruct players, as in other team invasion sports.

Unlike most team sports, coaches are not situated near the playing surface and so typically cannot call instructions or feedback to players from the sidelines. During match play, a team of coaches sit in a room known as the coaches' box. This room is elevated from the playing surface and away from the interchange bench where substituted players rest. In a typical coaches' box, the senior coach (also known as the head coach) is joined by: a senior assistant, three specialty coaches who are responsible for the three main positional groups or 'lines' (forwards, midfielders, defenders), and a team of analysts who provide live statistics and vision to the coaches. The coaches are provided with telephones with which they can contact personnel on the interchange bench. A typical interchange bench includes another coach, plus four resting players (who can be spoken to via telephone by coaches in the box) and a 'runner' who is permitted to enter the playing field at certain times to relay messages to active players. It should be noted that at the time of data collection the runner was able to enter the playing field while live play continued; however, this was changed at the conclusion of the 2018 Australian Football League (AFL; the highest level of the sport in Australia) season so that the runner can now only enter the playing field in a 45 second window after a goal is scored.

Prior research on Australian Rules coaching is sparse, and focuses primarily on the language of interactions between coaches rather than the content of the message relayed to players. Walsh and Jureidini (2016) analysed coaches' box language in a case study involving one semi-professional Australian Rules team, with a focus on understanding talk among the coaching team rather than the final message delivered to players. They noted a rate of approximately 10 messages from coaches' box to interchange bench per quarter, at a rate of one per 2-3 minutes. This rate was found to increase in situations where the margin was close, but the authors did not provide a

specific figure to accompany this statement. In their conclusion, Walsh and Jureidini suggested that future research should focus on quantifying the types of messages sent to players and, importantly, the messages that players actually receive.

Only one study to date has investigated the impact of feedback from coach to player in an in-game Australian Rules setting. Madden (1995) recorded 23 coach addresses delivered during game breaks of major, minor and junior leagues in Victoria, Australia. Coaches provided 27 units of communication during half time breaks, where a unit of communication is defined as a clear change in the subject matter of the coach's speech. During the shorter quarter and three-quarter time breaks, coaches provided 18 units of communication. Approximately half of these messages overall were prescriptive of future actions, while the other half simply described performance. Coaches directed 80% of their messages to the team as a whole, with 20% addressed to individual team members. Coaches of teams that went on to lose the match delivered 25% more messages than coaches of the teams that won. Winning coaches also used significantly more positive feedback, with the caveat provided that these relationships were not causal and may in fact be a by-product of success or failure. Madden concluded that coaches should avoid overloading players by prescribing large numbers of solutions, and should instead distil their game-break messaging to a small number of vital points. A suggestion for future research was that the same coaches should be followed during both wins and losses, to determine whether praise is a consequence of success or used as an a priori approach to coaching successfully.

Present study. Determining the quantity and characteristics of feedback in a live competition setting, along with how feedback fluctuates according to the state of the game (i.e., early or late in the game, small or large margin), appears important for

improving coach effectiveness. The aim of the current study was to examine the quantity and nature of instruction and feedback provided from coaches directly to players or via the runner in an Australian Rules game, and the relationship between these messages and various game outcome metrics. Unlike most existing studies involving Australian Rules football, the current study did not focus on between-coach interactions, but the outcome of these interactions represented by the final message delivered to players. As suggested by Madden (1995), the current study adopted a repeated-measures design with the same coaching staff, in order to determine changes in feedback during both winning and losing games/quarters of football. Additionally, observing an entire season of coaching allows for a more accurate account of the pedagogical strategies employed by coaches (Lacy & Darst, 1985).

Method

Participants. One Australian Rules football club competing in the highest level of competition (AFL) was recruited for participation in the study. All five coaches occupying the coaches' box on game day agreed to participate, including the head coach, senior assistant coach, and three line coaches responsible for the major playing positions on an Australian Rules football team (forwards, midfielders, and backs). All coaches had previous experience at elite level (years of AFL coaching experience: $M = 7.67$, $SD = 2.31$), and all had also been involved as players at elite level. All had taken part in formal coach accreditation courses as part of their professional development.

Materials. Verbal interactions in the coaches' box during each game of the 2018 AFL season were recorded using the Audio Recording feature of QuickTime software running on a 15" Apple MacBook Pro. Feedback provided to players was

coded according to a number of existing feedback classification methods; see Table 10 for a full list and examples of feedback in each category, and see Mason, Farrow & Hattie (2020c), for an extended description of categories. A number of game-related data were also collected, using freely available game information from the afl.com.au website. These data were: round, opponent, quarter (1-4), game outcome (win/loss), quarter outcome (win/loss), margin at the start of the quarter, and point differential for the quarter (margin at quarter end minus margin at quarter start).

All coding was completed using QuickTime for audio playback, and Microsoft Excel for the notation of codes. Data cleaning and analysis took place in IBM SPSS 25.

Procedure. Written consent was obtained from all participating coaches, along with the General Manager of Football. The study was approved by the University of Melbourne Human Ethics Advisory Group (HEAG) at the Melbourne Graduate School of Education. Ethics ID: 1851346.1.

An audio recording was obtained from the laptop of the coach who sat most central in the coaches' box each game day. Data was collected across each regular season game of the 2018 AFL season, but data coding did not begin until the completion of the season. This was to ensure a finite coding phase of the project, removed from any emotion of in-season win/loss outcomes. Coding was completed blind to the game-related data described above (win/loss, point differential, etc.) but references to the score that were verbalised by the coaches during the quarter were not removed. A second coder with experience working with feedback data coded one full game to ascertain inter-rater reliability. Reliability statistics are presented in the Results section of this paper.

Data Analysis. A repeated-measures design was used in order to observe the same coaching staff across the course of a full season. Overall, audio was recorded from 21 full games, totalling 84 quarters of football and approximately 42 hours of audio. Each instance of coaches speaking to players (either directly to resting players via phone, or sending messages to players via the team's runner) was separated into individual units of communication, using Madden's (1995) definition that a clear change of subject matter represents a new unit of communication. Each unit was then considered against the coding scheme (see Table 10) and scored once per category. For example, for each unit of communication it was decided whether the coach provided positive feedback, negative feedback, or if the feedback was devoid of positive/negative connotations (neutral).

Table 10.

Description and Examples of Feedback Provided in Each Coding Category

Coding category	Description (*and example*) of feedback provided
Valence	
Positive	Feedback that evaluates performance positively *Great start out there mate, love your energy*
Neutral	Feedback that does not evaluate performance *Stay low over those ground balls*
Negative	Feedback that evaluates performance negatively *Tell him not to be selfish, give the ball to his teammate*
Descriptive/Prescriptive	
Descriptive	Describes performance and/or errors made *We've had 7 kicks and 1 handball for the quarter*
Prescriptive	Provides information about how to change performance or what to do next time *You need to work hard to the front of the contest*
Hattie & Timperley model	
Self	Personal statements about the learner *He's a f*****g dill*
Task	How well tasks are understood/performed *Your contest work has been really good*
Process	The main processes needed to perform a task *We need to get outlets done faster*
Self-regulation	Self-monitoring, directing, and regulating actions *How can you recognise when their wings have gone back to stock?*
Autonomy-supportive	
Autonomy-supportive	Empathic, paired with choices of solutions, paired with tips, etc. *How are you feeling out there with stoppages?*

	Neutral	Neither autonomy-supportive or controlling *We look pretty safe behind the ball*
	Controlling	Pressures the player into thinking, feeling or being in specific ways *You need to stop giving away stupid frees*
Audience		
	Group	Feedback that refers to more than one player *We don't want all our forwards coming up to that next contest*
	Individual	Feedback that refers only to the individual's performance *You need to come up the ground and be more aggressive*

Once a count per quarter of football was established for each coding category, this was also converted to a percentage of the category. For example, positive feedback was expressed as a percentage of the category 'feedback valence' (positive + negative + neutral feedback). Univariate analysis of variance procedures (and follow-up pairwise comparisons) were conducted to examine differences in feedback proportions in winning and losing quarters, and when margins were close or large.

Results

Inter-rater reliability was established with the use of a second coder, blind to the first coder's work, who coded one randomly selected game (four quarters). The Kappa statistic (k) was used as a measure of inter-rater reliability, with agreement levels for each feedback code ranging between $k = 0.65$ and $k = 0.95$.

A representative example of each coding category is provided in Table 10. Examples are drawn from a number of coaches and from different games throughout the season.

Means for each feedback category per quarter are displayed in Table 11, along with percentages of each code's respective coding category. In the 84 quarters coded, a total of 1301 coach-player feedback instances were observed (*M* per quarter = 15.49, *SD* = 4.14). As shown in Table 11, neutral feedback was most commonly provided with respect to feedback valence. Over 80% of feedback was prescriptive in nature, with 19% descriptive. Task-level process accounted for over half of all levels of feedback, while self and self-regulation level feedback accounted for less than 3% each. Approximately 8% of feedback provided was autonomy-supportive, with a majority of feedback in this category considered controlling (58%). Group and individual feedback was split 30% to 70%, respectively.

Table 11.

Mean Values and Percentages for Feedback Coding Categories Per Quarter (n = 84)

Coding category category	Mean (SD)	% of coding
Total coach feedback	15.49 (4.14)	
Valence		
Positive	2.06 (1.83)	13.02%
Neutral	10.39 (3.32)	67.13%
Negative	3.00 (1.66)	19.86%
Descriptive/Prescriptive		
Descriptive	2.88 (1.85)	18.74%
Prescriptive	12.56 (3.66)	81.26%
Hattie & Timperley model		
Self	0.29 (0.51)	2.02%
Task	8.88 (2.48)	57.94%
Process	5.83 (2.15)	37.28%
Self-regulation	0.43 (0.63)	2.75%
Autonomy-supportive		
Autonomy-supportive	1.23 (1.06)	8.23%
Neutral	5.20 (2.24)	33.39%
Controlling	9.05 (3.22)	58.38%
Audience		
Group	4.63 (2.68)	30.41%
Individual	10.88 (4.26)	69.59%
Other		
Coach question	1.52 (1.27)	
Player talk	1.74 (1.43)	
Player question	0.07 (0.26)	

Figures 2-5 show how the above proportions vary based on the outcome of the quarter. A number of significant differences were found in the types of feedback provided during winning and losing quarters. Significantly more positive feedback was provided during winning quarters (M = 17.66%, SD = 9.72) than during losing quarters (M = 7.86%, SD = 8.83), $F(2, 81) = 11.50$, $p < .001$. Subsequently, more negative feedback was provided during losing quarters (M = 23.40%, SD = 10.37) than during winning quarters (M = 16.83%, SD = 10.17).

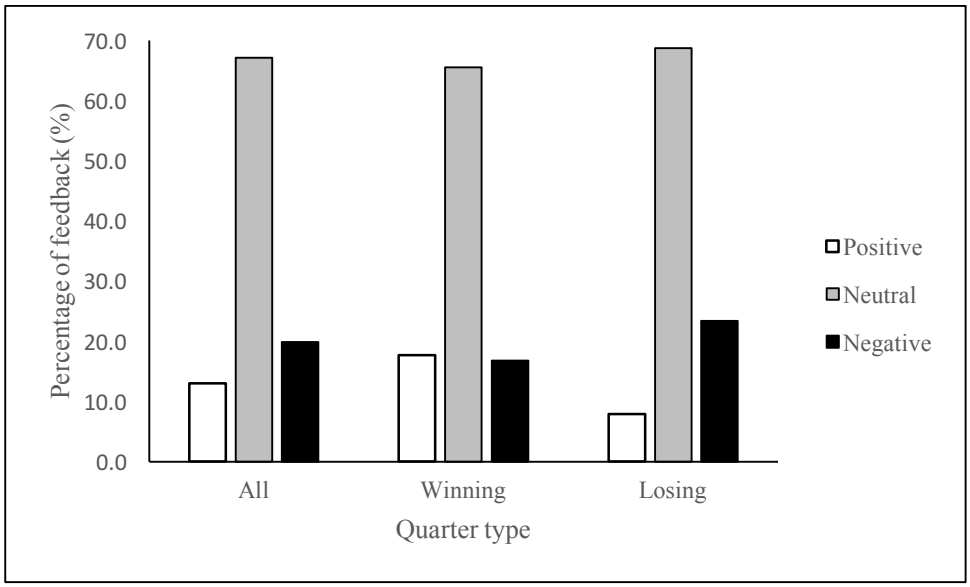

Figure 2.

Positive, Neutral and Negative Feedback Rates as a Function of Quarter Type

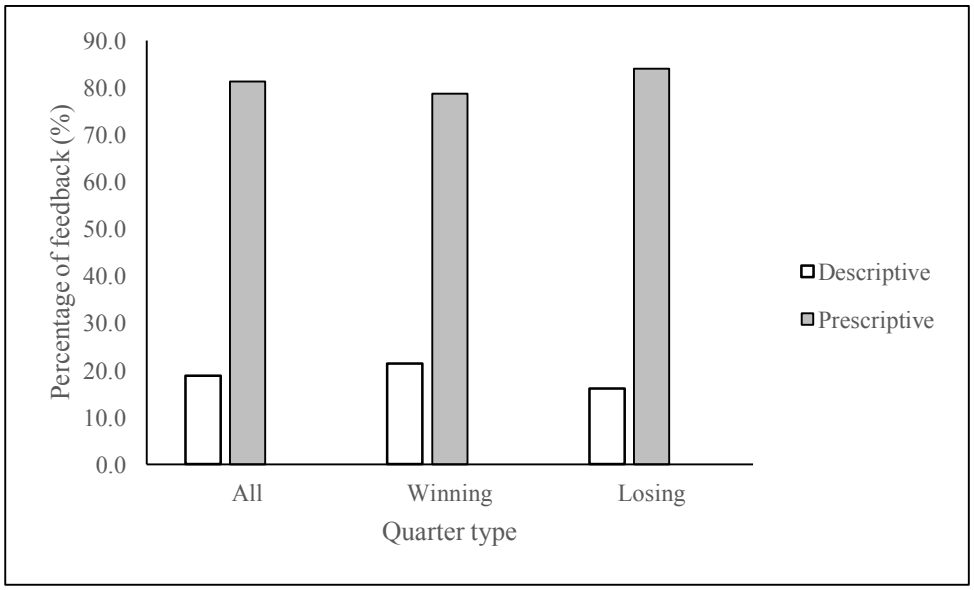

Figure 3.

Descriptive and Prescriptive Feedback Rates as a Function of Quarter Type

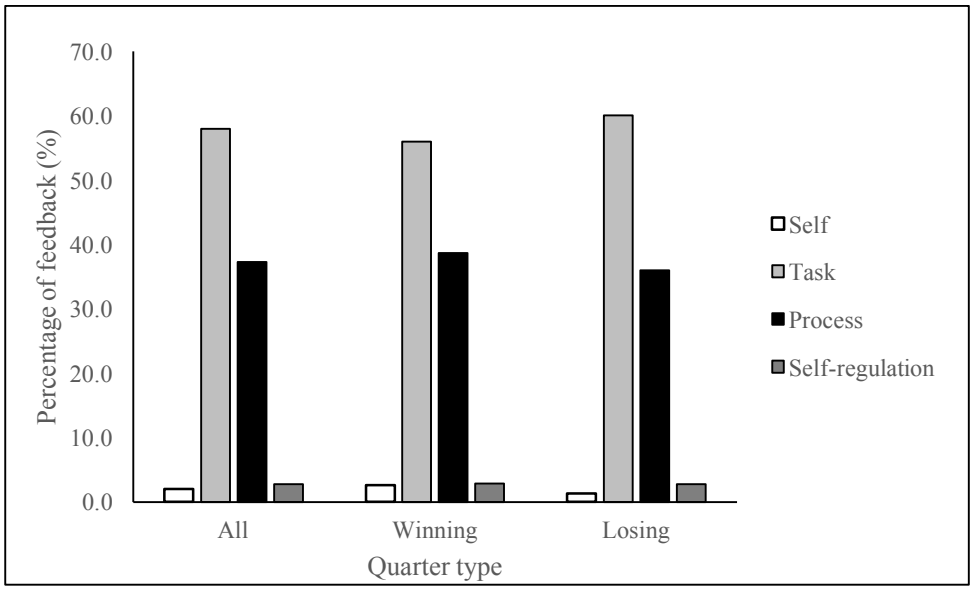

Figure 4.

Self, Task, Process, and Self-Regulation Feedback Rates as a Function of Quarter Type

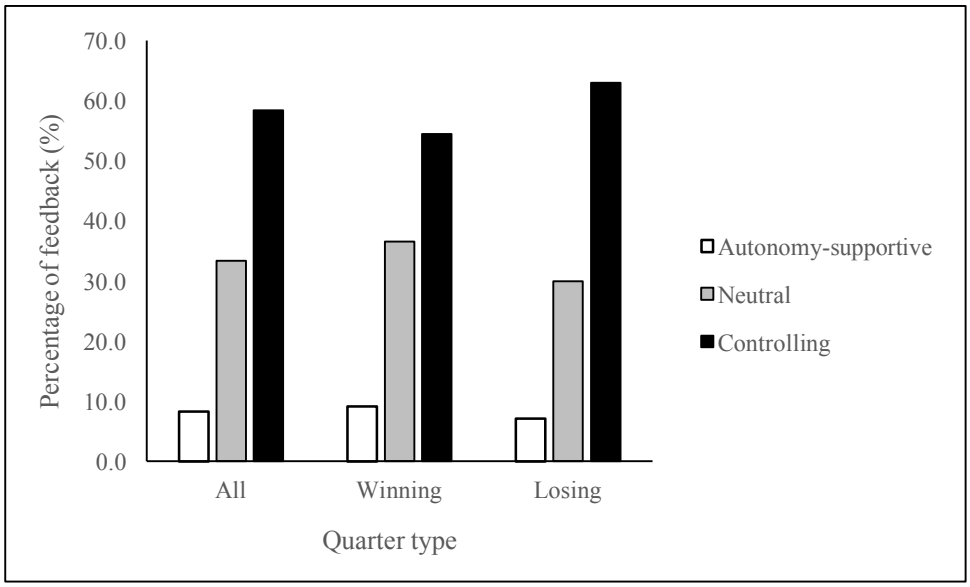

Figure 5.

Autonomy-Supportive, Neutral, and Controlling Feedback Rates as a Function of Quarter Type

A difference approaching significance was found in the descriptive or prescriptive nature of the feedback during winning (Descriptive $M = 21.34\%$, SD = 11.24) or losing (Descriptive $M = 16.02\%$, SD = 10.41) quarters, $F(2, 81) = 2.81$, $p = 0.07$. Additionally, an observation during the coding process that descriptive feedback was most often positive in nature was supported by a correlational analysis, revealing a strong positive correlation between positive feedback and descriptive feedback over the 84 quarters coded, $r = .72$, $p < .001$. It appears that most descriptive feedback involved reinforcing to players what they were doing well; for example, "your energy has been great".

Table 12 presents proportions and a test of significance for the Hattie and Timperley (2007) model of feedback, with only task level feedback observed to be significantly different during winning and losing quarters. Higher but non-significant

proportions of self-level and process-level feedback were seen during winning quarters. Given the infrequency of self-level feedback throughout the sample (self feedback ranged between 0-2 instances per quarter across the 84 quarters of the sample, compared to a range of 2-14 for task-level feedback), it is possible that a larger sample size was needed to detect a difference here.

Table 12.

Coding Categories from Hattie & Timperley Model in Winning And Losing Quarters

Coding category	Mean in winning qtr (SD)	Mean in losing qtr (SD)	*p*
Self	2.57% (4.31)	1.32% (4.42)	.34
Task	55.97% (8.28)	59.98 (7.37)	.05*
Process	38.61% (8.66)	35.98% (7.09)	.22
Self-regulation	2.85% (4.34)	2.72% (3.74)	.79

While coaches did not provide differing amounts of autonomy-supportive feedback during winning or losing quarters, $F(2, 81) = 1.31$, $p = .27$, significantly higher amounts of controlling feedback were present during losing quarters (M = 62.95%, SD = 12.99) than during winning quarters (M = 54.40%, SD = 14.32), $F(2, 81) = 4.04$, $p = .02$.

An analysis of feedback quantity based on quarter outcome revealed no significant difference in the amount of feedback provided during winning (M = 15.48, SD = 4.13) or losing (M = 15.38, SD = 4.18) quarters, $F(2, 81) = 10.39$, $p = .55$. However, Figure 5 shows the results of an analysis of feedback quantity based on the

margin at the start of each quarter, which provides a sense of "closeness" of a game that may have been felt by coaches at the time. Freely available data from AFL games since 2013 was analysed to find a margin at the start of each quarter from which teams go on to win the game 95% or more of the time. These margins were found to be: teams ahead by 5 or more goals at the start of quarter 2, teams ahead by 4 or more goals at the start of quarter 3, and teams ahead by 2 or more goals at the start of quarter 4. Each quarter of the sample was subsequently recoded into "95% chance of loss" (N = 10), "game in balance" (N = 60) and "95% chance of win" (N = 14) based on the above cutoffs.

Results of a univariate analysis of variance (ANOVA) revealed a significant main effect of quarter margin, $F(2, 81) = 7.91$, $p = .001$ (see Figure 6). Follow-up pairwise comparisons revealed that coaches provided significantly less feedback during quarters where the team was 95% or more likely to lose (M = 12.50, SD = 4.72) than during quarters where the game was in the balance (M = 16.53, SD = 3.69). Coaches also provided significantly less feedback when the team was 95% or more likely to win (M = 13.14, SD = 3.82) than when the game was in the balance. There was no significant difference between quarters where the team was 95% likely to win or 95% likely to lose.

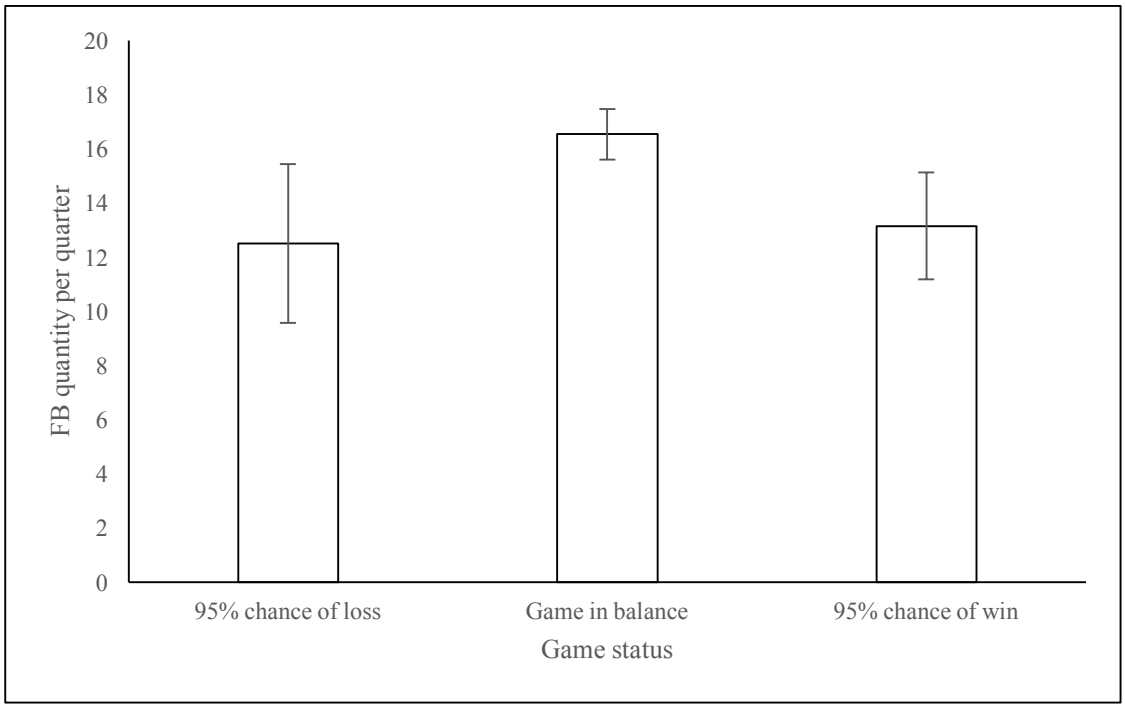

Figure 6.

Amount of Feedback Provided per Quarter by Game Status at the Start of the Quarter. Error Bars Denote 95% Confidence Intervals

Discussion

The aim of the current study was to determine the quantity and nature of feedback provided by coaches in a live competition setting. A secondary aim was to determine how feedback changes according to the margin or outcome of the game.

A majority of findings related to the types of feedback provided by coaches in the current study provide support to previous studies in other sports. One exception to this is for feedback valence, which was found to be negative (20%) more frequently than positive (13%) in the current study. Larger proportions of positive feedback were found in samples of boxing (Halperin et al., 2016), rugby (Mouchet et al., 2014), and soccer (Smith & Cushion, 2006), with rates of positive feedback ranging between 29%

and 100% in these studies. Only one previous study (Trudel et al., 1996) found more negative than positive feedback; however, the study by Trudel et al. utilised a sample of amateur rather than elite youth hockey coaches. During winning quarters, positive feedback increased but remained at a similar rate to negative feedback (18% vs 17% respectively), illustrating that positive feedback did not dominate coach feedback even when performance was strong. Additionally, coaches provided nearly three times more negative feedback (23%) than positive feedback (8%) in losing quarters. A consistent finding from motor control and coaching literature is that positive feedback can facilitate learning and performance outcomes more effectively than negative feedback (e.g., Mann, 2012; Stoate et al., 2011). However, an important caveat to note is that populations investigated in the literature are typically novice learners performing lab-based tasks, or junior athletes competing at a level below elite. Although it could be claimed that the findings in the current study are not in line with best practice feedback described in the literature, the differences in samples should warrant a degree of caution.

A finding from the current study in line with prior research was that controlling feedback was far more prevalent than autonomy-supportive statements. Rates in Halperin et al.'s boxing study (2016) sat at approximately 6% autonomy-supportive and 53% controlling, with little variation between winning and losing bouts. Coaches in the current study exhibited similar rates, with 8% autonomy-supportive feedback during all quarters and up to 9% in winning quarters. Similar rates of controlling feedback were also found in the current study, which ranged from 53% in winning quarters to 63% in losing quarters. While the relatively low rate of autonomy-supportive feedback may not reflect current theory or empirical evidence (Carpentier & Mageau, 2013; Teixeira et al., 2012), a key consideration in this context is that the

feedback is being provided in a live competition setting where the perception of pressure is likely to be far greater than in a training or lab-based setting. In the heat of competition, immediate performance may be valued over learning outcomes. Coaches may perceive a need to control player actions or decisions, particularly when the game outcome is not in their favour, and sacrifice any potential motivational or learning benefits with a view to improving immediate performance. Controlling feedback may also be seen as the "job" of coaches when results are not favourable, given the focus on coach decision-making during media interviews following a loss.

Results from Hattie and Timperley's (2007) coding scheme are novel in this context, but show similar patterns in winning and losing quarters to the schemes described above. A subtle pattern can be seen when examining the two higher levels of feedback focus (process and self-regulation) compared to the lower level task-focussed feedback. Higher-level feedback increases very slightly during winning quarters and decreases during losing quarters, whereas task feedback displays the opposite trend (with statistical significance). It is possible that the reduced pressure associated with a winning quarter allows coaches more freedom to provide teaching opportunities to players by focussing their attention on self-regulatory processes. Task-based feedback could be more prevalent during losing quarters, where feedback is typically also more controlling and negative, because coaches may perceive less room to provide detailed teaching and questioning to players. Self-level feedback, which typically has very low impact on performance (Kluger & DeNisi, 1998; Wilkinson, 1981) was typically associated with positive feedback when provided to players (e.g., "good man"), which may explain its trend upwards when winning and downwards when losing.

Feedback quantity did not vary based on quarter outcome, which is congruent with prior research (Halperin et al., 2016). Coaches in the current study provided approximately 15 messages per quarter, which is higher than the 10 messages found in a previous sample of Australian Rules coaches operating at the semi-professional level (Walsh & Jureidini, 2016). A novel finding in the current study was that message quantity was highest during quarters where the game was in the balance, and significantly lower when the game was 95% or more likely to result in a win or loss. This could be explained through the lens of psychological momentum (Moesch & Apitzsch, 2012). It is possible that coach passiveness, which may take the form of a reduction in feedback to players, is related to the negative psychological momentum associated with a losing performance. In simple terms, coaches may provide less feedback to players when they feel that the game is heading for a certain outcome and that this outcome is beyond their control.

Limitations and future studies. This study provides a novel insight into the types of feedback provided by coaches to players in an elite team sport environment. In the current study, feedback coding relied on audio from the coaches themselves. However, in the highest levels of Australian Rules football, coaches are removed from the playing surface and so do not communicate directly with players. A missing link in our understanding of coach-player feedback in this context is the message communicated to the players by the 'runner' who relays messages between coaches and players. Future studies should investigate discrepancies between feedback received by the runner from the coaches, and feedback provided from the runner to the players.

Additionally, future studies would benefit from focussing on not only the feedback provided by the runner, but the feedback received by the player. Walsh and

Jureidini (2016) suggested that knowledge about whether athletes receive the messages provided by coaches will add detail to our understanding of communication in sport. Hattie (2009, p. 174) observes that relatively few studies on feedback have considered it from the perspective of the feedback receiver, despite some evidence to suggest that feedback delivered is not equal to feedback received. Future research designs could include a post-match interview in which players are asked to recall key feedback they received during the game. This could also be explored through custom-designed training drills where access to players is not limited by match-day conventions.

Conclusions. This study is the first to explore the types of feedback provided during an elite team sport competition. It adds an important element to the study of feedback in sport, given the intensity of live competition not found in training or lab-based contexts. The findings suggest clear areas in which coach practice does not completely reflect evidence, particularly around feedback valence and autonomy support. It is of note, in a similar finding to Halperin et al. (2016), that feedback types more frequently associated with improved learning and performance in the literature appear to be provided more frequently during winning quarters. Teasing out the existence of a causal relationship between feedback and performance in future work appears important for moving coaching practice forward.

Acknowledgements. The authors wish to thank the General Manager of Football at the organisation in which this data was collected, for his generosity with allowing access to the coaches, Kieran Hattie for his assistance with coding, and Rob Younger for his assistance with the 95% win/loss rate data.

Chapter 7: Discussion

This thesis aimed to explore the knowledge, focus, use and reception of coach feedback in high performance sporting environments. This chapter begins by revisiting the research questions, the importance of the research area and the rationale for the direction of the three studies. Following this, a summary of findings across all three studies is presented in light of the research questions. A number of broader conclusions are then drawn to highlight the original and substantive contributions to knowledge offered by this thesis. Finally, a series of recommendations for future research are provided, suggesting further opportunities to improve feedback research in high performance sport and to fill new gaps identified in the current study.

The generation of five research questions sought to address the aim of the thesis. These research questions asked:

(1) What knowledge and beliefs do high performance sports coaches currently possess about the provision, reception, and evaluation of feedback?
(2) What is the nature of feedback provided to athletes in video-based feedback and competition settings?
(3) How does in-game feedback vary based on the state of the game?
(4) What is the impact of coach video-based feedback on athlete learning?
(5) What is the impact of athlete characteristics on feedback reception?

The three studies presented in this thesis have been designed to answer these questions and provide new knowledge about how feedback is considered in a sporting setting. This discussion chapter seeks to provide evidence around each of these questions, drawing broadly on the three studies that make up the thesis.

Importance of the research area

Findings from most large syntheses of feedback research reveal that the effects of feedback on learning and performance are highly variable (Kluger & DeNisi, 1996). With such a wide range of effects, it appears important to develop an understanding of what kind of feedback works, when, for whom, and in what context. Similar variance is also seen in the approaches taken in the myriad of coach observation studies that seek to quantify and analyse the feedback given by sports coaches to their athletes. Several commonly-used coach observation coding schemes rely heavily on a narrow band of feedback variables such as feedback valence, often termed 'praise' and 'scold' (Lacy & Darst, 1984). There has been little evolution of coding schemes to consider feedback variables that have emerged in more recent literature (Cope et al., 2017). As such, many modern feedback theories have been largely ignored in coach observation research, leaving gaps in the knowledge base about effective feedback in a sporting context.

Some of the major themes in recent education research have been of particular influence on the research undertaken for this thesis. These include evaluating the reception and subsequent use of feedback by a receiver (Hattie & Clarke, 2018), along with the general notion of 'know[ing] thy impact' as a teacher (Hattie, 2012, p. 19). Considering feedback from the perspective of the receiver appears an important step in knowing when feedback has been effective, but this has largely been ignored in coach feedback research. Tied in with this is the notion that characteristics or dispositions of the learner may mediate the feedback-performance relationship (Narciss & Huth, 2004), and must be more thoroughly understood in order to gain a deeper understanding of 'what works best' in the sporting context.

Another major gap identified in the literature with important implications for coaching practice was that that studies in which coach feedback is observed typically examine a training setting (Cope et al., 2017), despite evidence that coaches exhibit changed behaviour between training and competition settings (Cushion, 2010). Additionally, there is a paucity of research investigating the types of feedback provided in a video-based feedback session typical of a high performance team sport environment (Groom & Nelson, 2013), in which coaches provide verbal feedback with the aid of video from training or competition environments. Determining the contextual factors that impact the quality and quantity of feedback provided by a coach may help to illustrate particular barriers or situations in which feedback may become less impactful or 'usable' by an athlete. Future coach development efforts may then better prepare coaches for a variety of situations.

Summary of findings

The main findings of the three studies that make up this thesis are presented below, arranged according to the research question that they answer.

What knowledge and beliefs do high performance sports coaches currently possess about the provision, reception, and evaluation of feedback? Studies of the feedback provided from coaches to athletes have been conducted since the mid-1970s (Tharp & Gallimore, 1976), and have grown in popularity since this time (Cope et al., 2017). However, relatively little is known about the beliefs and knowledge that underpin feedback provision (Smith & Cushion, 2006). Several authors have called for the large body of coach observation research to be augmented with more qualitative investigations of coach practice (Potrac et al., 2002). It was therefore an aim of this thesis to examine the beliefs and knowledge of high performance coaches regarding

the provision, reception and evaluation of feedback in their roles. Study 1 provided a novel insight into a general set of beliefs and knowledge of coaches, through the collection of semi-structured interview data. While the coaches interviewed for Study 1 were not the same as those observed in Studies 2 and 3, they represent a typical and homogeneous group of Australian high performance coaches from team invasion sports. Some tentative comparisons can therefore be made between the views expressed by the coaches in Study 1, and the feedback observed in Studies 2 and 3.

The results of Study 1 suggest that coaches possess a detailed array of knowledge about feedback across a wide range of sub-topics. While the majority of these are covered in Chapter 4, a brief commentary is included here on the wider implications of the study's findings for the progression of the field.

A major contribution of this study is the finding that coaches are clearly able to articulate a range of strategies that they use for the major tasks associated with using feedback: providing the right types of feedback in the right amounts, taking the individual into consideration when doing so, and evaluating the reception of feedback by each athlete. Previous research (Côté et al., 1995; Potrac et al., 2002) suggested that coach knowledge about feedback is highly variable, in many cases at odds with current evidence, and often reflects a coach-centred approach where the athlete is a passive recipient of the feedback. Coaches in the current study, however, articulated philosophies around feedback that were athlete-centred, sensitive to the needs of the athlete and the context, and generally aligned with current evidence. While this may be a reflection of the quality and experience of the coaches recruited, it may also reflect a generational change in approaches to pedagogy between the earlier studies (1995 and 2002, respectively) and current-day trends. The increasing importance of athlete-

centred and autonomy-supportive coaching pedagogies is acknowledged by researchers and coaches alike in recent research (Bowles & O'Dwyer, 2019; Light & Harvey, 2017; Occhino et al., 2014), suggesting wider support for a generational shift. While there are still a number of areas that future coach education efforts can focus, it appears that the knowledge and beliefs of high performance coaches may have strengthened over the past 20-25 years.

What is the nature of feedback provided to athletes in video-based feedback and competition settings? A major aim of this thesis was to expand the repertoire of feedback coding categories used to observe and quantify coach feedback. This thesis included a broader range of feedback variables than typical coach observation coding schemes (e.g., Cushion et al., 2012; Lacy & Darst, 1984), including codes for autonomy-supportive feedback (Carpentier & Mageau, 2013), and Hattie and Timperley's (2007) four-level conceptualisation of feedback. This provided new evidence about the types and the focus of the feedback that coaches provide. Additionally, studies 2 and 3 provide new evidence about the types of feedback that occur in the under-researched areas of video-based feedback meetings, and an elite-level competition setting (Cope et al., 2017; Groom & Nelson, 2013).

Regarding the codes adapted from Hattie and Timperley's (2007) model, the results of study 2 suggest that coaches provide largely task-level feedback (around 60%) in video-based feedback meetings, with an additional third of feedback related to process. Self-regulation feedback, intended to develop autonomous learners, accounted for 6% of feedback. This may suggest an area for the improvement of feedback provision. There seems to be little evidence of a gradual increase in player responsibility (and release of coach control; Fisher & Frey, 2013) to seek, interpret,

and implement feedback information. Study 3, which examined the same coding scheme in a live competition setting, revealed similar rates of around 58% task-level feedback and 37% process-level feedback. In competition, self-regulation feedback dropped to under 3%, suggesting that coaches are less likely to foster self-regulation in the heat of a competitive event than they are away from the competitive setting. The use of simple praise or scorn (i.e., self-level feedback) was not observed at all in a video-based feedback setting, but accounted for 2% of feedback in a competition setting. Study 1 revealed that several coaches considered their game-day role as primarily providing reassurance and positive feedback to athletes, as they believed this could reduce anxiety and enhance performance. However, the large proportion of negative feedback (and small proportion of positive feedback) observed in the competitive setting of Study 3 may provide evidence that self-level feedback in this context was more likely to be scorn than praise.

The studies in this thesis represent the first time that Hattie and Timperley's model has been used in sport coaching research. This was not without its limitations; differentiating between task-level and process-level feedback in a live competition setting was difficult, and required several rounds of inter-rater reliability discussion before agreement could be reached. This is likely to be a limitation of using a largely cognitive-centric education model in a domain such as sport coaching, where physical performance outcomes are more highly valued. Future research may seek to adopt other elements of Hattie and Timperley's model that may be more readily translated to sport, such as the three feedback questions: Where am I going? How am I going? Where to next?

Autonomy-supportive feedback was also considered in Study 2 and 3. Such feedback is considered to be empathic, paired with choices of potential solutions, based on objectives that the learner sees as clear and attainable, avoiding person-related statements, including tips on how to improve next time, and delivered in a considerate tone of voice (Carpentier & Mageau, 2013). This is contrasted with controlling feedback, which forces the athlete to think or feel a certain way. Rates of autonomy-supportive feedback in the competitive setting observed in Study 3 were similar to those observed in prior research (Halperin et al., 2016), with around 8% of feedback considered autonomy-supportive and 58% considered controlling. In a video-based feedback setting, away from the pressure of competition, rates of autonomy-supportive feedback doubled to around 18%. The contrast between rates in Studies 2 and 3 presents clear evidence that feedback changes as a result of context. It appears that the challenges associated with a live competition setting (such as limited time and the perceived pressure of competition) influence the feedback that coaches provide.

Other than the novelty of an Australian Rules football sample, the inclusion of a positive/negative category in studies 2 and 3 does not provide new evidence on coach feedback, given its pervasiveness in previous coach observation studies dating back to the 1970s (Tharp & Gallimore, 1976). However, it does serve to provide a measure from which to judge the similarities of the coaches in the current studies to historical feedback averages found in prior research. Table 1 suggests a 63/37% positive-negative ratio for a competition setting, and a 78/22% split for a high performance setting in prior research. Removing the neutral category from the current studies to support comparison to these figures reveals an 80/20% positive-negative ratio for the video-based feedback setting of Study 2, and a 30/60% split for the competition setting of Study 3. These figures again provide clear evidence to support the notion that the

setting in which feedback is provided has a large impact on the types of feedback provided. This explored in more detail in the Conclusions section of this chapter (Conclusion 3: Feedback varies widely based on context).

Another category of interest, given its use in motor control literature, is the descriptive or prescriptive nature of feedback. A common claim is that prescriptive feedback is more beneficial to novices (Kernodle & Carlton, 1992), whereas descriptive feedback can benefit expert performers who are more readily able to self-correct errors (Magill & Anderson, 2012). Results in the studies presented in this thesis again suggest large variation between off-field and on-field feedback with respect to descriptive or prescriptive feedback. In the video-based feedback context of Study 2, a majority of feedback provided to athletes (63%) was descriptive in nature. However, in the competition setting of Study 3, this dropped to 19%, with 81% of feedback provided being prescriptive. These large changes in feedback provision provide further evidence of context playing a large role in shaping patterns of feedback. In contrast to the feedback categories described above, where the shift in feedback between contexts may detract from the quality of feedback provided, the shift between descriptive and prescriptive feedback across the competition and video-based feedback settings may be a positive adaptation by coaches. It is possible that coaches become more prescriptive in a competitive setting due to time pressure, and perhaps also due to a perceived need for certainty and clarity in feedback messaging. In this instance, short prescriptive messages may be most likely to be used by athletes. Coaches may then switch to a more descriptive mode away from the competition environment, when time allows the athlete to work with the coach to find a solution. This approach to providing descriptive feedback has support from a range of literature (Chow et al., 2016; Magill & Anderson, 2012), and may ultimately encourage the development of athletes who

are able to self-regulate. The high rates of prescriptive feedback found in competition also has implications for feelings of competence (Amorose & Smith, 2003), suggesting that future efforts to research this phenomenon should more carefully consider learner characteristics such as self-efficacy.

An interesting avenue for further exploration may be to more closely examine the way in which feedback categories interact with each other. As an example, it was noted in the above section that self-level feedback may have been associated with negative feedback (that is, that feedback directed at the learner was more frequently negative). Exploring the link between prescriptive and controlling feedback would have important implications for the promotion of an athlete-centred environment, where athletes should be given choices of solutions to problems or errors. The patterns of feedback seen in Chapter 6 suggest that coaches are more autonomy-supportive and positive when winning, and less so when losing. Examining correlations between feedback categories is likely to be a fruitful avenue for further teasing apart the nature of coach feedback.

How does in-game feedback vary based on the state of the game? The major goal of Study 3 was to quantify feedback provided in a high performance competition setting, given the scarcity of this evidence in the literature. However, a secondary aim of the study was to determine the variation in feedback as a result of the state of the game. This study provided strong evidence to suggest that variables such as the outcome of a game quarter (win/loss), or the 'closeness' of a game, can have a major influence on the types and amount of feedback provided by coaches. A novel finding in Study 3 was that feedback quantity was highest during quarters where the game was in the balance, and significantly lower when the game was 95% or more

likely to result in a win or loss. Although this has been hinted at in previous research (Walsh & Jureidini, 2016), this study is the first to quantify the change based on game 'closeness'.

Additionally, the finding that coaches provide significantly more negative and controlling feedback in losing quarters than in winning quarters provides further detail about the ways in which game state influences feedback. The absence of causal data to suggest that certain patterns of feedback may in fact lead to poorer performance limits the generalisations that can be made from this data. However, the findings provide a starting point from which to examine the barriers and constraints that coaches face when it comes to providing effective feedback to athletes during the intensity of competition. The contrast in feedback during various game states also provides an additional comparison point to the off-field feedback provided to athletes during a video-based feedback meeting, illustrating the wide variation in feedback depending on the context in which it is provided.

What is the impact of coach video-based feedback on athlete learning? The second study included in this thesis sought to determine the impact of feedback provided in a video-based feedback meeting on athlete learning and performance outcomes, while also considering the role of athlete characteristics such as working memory and attitudes towards receiving feedback. A common practice in feedback research is to describe and quantify the types and rates of particular feedback variables of interest, but very few studies (for a rare example, see Mesquita et al., 2008) evaluate the reception of feedback by the athlete.

Study 2 sought to determine rates for athlete recall of feedback messages provided by a coach in a video-based feedback meeting. To do this, coach feedback

was transcribed and separated into idea units, as is precedent in existing coaching science research (Januario et al., 2013; Januario et al., 2015; Mesquita et al., 2008). An idea unit represents the smallest unit of meaning in an interaction that carries information or affective value (Stafford et al., 1987). The results of study 2 determined that athlete recall of feedback messages provided by a coach in a video-based feedback meeting is fallible. Participants in Study 2 recalled an average of 6% of overall idea units, and approximately 50% of key feedback themes, at a one-week retention interval. These rates mirror those found in prior research (Januario et al., 2013). Also mirroring previous findings (Januario et al., 2015) was the notion that the amount of information provided by the coach was inversely related to the proportion of overall messages recalled. A practical takeaway from this finding was that information should be limited to a small number of salient points, rather than presenting a large number of video clips and accompanying feedback as reported in Study 1. Overall, the findings related to athlete recall of feedback suggest that video-based feedback provided away from the performance environment may not be as effective as coaches believe it to be.

The absence of performance benefits seen as a result of feedback should be interpreted with a degree of caution, given the range of additional factors that also impact on performance outcomes. This finding should be considered a starting point for further research that seeks more robust measures of performance change as a result of video-based feedback. Seeking a more holistic picture of feedback received by an athlete during a training cycle (including training feedback and game-day feedback) would assist in more accurately measuring impact at the level of performance changes. Determining links between feedback recall and subsequent performance change also appears important for determining the impact of providing off-field video-based

feedback; if improved feedback recall is not subsequently reflected in improved performance, this has strong implications for current coach practice.

What is the impact of athlete characteristics on feedback reception? A key area of interest in education research (Tomlinson et al., 2003), but less commonly considered in sports coaching research, is the idea that learners bring a wealth of individual characteristics and dispositions to a learning situation that may impact their success or failure as a learner. Evidence suggests positive effects on learning when teachers adapted instruction to suit student learning needs (Smale-Jacobse et al., 2019). In this thesis, evidence on this topic was sought in the coach interviews conducted as part of Study 1, and the collection of athlete variables of potential interest in Study 2.

Study 1 revealed a number of ways in which coaches actively consider the preferences and dispositions of the athlete when considering how to give the most readily-received and impactful feedback. They include the implementation of a pre-season survey with athletes, in which they are asked to identify their preferences for receiving feedback. This was articulated most commonly by the interviewed coaches as an exercise in determining the quantity and the valence of the feedback best suited to each athlete. Many coaches reported giving less feedback in a video-based feedback setting to players who they did not perceive to be receptive to large amounts, and vice versa. Similarly, coaches reported providing more positive feedback to athletes who need reassurance, or more negative feedback to athletes who felt the need to be motivated by a coach. These methods represent a naturalistic example of high performance coaches considering athlete characteristics and tailoring their subsequent use of feedback.

In addition to the finding that coaches tailor the amount of feedback given to the individual athlete, Study 2 sought to measure athlete working memory and determine a link between feedback recall and memory capacity. However, no significant relationships between feedback recall and verbal or spatial working memory capacity were found. Despite this, strong practical implications can be inferred from the finding in Study 2 that the number of units of feedback presented in a video-based feedback meeting is negatively correlated to feedback recall, such that more feedback leads to lower overall recall. It appears that a general recommendation for a 'less is more' approach to feedback quantity can be made until further evidence about the individual working memory capacity of athletes can be obtained.

Some coaches interviewed for Study 1 held the belief that their athletes' dispositions towards receiving feedback could be a potential barrier, preventing feedback from being successfully received. In particular, themes of entitlement stemming from receiving mostly positive feedback from previous coaches was seen as a major challenge to some coaches. The notion of readiness or openness to receiving feedback has emerged from management literature in the last 20 years, with London and Smither (2002) proposing a feedback orientation construct to describe an individual's disposition towards feedback. The use of an adapted version of the Feedback Orientation Scale (FOS; Linderbaum & Levy, 2010) in Study 2 was designed to assess the dispositions of the athletes included in the study towards receiving feedback. A novel finding from Study 2 was that the sample of elite athletes exhibited a ceiling effect on the scale, with little variation between participants and high scores across all subscales. It is likely that the high pressure experienced in a high performance sporting organisation (Calmeiro et al., 2014) is different to the setting in which the FOS was developed and validated, so future research would benefit from the

creation of a new scale that more effectively discerns between participants in a sporting context. Taken at face value, the results could suggest that elite athletes are genuinely highly receptive to feedback. Combined with evidence from Study 1, in which coaches reported that some athletes did not want to receive negative feedback, this finding may also reflect a desire by athletes for particular types of feedback (i.e., positive reinforcement) only. It may also reflect a social desirability effect (Krumpal, 2013); despite reassurances that data collection remains anonymous, athletes may have believed their answers could be used by a coach to justify team selection/non-selection. Further research is required to elucidate the nature of feedback orientation in a sample of elite athletes.

Conclusions

With each of the research questions considered in light of the evidence collected through the three studies of the thesis, an examination of broader themes that make an original and substantive contribution to the knowledge base is now provided. The following section considers the 'big picture' conclusions that this thesis contributes to the research area: (1) What coaches know about feedback does not always reflect how they give feedback, (2) Feedback given does not equal feedback received, (3) Feedback varies widely based on context, and (4) Modern feedback theories in sport should more closely consider elements that the athlete brings to the feedback interaction.

Conclusion 1: What coaches know about feedback does not always reflect how they give feedback. One of the main findings emerging from the thesis is that coaches are able to report a range of beliefs and knowledge about feedback and its use with athletes that are in line with current evidence on feedback effectiveness. Coaches

reported: tailoring their feedback to the individual needs of their athletes, allowing athletes to self-organise and develop autonomy through finding their own solutions, knowing when positive feedback is required for motivational or confidence purposes, evaluating feedback reception through questioning and creating an athlete-centred learning environment, and so on. Coaches were also aware of some barriers that prevent them from providing better feedback to their athletes, such as time constraints. Despite this, observational data collected in Studies 2 and 3 suggest that these intentions do not always emerge in practice. Previous studies have found gaps between coach knowledge and behaviour, such that changes to knowledge as a result of participation in coach education do not completely translate to practice (Stodter & Cushion, 2019). To illustrate the discrepancy between knowledge and behaviour found in the present studies, consider the following examples.

The benefits of questioning to assess feedback reception were acknowledged in the interviews conducted for Study 1. However, the finding that just 1.5 questions were asked by coaches each quarter in a competitive setting (Study 3) suggests that there are gaps between knowledge and execution of best practice in certain environments. The finding that athletes may forget over 90% of feedback provided by a coach in a video-based feedback meeting after a one-week retention interval (Study 2) suggests that checks for understanding undertaken by a coach (e.g., through questioning) may be ineffective or not occurring to the extent reported in Study 1, at least from the perspective of information retention. Many coach observation studies suggest that coaches ask very few questions (Cushion & Jones, 2001; Potrac et al., 2007), positioning the coach as the expert and the athlete as a passive recipient of information (Cope et al., 2016). Despite this, the coaches observed in Study 2 asked athletes questions at a rate of approximately one per minute. Approximately half of questions

asked were closed, requiring short, surface-level answers from athletes. This compares favourably to rates of around 78% closed questions found in a traditional classroom setting (Kim, 2015; Martin & Hand, 2009). Improving the quality of the open questioning techniques employed by coaches may be a possible point for future intervention, given the finding that coaches often employ similar questioning techniques with all athletes regardless of individual characteristics of the athlete (Cope et al., 2016). Moving the focus of the learning from surface to deep (Hattie & Donoghue, 2016) by considering frameworks such as the SOLO taxonomy (Biggs & Collis, 1982) may also assist with improving coach questioning.

The notion of allowing athletes to self-organise was acknowledged by coaches during the interviews conducted for Study 1. One way to determine the extent to which coaches allow for self-organisation in practice is by examining the quantity of feedback provided during the competition setting observed in Study 3. This data revealed that feedback messages increased in quantity in close game situations, mirroring previous findings (Walsh & Jureidini, 2016), and illustrating that pressure to win may be a barrier to coaches allowing self-organisation in practice. The adoption of a coaching approach that promotes self-organising athletes is also likely be aligned with feedback patterns that are less prescriptive and more descriptive in nature (Davids, Button, & Bennett, 2008), to allow the athlete a choice of movement solutions rather than prescribing them verbally. While feedback was slightly more descriptive than prescriptive in the video-based feedback context (Study 2), over 80% of feedback in a competitive setting was prescriptive. In addition, further analyses revealed that descriptive feedback shared a strong positive correlation with positive feedback in a competitive setting, such that most descriptive feedback was simply positive reinforcement of behaviours. Positive descriptive feedback such as this can

have important benefits for motivation (Mouratidis et al., 2008) and performance (Stoate et al., 2012). However, the notion that descriptive feedback should alert the performer to salient aspects of their performance or the environment, and allow athletes to explore solutions, was not reflected in the data.

A final example involves the notion put forward by several coaches that positive feedback was a tool to motivate and reassure. While many coaches spoke of the need to show positive video after a loss, some coaches also described their game day role as staying positive and supporting athletes through difficult periods of a competition. Feedback in video-based feedback meetings (Study 2) was largely positive, reflecting the views of coaches expressed in interviews. However, a contradictory finding from Study 3 was that feedback becomes less positive (and more negative) in losing quarters of Australian Rules football. This challenges the view that positive feedback (e.g., "great decision") is used to reassure during the intensity of competition; if this was the case, more positive feedback may have been observed during losing quarters. However, generalising the interview data to the group of coaches participating in Study 3 has its limitations; it is possible that coaches observed in competition did not hold the same views as those interviewed.

Conclusion 2: Feedback given does not equal feedback received. The reception of feedback was a major focus of this thesis. Feedback reception is considered to be a poorly studied area of feedback research (Butler & Winne, 1995). In a sporting setting, a poor understanding of feedback reception may have a deleterious effect on performance (Pensgaard & Duda, 2002). Data collected in both Study 1 and Study 2 provides insight into the beliefs and practices of coaches with regard to feedback reception.

Interview data collected in Study 1 revealed an overall agreement between coaches that evaluating feedback reception is commonly considered as part of the role of the coach. While one coach was a particularly strong advocate for more carefully considering feedback reception, most coaches fell into one of two categories: those who evaluated feedback reception through observing athlete performance, and those who additionally employed pedagogical strategies to check for understanding and reception before physical performance was observed. Coaches also displayed an awareness of athlete characteristics that may act as barriers and facilitators towards successful reception of feedback. Many coaches also reported differentiating their feedback based on the individual needs of their athlete. Taken as a whole, the interview data presents evidence that coaches regularly consider feedback reception as part of their role; the absence of research into feedback reception does not appear indicative of an absence of consideration for feedback reception by coaches themselves.

Despite the self-reported consideration for feedback reception by coaches, data from Study 2 reveal that rates of feedback reception observed in athletes are low. This suggests clear discrepancies between feedback provided and feedback received. Approximately 6% of idea units from a coach-athlete video-based feedback meeting were recalled by the athlete. This recall rate is much lower than the rates reported elsewhere in the literature. Rates of recall in previous studies range between 57% (Januario et al., 2015) and 69% (Mesquita et al., 2008). The finding that athletes tend to summarise individual feedback messages into broader themes was also taken into consideration during Study 2 analysis, revealing a rate of 47% recall for summarised feedback messages. A potential limitation of Study 2 was that the one-week retention interval between feedback meeting and recall interview was not supplemented with an

immediate recall interview. Determining the decay in memory that occurs from the feedback meeting over the course of a week is a vital piece of information missing from further evaluating athlete reception of feedback. However, the one-week retention interval used in Study 2 is also a close representation of the period of time between video-based feedback meeting and the next game in a typical weekly cycle in an Australian Rules football club; video-based feedback meetings typically occur on a Monday or Tuesday, and the following game occurs on the weekend after this. The similarity between intervals (video-based feedback meeting to retention test, and video-based feedback meeting to next game) allows for conclusions to be drawn about how much feedback athletes may remember by the time of their next game. It is clear from this data that feedback given is not the same as the feedback recalled after an ecologically valid retention interval.

Consistency between the interview data of Study 1 and the observational data collected in Studies 2 and 3 was found when examining rates of questioning. Several coaches mentioned the use of questioning as a tool to check for feedback reception. It appears that coaches do frequently question athletes during an off-field video-based feedback meeting; rates of approximately one question per minute in this context were observed. This dropped drastically to one question per quarter (representing approximately 25-30 minutes of elapsed time) between five coaches during the competition observed for Study 3. The low rates of questioning in a competition setting provide yet another example of the changes that occur in coach behaviour between contexts. A potentially productive point of intervention for improving coaching practice and athlete learning may be in upskilling coaches to ask quality questions, and supporting quality questioning during in-game coaching. This

represents one avenue for improving coach practice through evaluating feedback reception.

Conclusion 3: Feedback varies widely based on context. As alluded to in an earlier section of the discussion, a novel finding from Studies 2 and 3 was that context plays a large part in determining the rates and types of feedback provided by elite Australian Rules football coaches. It was an aim of Study 3 to investigate changes in feedback as a result of the state of the game. However, the off-field (video-based feedback) data collected in Study 2 provided a noteworthy finding about the changes in feedback seen when comparing various states of competition to a video-based feedback setting.

To illustrate this change, a model has been proposed based on the data collected across all three studies that make up this thesis. Figure 7 below illustrates the hypothesised model, in which feedback moves along a spectrum of feedback characteristics. Each of the circles represents a context from which data was collected: the coach interviews, the video-based feedback setting, and various states of competition (winning and losing).

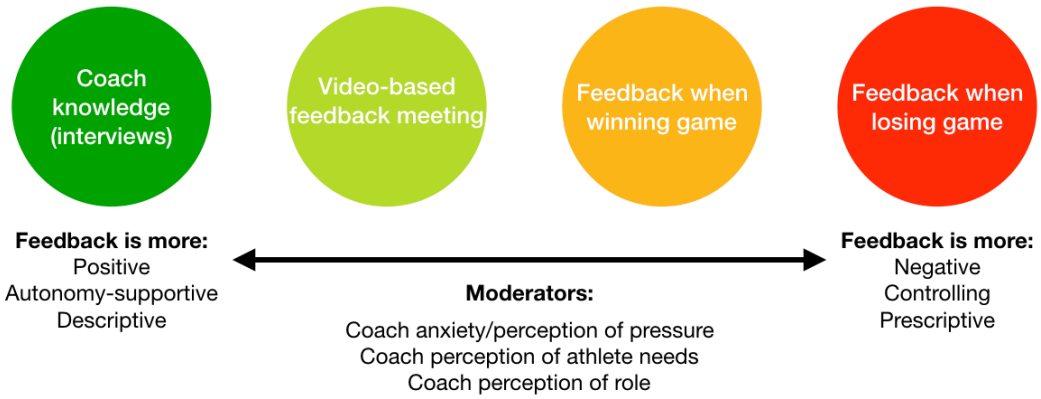

Figure 7.

Hypothesised Model of Feedback Based on Context

Figures 8-11 below provide data to support the stages of the model. The most pronounced changes in feedback rates between contexts can be seen for feedback valence, autonomy-supportive feedback, and the descriptive/prescriptive nature of the feedback. For valence, positive feedback approached 60% for the video-based feedback context, and dropped over 50% to 8% during a losing quarter of Australian Rules football. In the autonomy-supportive category, rates of controlling feedback increased from 18% in the video-based feedback context to 63% during a losing quarter, an increase of 45%. Descriptive feedback was at its highest in the video-based feedback context at 63%, but falls to 16% in a losing quarter, a drop of 47%. A finding described in an earlier section of this discussion was that rates of questioning by the coach also drop drastically from the video-based feedback context to a competition environment. Taken together, these findings suggest that coaches become less positive, more controlling, less descriptive (and therefore more prescriptive), and ask less questions as the context shifts from off-field, to winning a competition, to losing a competition.

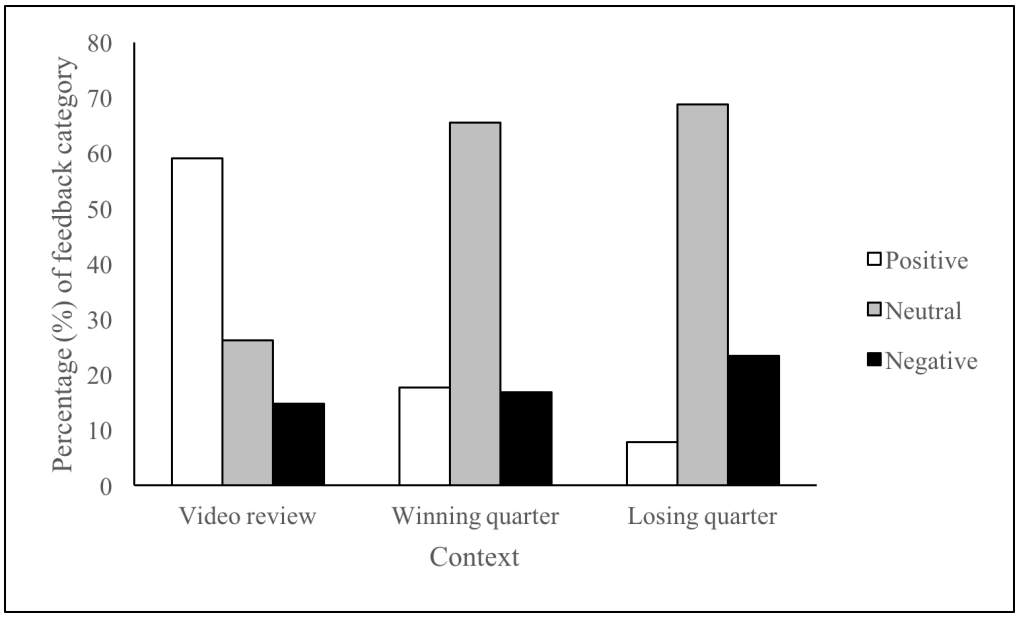

Figure 8.

Feedback Valence as a Function of Context

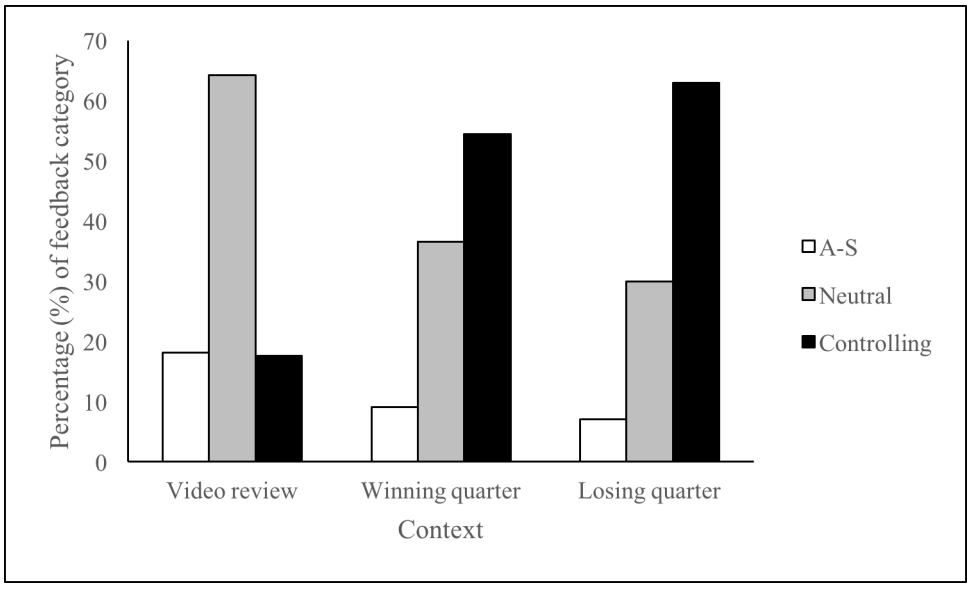

Figure 9.

Autonomy-Supportive/Neutral/Negative Feedback as a Function of Context

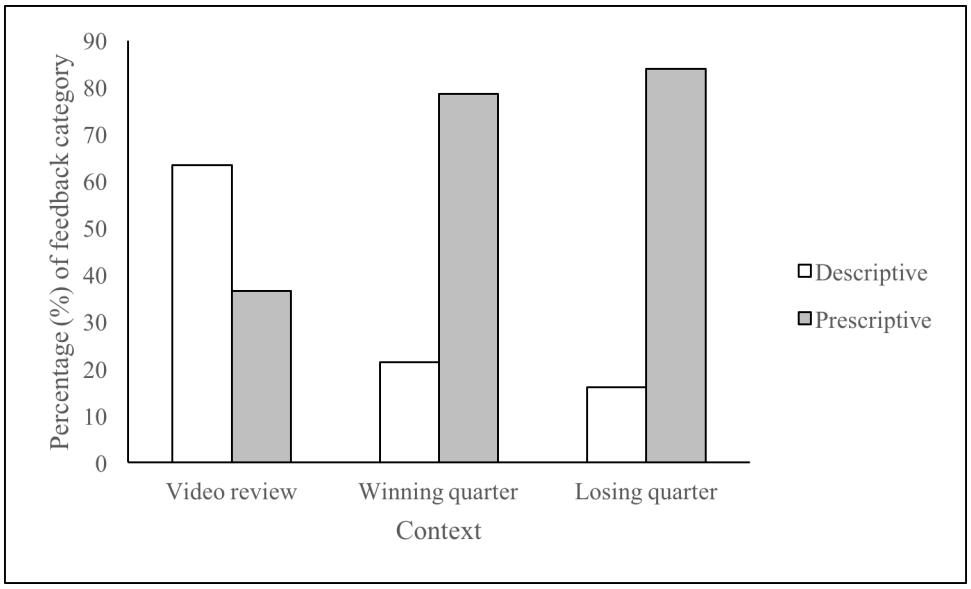

Figure 10.

Descriptive/Prescriptive Feedback as a Function of Context

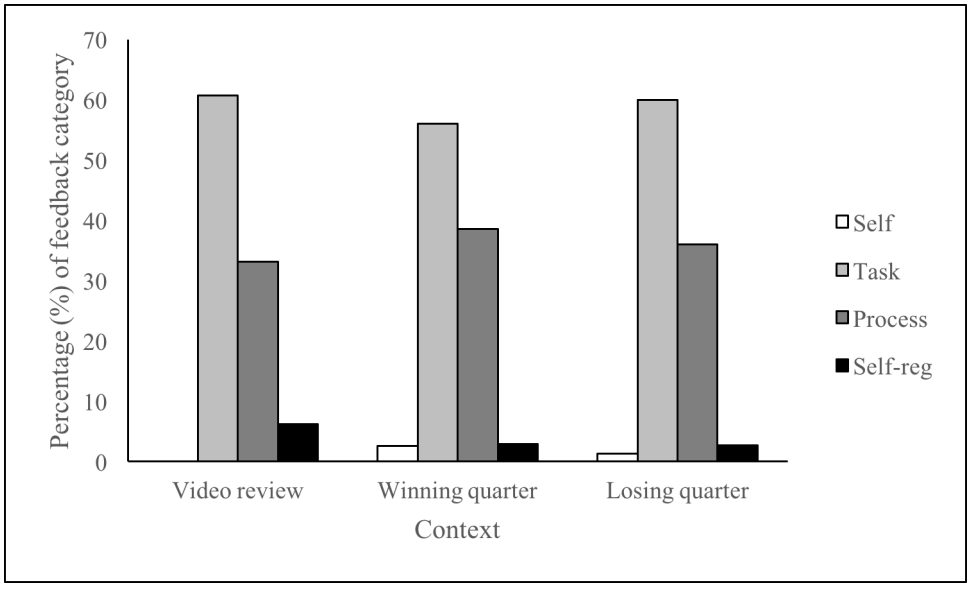

Figure 11.

Hattie & Timperley (2007) Feedback Categories as a Function of Context

Hypothesised mechanisms for this change in feedback are proposed at the bottom of Figure 7, and include pressure, time, and athlete or coach personality variables. Previous studies investigating feedback change as a result of context suggest that pressure to win (also known as 'scoreboard pressure') can influence coach feedback patterns (Allain et al., 2018), manifested specifically through increasing negative feedback (Calpe-Gomez et al., 2013). Coaches exhibit an elevated heart rate during critical game incidents such as a goal being scored against the team (Kennedy & Knight, 2017), suggesting that perceived pressure or psychophysiological stress may be an influence on coach feedback patterns. Coaches report adjusting feedback based on the mental state of their athletes, as judged by the coach through observing body language and verbal interactions (Allain et al., 2018). The coach's experience and general beliefs about their role have also been hypothesised as potential influence on changes to feedback, particularly as a function of the time of the game. Feedback given before the game in a team meeting is likely different in nature to feedback in the dying minutes of a close contest, and changes based on the coach's understanding of what is required or likely to be effective at each point (Mouchet et al., 2014). Future research could expand on this list of factors that contribute to the variations in feedback that occur between contexts.

Conclusion 4: Modern feedback theories in sport should more closely consider elements that the athlete brings to the feedback interaction. Literature across the fields of education (Butler & Winne, 1995; Kluger & DeNisi, 1996; Narciss & Huth, 2004) and coaching science (Chow et al., 2016; Cope et al., 2016) has suggested that considering athlete characteristics when providing feedback can enhance the effectiveness of that feedback. The results of the interviews conducted for Study 1 suggest that coaches acknowledge the benefits of differentiating feedback for

the individual athlete, and report several methods for doing so in their practice. These findings are in contrast to previous studies that suggest coaches use little variation in their teaching approach despite individual differences in athletes (Cope et al., 2016).

While the use of learning styles was not explicitly mentioned or used by coaches involved in the studies that make up this thesis, there is a range of evidence to suggest that learning styles are prevalent throughout many aspects of coaching. For example, many recent coaching science studies investigate the learning styles of athletes, indicating that it is an area of interest in coaching research (Brower et al., 2001; González-Haro et al., 2010). A recent survey of coaches revealed that 62% believe that athletes learn better when presented with information according to their preferred learning style (Bailey et al., 2018). In the same study, many coaches reported hearing about learning styles through formal coach education courses. There are many examples of learning styles being taught recently in prominent coach education courses (AFL, 2017). This evidence suggests that many coaches use learning styles in their practice, claiming this as an example of differentiating feedback to the individual. Despite this, the visual, auditory, and kinaesthetic categories that learning styles theory proposes have poor construct validity, cannot be measured reliably, and do not improve learning outcomes when learner preferences are matched to instructional style (Pashler, McDaniel, Rohrer, & Bjork, 2009).

In contrast to the application of learning styles described above, the data collected in Study 1 suggests that there may be benefits to differentiating feedback based not on broad categories (visual, auditory, kinaesthetic) but on specific characteristics of the individual learner. There was an agreement among expert high performance coaches that considering the individual athlete's preferences when

providing feedback may be of benefit. Coaches reported doing this on the basis of the athlete's self-reported preference for either positive or negative feedback, and their self-reported preference for the amount of feedback. Coaches reported matching their delivery of feedback with these self-reported preferences.

In Study 2, the inclusion of measures for working memory capacity, self-efficacy, and feedback orientation sought to evaluate the impact of these learner characteristics on feedback reception. However, their reliability as predictors of effective feedback and improvements to learning were not able to be confirmed. This could be due to a number of reasons: these measures simply are not reliable predictors, or the measures used (and adapted from other settings) may be insufficient in a population of elite athletes. It is possible that the self-report measures of self-efficacy and feedback orientation lack construct validity, in much the same way that self-reported measures of learning style preferences may be inaccurate at predicting the most effective teaching method (Pashler et al., 2009).

With the above evidence considered, future research should seek to identify those individual athlete characteristics that are valid and reliable predictors of feedback reception. Further to this, valid and reliable instruments to measure such characteristics are needed. Finally, the hypothesis must be tested that matching the provision of feedback to the athlete characteristics measured by the abovementioned instruments makes a difference to feedback reception. As a starting point, Pashler et al. (2009) list a number of aptitude and personality characteristics that have been established as reliable predictors of learning, advising that these should take preference over attributes such as learning styles.

Opportunities for future research

This section is presented with the aim of critically evaluating the research undertaken for this thesis, highlighting the new gaps and questions arising as a result of the research and those gaps that still exist in the literature. As part of the evaluation of the primary research contained in this thesis, an examination of the limitations of the research will be presented, along with suggestions for addressing these limitations in future research. The specific limitations of the individual studies presented within this thesis have been discussed in their relevant chapters, and an attempt to address some of these individual limitations was made by triangulating data between the three studies in this discussion section; this approach is considered a strength of mixed methods research (Creswell, 2012).

This thesis examined coaches working in a team invasion sport setting, to the exclusion of coaches of individual sports and other types of sports (e.g., striking/fielding). It is necessary in all research to limit the scope in order to focus on a specific area or research question. The rationale behind limiting this thesis to team invasion sports was that this group of coaches represented a reasonably homogeneous group with similar job requirements and pressures. The emphasis on coordination between team members (tactics and strategies) and countering the coordination of opposition teams (opposition scouting) in invasion sports was assumed to provide opportunities to investigate the effects of feedback that may not be as prevalent in individual sports or other game types. However, a comparison between the feedback provided between individual and team sports coaches would provide empirical data to support or refute this assumption. Given the one-on-one nature of the coach-athlete interaction in individual sports, studying the feedback provided by individual sports

coaches would also provide unique insight into the ways in which coaches differentiate feedback based on the characteristics of the receiver, which has been a focus of this thesis.

Another way in which the scope of this thesis was narrowed was to examine coaches working in a high performance environment, to the exclusion of coaches working at lower levels or with youth athletes. In this case, high performance coaches were recruited because their environment typically involves far higher coach-athlete contact time than sub-elite settings. This allowed for the observation of regular video-based feedback meetings (Study 2) which typically do not occur as frequently in lower levels of sport. A major area of interest for future studies involves mapping the differences in feedback between coaches of differing levels of experience or performance. Understanding more about the ways in which feedback changes between amateur and high performance, or between novice and experienced coaches, may provide insight into the ways that feedback practices develop. A comparison of expert and novice groups is commonly employed in research areas such as skill acquisition (Farrow et al., 2018) as a way of examining the development of expertise. Expert/novice comparisons have been conducted in some coaching science studies (Nash & Sproule, 2011), but typically focus on the career trajectory of expert coaches rather than providing a comparison of a specific pedagogical technique such as feedback. This represents a fruitful area for future research.

A related area for future research with strong practical implications involves investigating the most effective methods for developing coach skills in providing, using and evaluating feedback. While this thesis sought to describe and evaluate the feedback provided by coaches, it stopped short of providing a comprehensive analysis

of a vital missing link between research and practice: evidence about how to move coaches from current practice to best practice. There is an existing large body of research on coach education and development. Findings typically suggest that informal methods of learning, such as on-the-job experience and learning from peers, are preferred over formal coach education courses (Mallett, Rynne, et al., 2016). Evidence suggests that formal courses often fail to meet the needs of high performance coaches (Erickson et al., 2008), and this was also reflected by several coaches in Study 1 of this thesis. With this in mind, developing effective interventions for improving coach feedback likely involves drawing on informal sources of learning and embedding this in the realities of the day-to-day coaching setting. Educational research methods such as action research have been used elsewhere in the coaching science literature (Clements & Morgan, 2015; Evans & Light, 2007), and may provide a viable avenue through which to explore the most effective ways of developing feedback practice using methods preferred by coaches.

A custom feedback coding scheme was developed for Study 2 and Study 3 of this thesis, in order to describe and analyse verbal coach feedback in sufficient depth to answer the research questions. This scheme incorporated a range of feedback variables of theoretical importance to the research, and aimed to provide more information about feedback than existing coach observation systems. Traditionally, coach coding schemes rely heavily on a narrow range of feedback variables, often including a simple positive/negative (or 'praise' and 'scold') code (e.g., the ASUOI; Lacy & Darst, 1984). The inclusion of a wider range of feedback variables provides richer data from which to make conclusions about the types of feedback that coaches provide. For example, including Hattie and Timperley's (2007) feedback model allows for more information

to be obtained about the focus of the 'praises' or 'scolds' provided by coaches. Future studies should aim to continue improving on existing coach observation instruments.

Future research could further consider the relationship between the reported behaviours of coaches and the actual observed behaviours in an applied coaching context. An attempt to triangulate data between studies in this thesis was made to determine the extent to which the reported feedback behaviours in Study 1 matched the observed feedback behaviours in Studies 2 and 3. This method is not without its limitations; the coaches interviewed for Study 1 were not the same as those recruited for Studies 2 and 3, although there was a small amount of overlap. However, the three groups of coaches recruited for the three studies represent a reasonably homogeneous group of Australian high performance team sports coaches, so some cautious comparisons may be made. Previous research suggests that coaches can be inaccurate when reflecting on their use of feedback, and in some cases can over-represent desirable feedback patterns by as much as 40% (Millar et al., 2011), but comparisons between coach reflections and observed rates are rare in the literature. More closely examining these comparisons may provide further evidence about ways in which coach feedback can be improved; it is possible that assisting coaches to develop a more realistic impression of the feedback they provide may alter feedback provision. Reflective practice is one possible intervention used previously in sports coaching research (Knowles et al., 2005) that may have merit for this purpose.

A number of limitations specifically related to the capture of feedback in a high performance environment have been noted throughout the individual studies in the earlier chapters of this thesis. Data collected in a competition setting for Study 3 was hindered by the use of audio from the coaches' box, rather than audio captured at field-

level with interactions between the runner and player. An assumption here is that the messages that left the coaches' box (and were used for Study 3) were identical to those that were relayed from the runner to the player. Previous studies (Mouchet et al., 2014) have employed a clip-on microphone to capture on-field audio, but at the time of writing the AFL prevents on-field recording devices. Investigating the "Chinese whispers" effect (Walsh & Jureidini, 2016, p. 32) or the alterations to feedback messages between coaches' box, runner, and player could alternatively be investigated in a training setting or with sub-elite competitions where on-field recording is permitted.

Another difficulty in evaluating feedback in a high performance environment was seen in Study 2 of this thesis, which observed and coded a video-based feedback setting. While this approach yielded novel data for the video-based feedback context, a major limitation was that it excluded a variety of other situations in which athletes likely receive feedback. Testing recall specifically for video-based feedback ignores feedback received in-game, during training, and internal sources of feedback generated by the athlete themselves. Observing feedback across an entire weekly cycle represents a major avenue for future research in evaluating coach feedback; few existing studies compare feedback provided by the same coaches in more than one setting (Partington & Cushion, 2013). From a practical standpoint, this endeavour is likely too large for a single PhD study; it calls for a team of researchers to be present at all times to collect data from multiple athletes. Another obvious barrier in this setting is the willingness of a high performance organisation to allow such unrestricted access to a potentially sensitive environment.

Further, the nature of high performance sport is such that males still dominate high performance coaching positions, with females under-represented in coaching roles at the highest level (Greenhill et al., 2009). As can be seen in the demographic information for Study 1 of this thesis, the sample was dominated by males, with just one female coach. While the author approached a number of female high performance coaches, many declined, and one agreed to participate but later declined due to workload issues. Difficulties in recruiting female high performance coaches for research projects may be due to this group being 'over-researched' (Clark, 2008). While gender was not a variable of focus in this thesis, it is important to acknowledge the growing professionalisation of women's sport, and make authentic efforts to include the voice of female coaches wherever possible.

There are a number of opportunities for future research to investigate athlete characteristics influencing feedback reception. Feedback reception was a major focus of the thesis. It represents an area in which limited prior research has been conducted, particularly in the field of coaching science. The most urgent of these research questions is the need to determine relevant characteristics of the athlete that may impact feedback reception. For Study 2, this was done by examining evidence from the fields of skill acquisition (Buszard et al., 2017), psychology (Kluger & DeNisi, 1996), human resources (London & Smither, 2002) and education (Narciss & Huth, 2004). The findings of Study 2 did not determine that any of the hypothesised characteristics of the feedback receiver (working memory capacity, feedback self-efficacy, feedback orientation) predicted feedback reception, but several methodological issues were present. Further research in the sporting context is needed to determine the relevant characteristics of an athlete that may impact feedback reception, and the most valid and reliable measures of such characteristics in an elite athlete population. This

requires a far larger sample size than that used in Study 2, and also calls for tests that are validated in the sporting context. Finally, the hypothesis must be tested that matching the provision of feedback to the athlete characteristics measured by the abovementioned instruments makes a difference to feedback effectiveness.

Along with measuring athlete characteristics, a viable avenue for future research in this area lies in interviewing athletes themselves about feedback preferences. However, just as coaches are not particularly good judges of the feedback they provide (Millar et al., 2011), athletes may be poor judges of the types of feedback they prefer. Evidence from educational psychology research suggests that learners are able to state reasonably strong and reliable preferences for certain types of learning (visual vs verbal; Massa & Mayer, 2006). However, these preferences are found to have little bearing on learning outcomes (Pashler et al., 2008). Given the finding in Study 1 that some high performance coaches ask their athletes directly about the types of feedback they prefer, it appears important that the practice of matching coach feedback to athlete preferences is evaluated.

Future research may be strengthened by more extensively incorporating athlete recall interviews into studies evaluating feedback reception. Aside from their use in Study 2 of this thesis, feedback recall interviews with athletes have been used sparingly, and mainly by one research group from Portugal (Januario et al., 2013; Mesquita et al., 2008; Januario et al., 2015; Rosado et al., 2008). Investigating the use of post-match interviews, where players are asked to recall the feedback provided to them during the game, may provide an indication of feedback reception in a competition setting. Another possibility involves interviewing players about their interpretation of the feedback and comparing this to the interpretation provided by the

coach who gave the feedback. Evidence suggests that these two interpretations often differ (Boud & Molloy, 2013). Feedback lacking clarity can negatively impact working memory and subsequent retention of information (Bangert-Drowns et al., 1991), so variations in feedback recall could be further investigated by determining inconsistencies between the coach and player's interpretations of the same piece of feedback.

Finally, a major missing piece of the feedback puzzle is its ultimate impact on physical performance. Professional athletes are not paid for remembering the coach's feedback and reciting it to an inquisitive PhD student; they are paid for executing physical skills in the context of a game. Although an attempt was made in Study 2 to collect a performance measure that may indicate changes as a result of feedback, this measure came with a number of methodological issues. Objectively and validly measuring the performance impact of feedback remains a major challenge to this research area. The method of measuring performance changes in Study 2 was a statistic using the closest approximation to the feedback given by the coach from a list of AFL-collected game data. This statistic was collected for the game before the feedback was given, and the game following the video-based feedback meeting. This measure of performance does not account for the wide range of extraneous variables found in such a complex sport as Australian Rules football. Variables such as opposition difficulty, playing position, fatigue, time on the ground, opportunities to perform the skill that feedback was given on, and weather conditions are highly likely to impact the statistics used as an indicator of performance change. Future studies would be strengthened by including multiple performance indicators in triangulation to provide a more complete picture of performance change, as advocated elsewhere in the sport literature (Anderson et al., 2002).

Practical implications

Despite the potential for a mutually beneficial relationship between sports coaching researchers and practitioners, many have observed that there is a disconnect between research evidence on coaching science and its translation through coach education courses and its eventual application in practice (Abraham & Collins, 1998; Cushion, 2007). Suggested reasons for this include: a) the research findings are considered obvious or already known by coaches; b) findings are presented cautiously with several caveats that undermine the certainty that coaches need to implement recommendations; and c) there is a language barrier created by researchers in academic writing, such that it is inaccessible for coaching practitioners (Farrow et al., 2013).

With these barriers in mind, it is considered important to conclude this thesis with a series of practical recommendations that can be confidently put forward as a result of the research undertaken. Not all of the findings stemming from this thesis are readily translatable into practice; Lyle (2018) contends that dissemination of research is dependent on its purpose. Findings with clear practical implications are summarised as recommendations for coaches and coach developers in plain English below:

- Coaches should experiment with methods for checking that their athletes have received the feedback they have given them. This might be done by asking them questions, allowing them to describe what's happening in some video-based feedback, or by observing them at training or in a competition.
- Coaches can sometimes be poor judges of the types of feedback they give. This could be improved by reflecting on their use of feedback after a training session, video-based feedback meeting, or competition. This could

be done with the help of a peer, mentor, coach developer or simply with audio or video of their coaching.

- Coach developers should support coaches to give effective feedback in an informal way rather than through formal courses. This might be achieved by creating groups where coaching peers can learn from each other, or by providing opportunities for coaches to observe a more experienced coach.
- In video-based feedback meetings, coaches should adopt a 'less is more' approach to giving feedback. They should focus on a few key points rather than overloading the athlete with a long meeting containing many points. This is likely to improve the amount of information that athletes remember.
- Coaches should encourage athletes to ask more questions in video-based feedback meetings, and reduce the number of surface-level, closed questions they ask to athletes.
- When coaching a game, try to be aware of how the pressure of the game influences the feedback you give. Coaches can become more negative and controlling when losing, and also tend to give more messages when the game is tight.

Concluding remarks

In summary, this thesis provided novel insights into the knowledge, focus, use and reception of coach feedback in a high performance sporting environment. It found that coaches possess a detailed understanding about a range of topics related to the provision of feedback and, importantly, the ways in which its reception by an athlete can be evaluated. Types and rates of feedback were found to vary significantly between the under-researched contexts of video-based feedback meetings and in-game

feedback. Athlete recall of coach feedback was generally found to be poor, but factors contributing to these low rates of recall require further exploration. To revisit the quote presented at the start of this thesis, Madden (1995) reflected that sports journalists claim "winning or losing a game of Australian Rules football depends almost entirely on what the coach says to players, and how it is said" (p. 525). Journalists often get things wrong (see Gladwell, 2008, for a famous example), and sports coaching is no exception. However, the small advantage that may be afforded to coaches who get feedback "right" may be the difference between glory and defeat.

References

Abernethy, B., Thomas, K., & Thomas, J. (1993). Strategies for improving understanding of motor expertise (or mistakes we have made and things we have learned!!). In J.L. Starkes & F. Allard (Eds.), *Cognitive issues in motor expertise* (pp. 317–356). Elsevier Science.

Abraham, A., & Collins, D. (1998). Examining and extending research in coach development. *Quest*, *50*(1), 59-79. https://doi.org/10.1080/00336297.1998.10484264

Adcroft, A. (2011). The mythology of feedback. *Higher Education Research & Development*, *30*(4), 405-419. https://doi.org/10.1080/07294360.2010.526096

Allain, J., Bloom, G. A., & Gilbert, W. D. (2018). Successful high-performance ice hockey coaches' intermission routines and situational factors that guide implementation. *The Sport Psychologist*, *32*(3), 210-219. https://doi.org/10.1123/tsp.2017-0088

Allan, V., Vierimaa, M., Gainforth, H. L., & Côté, J. (2018). The use of behaviour change theories and techniques in research-informed coach development programmes: A systematic review. *International Review of Sport and Exercise Psychology*, *11*(1), 47-69. https://doi.org/10.1080/1750984X.2017.1286514

Amorose, A. J. (2007). Coaching effectiveness: Exploring the relationship between coaching behavior and self-determined motivation. In M. S. Hagger & N. L. D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 209–227). Human Kinetics.

Amorose, A. J., & Smith, P. J. (2003). Feedback as a source of physical competence information: Effects of age, experience and type of feedback. *Journal of Sport and Exercise Psychology*, *25*(3), 341-359. https://doi.org/10.1123/jsep.25.3.341

Anderson, A. G., Mahoney, C., Miles, A., & Robinson, P. (2002). Evaluating the effectiveness of applied sport psychology practice: Making the case for a case study approach. *The Sport Psychologist*, *16*(4), 432-453. https://doi.org/10.1123/tsp.16.4.432

Anderson, R. (2010). Augmented feedback - the triptych conundrum. In R. Jensen, W. Ebben, E. Petushek, C. Richter, & K. Roemer (Eds.), *28th International Conference on Biomechanics in Sports 2010*. ISBS Conference Proceedings Archive.

Armour, K.M., Jones, R., & Potrac, P. (2004). Coaching pedagogy. In R. Jones, K. Armour, & P. Potrac (Eds.), *Sports coaching cultures: From theory to practice* (pp. 104-125). Routledge.

Australian Football League [AFL]. (2017). *Foundation coaching.* https://coach.afl/become-coach

Bailey, R. P., Madigan, D. J., Cope, E., & Nicholls, A. R. (2018). The prevalence of pseudoscientific ideas and neuromyths among sports coaches. *Frontiers in Psychology, 9*, 641. https://doi.org/10.3389/fpsyg.2018.00641

Balzer, W. K., & Doherty, M. E. (1989). Effects of cognitive feedback on performance. *Psychological Bulletin*, *106*(3), 410-433. https://doi.org/10.1037/0033-2909.106.3.410

Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307-337). Information Age Publishing.

Bangert-Drowns, R. L., Kulik, C.-L. C., Kulik, J. A., & Morgan, M. (1991). The instructional effect of feedback in test-like events. *Review of Educational Research, 61*(2), 213-238. https://doi.org/10.3102/00346543061002213

Becker, A. J., & Wrisberg, C. A. (2008). Effective coaching in action: Observations of legendary collegiate basketball coach Pat Summitt. *The Sport Psychologist*, *22*(2), 197-211. https://doi.org/10.1123/tsp.22.2.197

Bertram, C. P., Marteniuk, R. G., & Guadagnoli, M. A. (2007). On the use and misuse of video analysis. *International Journal of Sports Science & Coaching, 2*(1_suppl), 37-46. https://doi.org/10.1260/174795407789705406

Biggs, J. B., & Collis, K. F. (1982). *Evaluating the quality of learning: the SOLO taxonomy (structure of the observed learning outcome)*. Academic Press.

Bing-You, R. G., & Trowbridge, R. L. (2009). Why medical educators may be failing at feedback. *JAMA*, *302*(12), 1330-1331. https://doi.org/10.1001/jama.2009.1393

Blackett, A. D., Evans, A., & Piggott, D. (2017). Why 'the best way of learning to coach the game is playing the game': Conceptualising 'fast-tracked' high-performance coaching pathways. *Sport, Education and Society*, *22*(6), 744-758. https://doi.org/10.1080/13573322.2015.1075494

Bloom, G. A., Crumpton, R., & Anderson, J. E. (1999). A systematic observation study of the teaching behaviors of an expert basketball coach. *The Sport Psychologist*, *13*(2), 157-170. https://doi.org/10.1123/tsp.13.2.157

Bodner, G. M. (1986). Constructivism: A theory of knowledge. *Journal of Chemical Education,* 63, 873–878. https://doi.org/10.1021/ed063p873

Boekaerts, M. (2006). Self-regulation and effort investment. In K. A.Renninger & I. E.Sigel (Eds.), *Handbook of child psychology: Vol. 4*. *Child psychology in practice* (6th ed., pp. 345–377). John Wiley.

Boud, D., & Molloy, E. (2013). Rethinking models of feedback for learning: the challenge of design. *Assessment & Evaluation in Higher Education*, *38*(6), 698-712. https://doi.org/10.1080/02602938.2012.691462

Bowles, R., & O'Dwyer, A. (2019). Athlete-centred coaching: perspectives from the sideline. *Sports Coaching Review*, *2019,* 1-22. https://doi.org/10.1080/21640629.2019.1649901

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Brower, K. A., Stemmans, C. L., Ingersoll, C. D., & Langley, D. J. (2001). An investigation of undergraduate athletic training students' learning styles and program admission success. *Journal of Athletic Training*, *36*(2), 130-135.

Bruner, J.S. (1996). *The culture of education.* Harvard University Press.

Bruner, M. W., Erickson, K., McFadden, K., & Côté, J. (2009). Tracing the origins of athlete development models in sport: a citation path analysis. *International Review of Sport and Exercise Psychology*, *2*(1), 23-37. https://doi.org/10.1080/17509840802687631

Burgess, I., Edwards, A., & Skinner, J. (2003). Football culture in an Australian school setting: The construction of masculine identity. *Sport, Education and Society*, *8*(2), 199-212. https://doi.org/10.1080/13573320309250

Burke, N. (2019, March 25). Why AFL clubs with a 'teacher' coach have a lot to learn. *The New Daily. https://thenewdaily.com.au/sport/afl/2019/03/25/teacher-coach-experience-afl/*

Buszard, T., Farrow, D., Verswijveren, S. J., Reid, M., Williams, J., Polman, R., Ling, F.C.M., & Masters, R. S. (2017). Working memory capacity limits motor learning when implementing multiple instructions. *Frontiers in Psychology, 8*, 1350. https://doi.org/10.3389/fpsyg.2017.01350

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65*(3), 245-281. https://doi.org/10.3102/00346543065003245

Calmeiro, L., Tenenbaum, G., & Eccles, D. W. (2014). Managing pressure: patterns of appraisals and coping strategies of non-elite and elite athletes during competition. *Journal of Sports Sciences*, *32*(19), 1813-1820. https://doi.org/10.1080/02640414.2014.922692

Calpe-Gomez, V., Guzmán, J., & Grijalbo, C. (2013). Relationship between score and coaches' verbal behaviour. *Journal of Human Sport and Exercise, 8*(3), 728–737. doi:10.4100/jhse.2013.8.Proc3.19.

Carless, D. (2006). Differing perceptions in the feedback process. *Studies in Higher Education, 31*(2), 219-233. https://doi.org/10.1080/03075070600572132

Carpentier, J., & Mageau, G. A. (2013). When change-oriented feedback enhances motivation, well-being and performance: A look at autonomy-supportive feedback in sport. *Psychology of Sport and Exercise*, *14*(3), 423-435, https://doi.org/10.1016/j.psychsport.2013.01.003

Cassidy, T., Jones, R., & Potrac, P. (2009). *Understanding sport coaching: The social, cultural, and pedagogical foundations of coaching practice.* Routledge.

Chambers, K. L., & Vickers, J. N. (2006). Effects of bandwidth feedback and questioning on the performance of competitive swimmers. *The Sport Psychologist*, *20*(2), 184-197. https://doi.org/10.1123/tsp.20.2.184

Chen, D. D., & Rikli, R. E. (2003). Survey of preferences for feedback style in high school athletes. *Perceptual and Motor Skills*, *97*(3), 770-776. https://doi.org/10.2466/pms.2003.97.3.770

Chiviacowsky, S., & Wulf, G. (2005). Self-controlled feedback is effective if it is based on the learner's performance. *Research Quarterly for Exercise and Sport*, *76*(1), 42-48. https://doi.org/10.1080/02701367.2005.10599260

Chiviacowsky, S., & Wulf, G. (2007). Feedback after good trials enhances learning. *Research Quarterly for Exercise and Sport*, *78*(2), 40-47. https://doi.org/10.1080/02701367.2007.10599402

Chow, J. Y., Davids, K., Button, C., Rein, R., Hristovski, R., & Koh, M. (2009). Dynamics of multi-articular coordination in neurobiological systems. *Nonlinear Dynamics Psychology and Life Sciences*, *13*(1), 27-52.

Chow, J. Y., Davids, K., Button, C., & Renshaw, I. (2016). *Nonlinear pedagogy in skill acquisition: An introduction.* Routledge.

Clark, T. (2008). We're over-researched here!' exploring accounts of research fatigue within qualitative research engagements. Sociology, 42(5), 953-970. https://doi.org/10.1177/0038038508094573

Claxton, D. B. (1988). A systematic observation of more and less successful high school tennis coaches. *Journal of Teaching in Physical Education*, *7*(4), 302-310. https://doi.org/10.1123/jtpe.7.4.302

Clements, D., & Morgan, K. (2015). Coach development through collaborative action research: enhancing the learning environment within a national talent

development system. *Sports Coaching Review*, *4*(2), 139-161. https://doi.org/10.1080/21640629.2016.1159453

Cohen, L., Manion, L., & Morrison, K. (2011). *Research methods in education.* Routledge.

Cope, E., Partington, M., & Harvey, S. (2017). A review of the use of a systematic observation method in coaching research between 1997 and 2016. *Journal of Sports Sciences*, *35*(20), 2042-2050. https://doi.org/10.1080/02640414.2016.1252463

Côté, J., & Gilbert, W. (2009). An integrative definition of coaching effectiveness and expertise. *International Journal of Sports Science & Coaching, 4*(3), 307-324. https://doi.org/10.1260/174795409789623892

Côté, J., Salmela, J. H., & Russell, S. (1995). The knowledge of high-performance gymnastic coaches: Methodological framework. *The Sport Psychologist*, *9*(1), 65-75. https://doi.org/10.1123/tsp.9.1.65

Côté, J., Salmela, J. H., Baria, A., & Russell, S. J. (1993). Organizing and interpreting unstructured qualitative data. *The Sport Psychologist, 7*(2), 127–137. https://doi.org/10.1123/tsp.7.2.127

Creswell, J. W. (2012). *Research design: Qualitative, quantitative, and mixed methods approaches.* Sage Publications.

Creswell, J.W. (2015). *A concise introduction to mixed methods research.* Sage Publications.

Cross, N. (2017, March 24). Port Adelaide development coach Aaron Greaves fast tracked to AFL by teaching degree. *ABC News*. Retrieved from http://www.abc.net.au/news/2017-03-24/teaching-degree-fast-tracks-afl-coaching-career/8385098

Cushion, C. (2007). Modelling the complexity of the coaching process. *International journal of Sports Science & Coaching*, *2*(4), 395-401. https://doi.org/10.1260/174795407783359650

Cushion, C. J., & Jones, R. L. (2001). A systematic observation of professional top-level youth soccer coaches. *Journal of Sport Behavior, 24*(4), 354-376.

Cushion, C. J., Armour, K. M., & Jones, R. L. (2003). Coach education and continuing professional development: Experience and learning to coach. *Quest*, *55*(3), 215-230. https://doi.org/10.1080/00336297.2003.10491800

Cushion, C., Harvey, S., Muir, B., & Nelson, L. (2012). Developing the Coach Analysis and Intervention System (CAIS): Establishing validity and reliability of a computerised systematic observation instrument. *Journal of Sports Sciences*, *30*(2), 201-216. https://doi.org/10.1080/02640414.2011.635310

Cushion, C.J. (2010). Coach behaviour. In J. Lyle & C.J. Cushion (Eds.), *Sports Coaching* (1st ed., pp. 43-62). Churchill Livingstone.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development.* Learning Policy Institute.

Davids, K. W., Button, C., & Bennett, S. J. (2008). *Dynamics of skill acquisition: A constraints-led approach*. Human Kinetics.

Davids, K., Araújo, D., Vilar, L., Renshaw, I., & Pinder, R. (2013). An ecological dynamics approach to skill acquisition: implications for development of talent in sport. Talent Development and Excellence, 5(1), 21-34.

Davids, K., Renshaw, I., Pinder, R., Greenwood, D., & Barris, S. (2017). The role of psychology in enhancing skill acquisition and expertise in high performance programmes. In N. Weston, G. Breslin, & S. Cotterill (Eds*.), Sport and exercise psychology: Practitioner case studies* (pp. 329-353). Wiley-Blackwell.

Davis, B., & Sumara, D. (2003). Why aren't they getting this? Working through the regressive myths of constructivist pedagogy. *Teaching Education*, *14*(2), 123-140. https://doi.org/10.1080/1047621032000092922

de Muynck, G. J., Vansteenkiste, M., Delrue, J., Aelterman, N., Haerens, L., & Soenens, B. (2017). The effects of feedback valence and style on need satisfaction, self-talk, and perseverance among tennis players: An experimental study. *Journal of Sport and Exercise Psychology*, *39*(1), 67-80, https://doi.org/10.1123/jsep.2015-0326

Deci, E.L., & Ryan, R.M. (2000). The "what" and "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11*, 227-268. https://doi.org/10.1207/S15327965PLI1104_01

Demers, G., Woodburn, A. J., & Savard, C. (2006). The development of an undergraduate competency-based coach education program. *The Sport Psychologist*, *20*(2), 162-173. https://doi.org/10.1123/tsp.20.2.162

Dodds, P. and F. Rife. 1981. A descriptive-analytic study of the practice field behavior of a winning female coach. Unpublished paper, University of Massachusetts. https://eric.ed.gov/?id=ED196920

Dohrenwend, A. (2002). Serving up the feedback sandwich. *Family Practice Management, 9*(10), 43.

Dorsch, K. D., & Etheredge, M. (2017). Softball coaches' perceptions of athlete entitlement. *Journal of Exercise, Movement, and Sport (SCAPPS refereed abstracts repository)*, *49*(1), 77.

Dweck, C. S. (2000). *Self-theories: Their role in motivation, personality and development.* Psychology Press.

Engle, R. W. (2002). Working Memory Capacity as Executive Attention. *Current Directions in Psychological Science, 11*(1), 19-23. doi:10.1111/1467-8721.00160

Erickson, K., Bruner, M. W., MacDonald, D. J., & Côté, J. (2008). Gaining insight into actual and preferred sources of coaching knowledge. *International Journal of Sports Science & Coaching, 3*(4), 527-538. https://doi.org/10.1260/174795408787186468

Evans, J. R., & Light, R. L. (2008). Coach development through collaborative action research: A rugby coach's implementation of game sense pedagogy. *Asian Journal of Exercise & Sports Science*, *5*(1), 31-37.

Fang, Z. (1996). A review of research on teacher beliefs and practices. *Educational Research*, *38*(1), 47-65. https://doi.org/10.1080/0013188960380104

Farrow, D., Baker, J., & MacMahon, C. (2013). *Developing sport expertise: Researchers and coaches put theory into practice* (2nd Ed.). Routledge.

Farrow, D., Reid, M., Buszard, T., & Kovalchik, S. (2018). Charting the development of sport expertise: challenges and opportunities. *International Review of Sport and Exercise Psychology, 11*(1), 238-257. https://doi.org/10.1080/1750984X.2017.1290817

Fisher, D., & Frey, N. (2013). *Better learning through structured teaching: A framework for the gradual release of responsibility*. ASCD.

Flanders, N. (1970). *Analyzing teaching behavior.* Addison-Wesley.

Ford, P. R., Yates, I., & Williams, A. M. (2010). An analysis of practice activities and instructional behaviours used by youth soccer coaches during practice: Exploring the link between science and application. *Journal of Sports Sciences*, *28*(5), 483-495, https://doi.org/10.1080/02640410903582750

Foster, J. L., Shipstead, Z., Harrison, T. L., Hicks, K. L., Redick, T. S., & Engle, R. W. (2015). Shortened complex span tasks can reliably measure working memory capacity. *Memory & Cognition, 43*(2), 226-236. https://doi.org/10.3758/s13421-014-0461-7

Garcia-Gonzalez, L., Moreno, M. P., Moreno, A., Gil, A., & del Villar, F. (2013). Effectiveness of a video-feedback and questioning programme to develop cognitive expertise in sport. *PloS one*, *8*(12).

Gilbert, W. D. (2002). *An annotated bibliography and analysis of coaching science.* American Alliance for Health, Physical Education, Recreation, and Dance.

Gilbert, W. D., & Trudel, P. (2004). Analysis of coaching science research published from 1970–2001. *Research Quarterly for Exercise and Sport*, *75*(4), 388-399, https://doi.org/10.1080/02701367.2004.10609172

Gilbert, W.D. (2016). *Busting a culture of athlete entitlement.* School Sport Canada. http://www.schoolsport.ca/busting-a-culture-of-athlete-entitlemen/

Gillet, N., Vallerand, R. J., Amoura, S., & Baldes, B. (2010). Influence of coaches' autonomy support on athletes' motivation and sport performance: A test of the hierarchical model of intrinsic and extrinsic motivation. *Psychology of Sport and Exercise*, *11*(2), 155-161. https://doi.org/10.1016/j.psychsport.2009.10.004

Gladwell, M. (2008). *Outliers: The story of success*. Little, Brown and Company.

González-Haro, C., Calleja-González, J., & Escanero, J. F. (2010). Learning styles favoured by professional, amateur, and recreational athletes in different sports. *Journal of Sports Sciences*, *28*(8), 859-866. https://doi.org/10.1080/02640411003734077

Gordesch, J., & Dretzke, B. (1998). Correctness in language: A formal theory. *Journal of Quantitative Linguistics*, *5*(1-2), 13-26. https://doi.org/10.1080/09296179808590108

Governali, P. (1966). The physical educator as coach. *Quest*, *7*(1), 30-33. https://doi.org/10.1080/00336297.1966.10519618

Graham, S., & Barker, G. (1990). The down side of help: An attributional-developmental analysis of helping behavior as a low-ability cue. *Journal of Educational Psychology, S2*, 7-14. https://doi.org/10.1037/0022-0663.82.1.7

Greenhill, J., Auld, C., Cuskelly, G., & Hooper, S. (2009). The impact of organisational factors on career pathways for female coaches. *Sport Management Review*, *12*(4), 229-240. https://doi.org/10.1016/j.smr.2009.03.002

Greenwood, D., Davids, K., & Renshaw, I. (2014). Experiential knowledge of expert coaches can help identify informational constraints on performance of dynamic interceptive actions. *Journal of Sports Sciences*, *32*(4), 328-335. https://doi.org/10.1080/02640414.2013.824599

Groom, R., & Nelson, L. (2013). The application of video-based performance analysis: The coach supporting athlete learning. In P. Potrac, W. Gilbert, & J. Denison (Eds.), *Routledge handbook of sports coaching* (pp. 96-107). Routledge.

Groom, R., Cushion, C. J., & Nelson, L. J. (2012). Analysing coach–athlete 'talk in interaction' within the delivery of video-based performance feedback in elite youth soccer. *Qualitative Research in Sport, Exercise and Health, 4*(3), 439-458. https://doi.org/10.1080/2159676X.2012.693525

Groom, R., Cushion, C., & Nelson, L. (2011). The delivery of video-based performance analysis by england youth soccer coaches: Towards a grounded theory. *Journal of Applied Sport Psychology, 23*(1), 16-32. https://doi.org/10.1080/10413200.2010.511422

Guadagnoli, M., Holcomb, W., & Davis, M. (2002). The efficacy of video feedback for learning the golf swing. *Journal of Sports Sciences*, *20*(8), 615-622. https://doi.org/ 10.1080/026404102320183176

Hall, E. T., Gray, S., & Sproule, J. (2016). The microstructure of coaching practice: behaviours and activities of an elite rugby union head coach during preparation

and competition. *Journal of Sports Sciences, 34*(10), 896-905. https://doi.org/10.1080/02640414.2015.1076571

Halperin, I., Chapman, D. W., Martin, D. T., Abbiss, C., & Wulf, G. (2016). Coaching cues in amateur boxing: An analysis of ringside feedback provided between rounds of competition. *Psychology of Sport and Exercise*, *25*, 44-50, https://doi.org/10.1016/j.psychsport.2016.04.003

Harden, M., Bruce, C., Wolf, A., Hicks, K. M., & Howatson, G. (2020). Exploring the practical knowledge of eccentric resistance training in high-performance strength and conditioning practitioners. *International Journal of Sports Science & Coaching, 15*(1), 41-52. https://doi.org/10.1177/1747954119891154

Harris, L. R., Brown, G. T., & Harnett, J. A. (2014). Understanding classroom feedback practices: A study of New Zealand student experiences, perceptions, and emotional responses. *Educational Assessment, Evaluation and Accountability*, *26*(2), 107-133. https://doi.org/10.1007/s11092-013-9187-5

Harvey, S., Cushion, C. J., Cope, E., & Muir, B. (2013). A season long investigation into coaching behaviours as a function of practice state: The case of three collegiate coaches. *Sports Coaching Review, 2*(1), 13– 32. https://doi.org/10.1080/21640629.2013.837238

Hattie, J. (2009). *Visible learning*. Routledge.

Hattie, J., & Clark, S. (2019). *Visible learning: Feedback*. Routledge.

Hattie, J. A., & Donoghue, G. M. (2016). Learning strategies: A synthesis and conceptual model. *npj Science of Learning*, *1*(1), 1-13. https://doi.org//10.1038/npjscilearn.2016.13

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, *77*(1), 81-112. https://doi.org/10.3102/003465430298487

Heubusch, J. D., & Lloyd, J. W. (1998). Corrective feedback in oral reading. *Journal of Behavioral Education*, *8*(1), 63-79.

Horton, S., Baker, J., & Deakin, J. (2005). Experts in action: A systematic observation of 5 national team coaches. *International Journal of Sport Psychology, 36*(4), 299-319.

Huang, H. J., & Mercer, V. S. (2001). Dual-task methodology: Applications in studies of cognitive and motor performance in adults and children. *Pediatric Physical Therapy*, *13*(3), 133-140. https://doi.org/10.1097/00001577-200110000-00005

Hughes, R. E., Bass, K. E., & Hebert, F. J. (1997). Self-evaluation with and without feedback as a predictor of attributions. *Psychological Reports*, *80*(3_suppl), 1075-1085. https://doi.org/10.2466/pr0.1997.80.3c.1075

Ilgen, D. R., Fisher, C. D., & Taylor, M. S. (1979). Consequences of individual feedback on behavior in organizations. *Journal of Applied Psychology, 64*(4), 349-371. https://doi.org/10.1037/0021-9010.64.4.349

Ives, J. C., Straub, W. F., & Shelley, G. A. (2002). Enhancing athletic performance using digital video in consulting. *Journal of Applied Sport Psychology, 14*, 237–245. https://doi.org/10.1080/10413200290103527

Januario, N., Rosado, A., Mesquita, I., Gallego, J., & Aguilar-Parra, J.-M. (2015). Student retention of the information transmitted by the teacher in physical education classes depending on the characteristics of the information. *Journal for the Study of Education and Development, 38*(1), 212-242. https://doi.org/10.1080/02103702.2014.996405

Jones, R., Morgan, K., & Harris, K. (2012). Developing coaching pedagogy: Seeking a better integration of theory and practice. *Sport, Education and Society*, *17*(3), 313-329. https://doi.org/10.1080/13573322.2011.608936

Kahan, D. (1999). Coaching behavior: A review of the systematic observation research literature. *Applied Research in Coaching and Athletics Annual*, *14,* 17-58.

Kelly, S. (2008). Understanding the role of the football manager in Britain and Ireland: A Weberian approach. *European Sport Management Quarterly*, *8*(4), 399-419. https://doi.org/10.1080/16184740802461652

Kennedy, M. D., & Knight, C. J. (2017). Bench behaviour of ice hockey coaches: Psychophysiological and verbal responses to critical game incidents. *International Journal of Sports Science & Coaching*, *12*(3), 303-311. https://doi.org/10.1177/1747954117710509

Kernodle, M. W., & Carlton, L. G. (1992). Information feedback and the learning of multiple-degree-of-freedom activities. *Journal of Motor Behavior*, *24*(2), 187-195, https://doi.org/10.1080/00222895.1992.9941614

Kim, S. (2015). *An analysis of teacher question types in inquiry-based classroom and traditional classroom settings* [Unpublished PhD thesis]. University of Iowa.

King, P. E., Schrodt, P., & Weisel, J. J. (2009). The instructional feedback orientation scale: Conceptualizing and validating a new measure for assessing perceptions of instructional feedback. *Communication Education, 58*(2), 235-261. https://doi.org/10.1080/03634520802515705

Kluger, A. N., & Denisi, A. (1996). The effects of feedback interventions on performance: A historical review, a meta-analysis, and a preliminary feedback intervention theory. *Psychological Bulletin, 119*(2), 254–284. https://doi.org/10.1037/0033-2909.119.2.254

Kluger, A. N., & DeNisi, A. (1998). Feedback interventions: Toward the understanding of a double-edged sword. *Current Directions in Psychological Science*, *7*(3), 67-72, https://doi.org/10.1111/1467-8721.ep10772989

Knowles, Z., Borrie, A., & Telfer, H. (2005). Towards the reflective sports coach: Issues of context, education and application. *Ergonomics*, *48*(11-14), 1711-1720. https://doi.org/10.1080/00140130500101288

Krumpal, I. (2013). Determinants of social desirability bias in sensitive surveys: A literature review. *Quality and Quantity, 47*(4), 2025-2047. https://doi.org/10.1007/s11135-011-9640-9

Kulhavy, R. W. (1977). Feedback in written instruction. *Review of Educational Research*, *47*(2), 211-232, https://doi.org/10.3102/00346543047002211

Kulhavy, R. W., & Stock, W. A. (1989). Feedback in written instruction: The place of response certitude. *Educational Psychology Review, 1*(4), 279–308. https://doi.org/10.1007/bf01320096

Kulhavy, R. W., & Wager, W. (1993). Feedback in programmed instruction: Historical context and implications for practice. In J. V. Dempsey & G. C. Sales (Eds.), *Interactive instruction and feedback* (pp. 3–20). Englewood Cliffs, NJ: Educational Technology.

Lacy, A. C., & Darst, P. W. (1984). Evolution of a systematic observation system: The ASU coaching observation instrument. *Journal of Teaching in Physical Education*, *3*(3), 59-66, https://doi.org/10.1123/jtpe.3.3.59

Lacy, A. C., & Darst, P. W. (1985). Systematic observation of behaviours of winning high school head football coaches. *Journal of Teaching in Physical Education*, 4(4), 256–270. https://doi.org/10.1123/jtpe.4.4.256

Lacy, A.C. (1983). *Systematic observation of behaviors of winning high school head football coaches* [Unpublished doctoral dissertation]. Arizona State University.

Langley, D. J. (1997). Exploring student skill learning: A case for investigating subjective experience. *Quest*, *49*(2), 142-160. https://doi.org/10.1080/00336297.1997.10484230

Langsdorf, E.V. (1979). A systematic observation of football coaching behavior in a major university environment [Unpublished PhD dissertation]. Arizona State University.

Leas, R. R., & Chi, M. T. (1993). Analyzing diagnostic expertise of competitive swimming coaches. In *Advances in psychology* (Vol. 102, pp. 75-94). North-Holland. https://doi.org/10.1016/S0166-4115(08)61466-1

Leslie-Toogood, A., & Martin, G. L. (2003). Do coaches know the mental skills of their athletes? Assessments from volleyball and track. *Journal of Sport Behavior*, *26*(1), 56-58.

Liberman, A., Liberman, M., Steinert, Y., McLeod, P., & Meterissian, S. (2005). Surgery residents and attending surgeons have different perceptions of feedback. *Medical Teacher*, *27*(5), 470-472. https://doi.org/10.1080/0142590500129183

Light, R. L., & Harvey, S. (2017). Positive pedagogy for sport coaching. *Sport, Education and Society*, *22*(2), 271-287. https://doi.org/10.1080/13573322.2015.1015977

Linderbaum, B. A., & Levy, P. E. (2010). The Development and Validation of the Feedback Orientation Scale (FOS). *Journal of Management, 36*(6), 1372-1405. https://doi.org/10.1177/0149206310373145

London, M., & Smither, J. W. (2002). Feedback orientation, feedback culture, and the longitudinal performance management process. *Human Resource Management Review, 12*(1), 81-100. https://doi.org/10.1016/S1053-4822(01)00043-2

Lyle, J. (2002). *Sports coaching concepts: A framework for coaches' behaviour.* Routledge.

Lyle, J. (2018). The transferability of sport coaching research: A critical commentary. *Quest*, *70*(4), 419-437. https://doi.org/10.1080/00336297.2018.1453846

Lyster, R., & Saito, K. (2010). Oral feedback in classroom SLA: A meta-analysis. *Studies in Second Language Acquisition*, *32*(2), 265-302. https://doi.org/10.1017/S0272263109990520

Madden, C.C. (1995). The nature and relative importance of coaching communications in Australian rules football. *International Journal of Sport Psychology, 26*(4), 524-540.

Magill, R. A. (1993). Modeling and verbal feedback influences on skill learning. *International Journal of Sport Psychology, 24*(4), 358–369. https://psycnet.apa.org/record/1994-28263-001

Magill, R. A. (2010). *Motor learning and control: Concepts and applications* (9th ed.). McGraw-Hill.

Magill, R. A., & Anderson, D. I. (2012). The role and uses of augmented feedback in motor skill acquisition. In N. J. Hodges & A. M. Williams (Eds.), *Skill Acquisition in Sport* (2nd ed.). Routledge.

Mallett, C. J., Rynne, S. B., & Billett, S. (2016). Valued learning experiences of early career and experienced high-performance coaches. *Physical Education and Sport Pedagogy*, *21*(1), 89-104. https://doi.org/10.1080/17408989.2014.892062

Mallett, C. J., Trudel, P., Lyle, J., & Rynne, S. B. (2009). Formal vs. informal coach education. *International Journal of Sports Science & Coaching*, *4*(3), 325-364. https://doi.org/10.1260/174795409789623883

Mallett, C. J., Rossi, T., Rynne, S. B., & Tinning, R. (2016). In pursuit of becoming a senior coach: The learning culture for Australian Football League coaches. *Physical Education and Sport Pedagogy*, *21*(1), 24-39. https://doi.org/10.1080/17408989.2015.1072508

Mallett, C., Rossi, T., & Tinning, R. (2007). *Coaching knowledge, learning and mentoring in the Australian Football League: A final research report submitted to the Australian Football League Research Board.* Australian Football League. https://eprints.qut.edu.au/94212/

Mandouit, L. (2018). Using student feedback to improve teaching. *Educational Action Research*, *26*(5), 755-769. https://doi.org/10.1080/09650792.2018.1426470

Mann, M. D. (2012). *Systematic observation of coach feedback in elite youth volleyball* [Unpublished doctoral dissertation]. University of Arkansas.

Martin, A. M., & Hand, B. (2009). Factors affecting the implementation of argument in the elementary science classroom. A longitudinal case study. *Research in Science Education*, *39*(1), 17-38. https://doi.org/10.1007/s11165-007-9072-7

Mason, R. J., Farrow, D., & Hattie, J.A.C. (2020). An analysis of in-game feedback provided by coaches in an Australian Football League competition. *Physical Education and Sport Pedagogy*, 2020, 1-14. https://doi.org/10.1080/17408989.2020.1734555

Mason, R.J., Farrow, D., & Hattie, J.A.C. (2020b). Sports coaches' knowledge and beliefs about the provision, reception, and evaluation of verbal feedback. *Frontiers in Psychology, 11,* 2424. https://doi.org/10.3389/fpsyg.2020.571552

Mason, R.J., Farrow, D., & Hattie, J.A. (2020c). An exploratory investigation into the reception of verbal and video feedback provided to players in an Australian Football League club. *International Journal of Sport Science and Coaching, x,* 1-11. https://doi.org/10.1177/1747954120951080

Mason, R.J. (2016). *From classroom to locker room: Visible learning for sports coaching* [Unpublished masters thesis]. University of Melbourne.

Massa, L.J., & Mayer, R.E. (2006). Testing the ATI hypothesis: Should multimedia instruction accommodate verbalizer-visualizer cognitive style? *Learning and Individual Differences, 16*(4), 321–336. https://doi.org/10.1016/j.lindif.2006.10.001

Massey, C. D., Maneval, M. W., Phillips, J., Vincent, J., White, G., & Zoeller, B. (2002). An analysis of teaching and coaching behaviors of elite strength and conditioning coaches. *The Journal of Strength & Conditioning Research, 16*(3), 456–460. https://doi.org/ 10.1519/00124278-200208000-00019

Maurer, T. J., Mitchell, D. R., & Barbeite, F. G. (2002). Predictors of attitudes toward a 360-degree feedback system and involvement in post-feedback management development activity. *Journal of Occupational and Organizational Psychology*, *75*(1), 87-107. https://doi.org/10.1348/096317902167667

McPherson, S. L., & Kernodle, M. W. (2003). Tactics, the neglected attribute of expertise: Problem representations and performance skills in tennis. In J. L. Starkes & K. A. Ericsson (Eds.), *Expert performance in sports: Advances in research on sport expertise* (pp. 137–167). Human Kinetics.

McQuade, S., Davis, L., & Nash, C. (2015). Positioning mentoring as a coach development tool: Recommendations for future practice and research. *Quest*, *67*(3), 317-329. https://doi.org/10.1080/00336297.2015.1048810

Merriam-Webster. (n.d.). *Feedback*. https://www.merriam-webster.com/dictionary/feedback

Mesquita, I., Rosado, A., Januário, N., & Barroja, E. (2008). Athlete's retention of a coach's instruction before a judo competition. *Journal of Sports Science & Medicine*, *7*(3), 402-407.

Middlemas, S., & Harwood, C. (2017). No place to hide: Football players' and coaches' perceptions of the psychological factors influencing video feedback. *Journal of Applied Sport Psychology, 30*(1), 23-44. https://doi.org/10.1080/10413200.2017.1302020

Mielke, D. (2007). Coaching experience, playing experience and coaching tenure. *International Journal of Sports Science & Coaching*, *2*(2), 105-108. https://doi.org/10.1260/174795407781394293

Millar, S. K., Oldham, A. R., & Donovan, M. (2011). Coaches' self-awareness of timing, nature and intent of verbal instructions to athletes. *International Journal of Sports Science & Coaching*, *6*(4), 503-513. https://doi.org/10.1260/1747-9541.6.4.503

Miller, G. A. (1956). The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81. https://doi.org/10.1037/h0043158

Model, R.L. (1983). Coaching behaviors of non-winning high school football coaches in Arizona [Unpublished doctoral thesis]. Arizona State University.

Moesch, K., & Apitzsch, E. (2012). How do coaches experience psychological momentum? A qualitative study of female elite handball teams. *The Sport Psychologist*, *26*(3), 435-453, https://doi.org/10.1123/tsp.26.3.435

Moreno, M. P., Santos, J. A., Ramos, L. A., Cervelló, E., Iglesias, D., & Del Villar, F. (2005). The efficacy of the verbal behaviour of volleyball coaches during competition. *Motricidad: European Journal of Human Movement*, *13*, 55-69.

Morris, K. S., Jenkins, D. G., Osborne, M. A., Rynne, S. B., Shephard, M. E., & Skinner, T. L. (2019). The role of the upper and lower limbs in front crawl swimming: The thoughts and practices of expert high-performance swimming coaches. *International Journal of Sports Science & Coaching*, *14*(5), 629-638. https://10.1177/1747954119866358

Mory, E. H. (2004). *Feedback research revisited.* In D. H. Jonassen (Ed.), *Handbook of research on educational communications and technology* (p. 745–783). Lawrence Erlbaum Associates Publishers.

Mouchet, A., & Duffy, P. (2020). Rugby coaches' perceptions of their in-competition role. *Sports Coaching Review*, *9*(1), 24-47. https://doi.org/10.1080/21640629.2018.1532650

Mouchet, A., Harvey, S., & Light, R. (2014). A study on in-match rugby coaches' communications with players: a holistic approach. *Physical Education and Sport Pedagogy*, *19*(3), 320-336, https://doi.org/10.1080/17408989.2012.761683

Mouratidis, A., Lens, W., & Vansteenkiste, M. (2010). How you provide corrective feedback makes a difference: The motivating role of communicating in an

autonomy-supporting way. *Journal of Sport and Exercise Psychology*, *32*(5), 619-637. https://doi.org/10.1123/jsep.32.5.619

Mouratidis, A., Vansteenkiste, M., Lens, W., & Sideridis, G. (2008). The motivating role of positive feedback in sport and physical education: Evidence for a motivational model. *Journal of Sport and Exercise Psychology*, *30*(2), 240-268. https://doi.org/10.1123/jsep.30.2.240

Narciss, S., & Huth, K. (2004). How to design informative tutoring feedback for multimedia learning. In H. M. Niegemann, D. Leutner, & R. Brunken (Eds.), *Instructional design for multimedia learning* (pp. 181-195). Waxmann.

Nash, C., & Collins, D. (2006). Tacit knowledge in expert coaching: Science or art? *Quest*, *58*, 464-476. https://doi.org/10.1080/00336297.2006.10491894

Nash, C., & Sproule, J. (2011). Insights into experiences: Reflections of an expert and novice coach. *International Journal of Sports Science & Coaching*, *6*(1), 149-161. https://doi.org/10.1260/1747-9541.6.1.149

Nelson, L. J., Potrac, P., & Groom, R. (2011). Receiving video-based feedback in elite ice-hockey: a player's perspective. *Sport, Education and Society, 1*(June 2012), 37-41. https://doi.org/10.1080/13573322.2011.613925

Nelson, L., Groom, R., & Potrac, P. (2016). *Learning in sports coaching: Theory and application*. Routledge.

Newell, K. M., & Ranganathan, R. (2010). Instructions as constraints in motor skill acquisition. In I. Renshaw, K. Davids, & G. J. P. Savelsbergh (Eds.), *Motor learning in practice* (pp. 17-32). Routledge.

Niall, J. (2015, March 8). Hawthorn's lesson for the competition. *The Age*. Retrieved from http://www.theage.com.au/afl/hawthorns-lesson-for-the-competition-20150307-13y06n.html

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in Higher Education*, *31*(2), 199-218. https://doi.org/10.1080/03075070600572090

North, J. (2010). Using 'coach developers' to facilitate coach learning and development: Qualitative evidence from the UK. *International Journal of Sports Science & Coaching*, *5*(2), 239-256. https://doi.org/10.1260/1747-9541.5.2.239

Nunes, M. E. d. S., Correa, U. C., de Souza, M. G. T. X., & Santos, S. (2020). Descriptive versus prescriptive feedback in the learning of golf putting by older persons. *International Journal of Sport and Exercise Psychology, (2020)*, 1-13. https://doi.org/10.1080/1612197X.2020.1717579

Occhino, J. L., Mallett, C. J., Rynne, S. B., & Carlisle, K. N. (2014). Autonomy-supportive pedagogical approach to sports coaching: Research, challenges and opportunities. *International Journal of Sports Science & Coaching*, *9*(2), 401-415. https://doi.org/10.1260/1747-9541.9.2.401

O'Connor, D., Larkin, P., & Williams, A. M. (2018). Observations of youth football training: How do coaches structure training sessions for player development?. *Journal of Sports Sciences*, *36*(1), 39-47. https://doi.org/10.1080/02640414.2016.1277034

OECD. (2009). Teaching practices, teachers' beliefs and attitudes. In *Creating effective teaching and learning environments* (pp. 87-135). OECD. https://www.oecd-ilibrary.org/education/creating-effective-teaching-and-learning-environments/teaching-practices-teachers-beliefs-and-attitudes_9789264068780-6-en

O'Sullivan, R. G. (2004). *Practicing evaluation.* Sage Publications.

Oxford University Press. (n.d.). Coach. In *Oxford English Dictionary.* Oxford University Press. https://www.oed.com/view/Entry/34954?isAdvanced=false&result=1&rskey=Hc19cc&

Pain, M. A., & Harwood, C. (2007). The performance environment of the England youth soccer teams. *Journal of Sports Sciences, 25*(12), 1307-1324. https://doi.org/10.1080/02640410601059622

Parkes, J., Abercrombie, S., & McCarty, T. (2013). Feedback sandwiches affect perceptions but not performance. *Advances in Health Sciences Education*, *18*(3), 397-407. https://doi.org/10.1007/s10459-012-9377-9

Partington, M., & Cushion, C. (2013). An investigation of the practice activities and coaching behaviors of professional top-level youth soccer coaches. *Scandinavian Journal of Medicine & Science in Sports*, *23*(3), 374-382. https://doi.org/10.1111/j.1600-0838.2011.01383.x

Partington, M., Cushion, C. J., Cope, E., & Harvey, S. (2015). The impact of video feedback on professional youth football coaches' reflection and practice

behaviour: A longitudinal investigation of behaviour change. *Reflective Practice*, *16*(5), 700-716. https://doi.org/10.1080/14623943.2015.1071707

Partington, M., Cushion, C., & Harvey, S. (2014). An investigation of the effect of athletes' age on the coaching behaviours of professional top-level youth soccer coaches. *Journal of Sports Sciences*, *32*(5), 403-414. https://doi.org/10.1080/02640414.2013.835063

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning styles: Concepts and evidence. *Psychological Science in the Public Interest*, *9*(3), 105-119. https://doi.org/10.1111/j.1539-6053.2009.01038.x

Pensgaard, A. M., & Duda, J. L. (2002). "If we work hard, we can do it": A tale from an olympic (gold) medallist. *Journal of Applied Sport Psychology, 14*(3), 219-236. https://doi.org/10.1080/10413200290103518

Pereira, F., Mesquita, I., & Graça, A. (2009). Accountability systems and instructional approaches in youth volleyball training. *Journal of Sports Science & Medicine*, *8*(3), 366. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3763281/

Phillips, E., Farrow, D., Ball, K., & Helmer, R. (2013). Harnessing and understanding feedback technology in applied settings. *Sports Medicine*, *43*(10), 919-925. https://doi.org/10.1007/s40279-013-0072-7

Potrac, P., Brewer, C., Jones, R., Armour, K., & Hoff, J. (2000). Toward an holistic understanding of the coaching process. *Quest*, *52*(2), 186-199. https://doi.org/10.1080/00336297.2000.10491709

Potrac, P., Jones, R., & Armour, K. (2002). 'It's all about getting respect': The coaching behaviors of an expert English soccer coach. *Sport, Education and Society*, *7*(2), 183-202. https://doi.org/10.1080/1357332022000018869

Potrac, P., Jones, R., & Cushion, C. (2007). Understanding power and the coach's role in professional English soccer: A preliminary investigation of coach behaviour. *Soccer & Society*, *8*(1), 33-49. https://doi.org/10.1080/14660970600989509

Putnam, R. T., & Borko, H. (1997). Teacher learning: Implications of new views of cognition. In B.J. Biddle, T.L. Good, & I.F. Goodson (Eds.), *International handbook of teachers and teaching* (pp. 1223-1296). Springer.

Ramaprasad, A. (1983). On the definition of feedback. *Systems Research and Behavioral Science*, *28*(1), 4-13. https://doi.org/10.1002/bs.3830280103

Randell, A. D., Cronin, J. B., Keogh, J. W., Gill, N. D., & Pedersen, M. C. (2011). Effect of instantaneous performance feedback during 6 weeks of velocity-based resistance training on sport-specific performance tests. *The Journal of Strength & Conditioning Research*, *25*(1), 87-93. https://doi.org/10.1519/jsc.0b013e3181fee634

Rasheed, A., Khan, S.-U.-R., Rasheed, M. F., & Munir, Y. (2015). The Impact of Feedback Orientation and the Effect of Satisfaction With Feedback on In-Role Job Performance. *Human Resource Development Quarterly, 26*(1), 31-51. https://doi.org/10.1002/hrdq

Renshaw, I., Araújo, D., Button, C., Chow, J. Y., Davids, K., & Moy, B. (2016). Why the constraints-led approach is not teaching games for understanding: A

clarification. *Physical Education and Sport Pedagogy*, *21*(5), 459-480. https://doi.org/10.1080/17408989.2015.1095870

Renshaw, I., Oldham, A. R., & Bawden, M. (2012). Nonlinear pedagogy underpins intrinsic motivation in sports coaching. *The Open Sports Sciences Journal*, *5*, 88-99. https://doi.org/10.2174/1875399x01205010088

Roberts, A. H., Greenwood, D. A., Stanley, M., Humberstone, C., Iredale, F., & Raynor, A. (2019). Coach knowledge in talent identification: A systematic review and meta-synthesis. *Journal of Science and Medicine in Sport*, *22*(10), 1163-1172. https://doi.org/10.1016/j.jsams.2019.05.008

Rollinson, S. (2016, April 29). Teaching skills proving vital for a new breed of Aussie Rules coaches. *ABC News*. Retrieved from http://www.abc.net.au/news/2016-04-30/teaching-skills-proving-vital-for-a-new-breed-of-football-coach/7367794

Rosado, A., Mesquita, I., Breia, E., & Januário, N. (2008). Athlete's retention of coach's instruction on task presentation and feedback. *International Journal of Performance Analysis in Sport, 8*(1), 19-30. https://doi.org/10.1017/CBO9781107415324.004

Rothstein, A. L., & Arnold, R. K, (1976), Bridging the gap: Application of research on video-tape feedback and bowling. *Motor Skills: Theory into Practice, 1,* 35-62. https://ci.nii.ac.jp/naid/10007442901/

Rushall, B.S. (2003). Coaching development and the second law of thermodynamics (or belief-based versus evidence-based coaching development). http://coachsci.sdsu.edu/csa/thermo/thermo.htm

Rynne, S. B., & Mallett, C. J. (2012). Understanding the work and learning of high performance coaches. *Physical Education and Sport Pedagogy*, *17*(5), 507-523. https://doi.org/10.1080/17408989.2011.621119

Rynne, S. B., & Mallett, C. J. (2014). Coaches' learning and sustainability in high performance sport. *Reflective Practice*, *15*(1), 12-26. https://doi.org/10.1080/14623943.2013.868798

Sadler, R. (1989). Formative assessment and the design of instructional systems. *Instructional Science, 18*, 119-144. https://doi.org/10.1007/bf00117714

Sadowski, J., Mastalerz, A., & Niznikowski, T. (2013). Benefits of bandwidth feedback in learning a complex gymnastic skill. *Journal of Human Kinetics*, *37*(1), 183-193. https://doi.org/10.2478/hukin-2013-0039

Sagar, S. S., & Jowett, S. (2012). Communicative acts in coach–athlete interactions: When losing competitions and when making mistakes in training. *Western Journal of Communication*, *76*(2), 148-174. https://doi.org/10.1080/10570314.2011.651256

Salmoni, A.W., Schmidt, R.A., & Walter, C.B. (1984). Knowledge of results and motor learning: A review and critical reappraisal. *Psychological Bulletin, 95*(3), 355-386. https://doi.org/10.1037/0033-2909.95.3.355

Schmidt, R. A., & Wrisberg, C. A. (2008). *Motor learning and performance: A situation-based learning approach* (4th ed.). Champaign, IL.: Human Kinetics.

Shea, J. B. (1977). Effects of labeling on motor short-term memory. *Journal of Experimental Psychology: Human Learning and Memory*, *3*(1), 92. https://doi.org/10.1037/0278-7393.3.1.92

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, *78*(1), 153-189. https://doi.org/10.3102/0034654307313795

Sigrist, R., Rauter, G., Riener, R., & Wolf, P. (2013). Augmented visual, auditory, haptic, and multimodal feedback in motor learning: a review. *Psychonomic Bulletin & Review*, *20*(1), 21-53. https://doi.org/10.3758/s13423-012-0333-8

Smale-Jacobse, A. E., Meijer, A., Helms-Lorenz, M., & Maulana, R. (2019). Differentiated Instruction in Secondary Education: A Systematic Review of Research Evidence. *Frontiers in Psychology*, *10*, 2366. https://doi.org/10.3389/fpsyg.2019.02366

Smedley, F.E. (1850). *Frank Fairleigh*. Arthur Hall Virtue & Co.

Smith, M. R., Marcora, S. M., & Coutts, A. J. (2015). Mental fatigue impairs intermittent running performance. *Med Sci Sports Exerc*, *47*(8), 1682-1690, https://doi.org/10.1249/MSS.0000000000000592

Smith, M. R., Zeuwts, L., Lenoir, M., Hens, N., De Jong, L. M., & Coutts, A. J. (2016). Mental fatigue impairs soccer-specific decision-making skill. *Journal of Sports Sciences*, *34*(14), 1297-1304, https://doi.org/10.1080/02640414.2016.1156241

Smith, M., & Cushion, C. J. (2006). An investigation of the in-game behaviours of professional, top-level youth soccer coaches. *Journal of Sports Sciences, 24*(4), 355-366. https://doi.org/10.1080/02640410500131944

Smith, M.F. (2010). *Research methods in sport.* Learning Matters Ltd.

Smith, R. E., Smoll, F. L., & Hunt, E. (1977). A system for the behavioral assessment of athletic coaches. *Research Quarterly. American Alliance for Health, Physical Education and Recreation*, *48*(2), 401-407. https://doi.org/10.1080/10671315.1977.10615438

Smoll, F. L., & Smith, R. E. (1980). Techniques for improving self-awareness of youth sports coaches. *Journal of Physical Education and Recreation*, *51*(2), 46-52. https://doi.org/10.1080/00971170.1980.10624089

Solomon, G. B., Striegel, D. A., Eliot, J. F., Heon, S. N., Maas, J. L., & Wayda, V. K. (1996). The self-fulfilling prophecy in college basketball: Implications for effective coaching. *Journal of Applied Sport Psychology, 8*(1), 44-59. https://doi.org/10.1080/10413209608406307

Sotiriadou, P., & De Bosscher, V. (2018). Managing high-performance sport: Introduction to past, present and future considerations. *European Sport Management Quarterly, 18*(1), 1-7. https://doi.org/10.1080/16184742.2017.1400225

Stafford, L., Burggraf, C. S., & Sharkey, W. F. (1987). Conversational memory: The effects of time, recall, mode, and memory expectancies on remembrances of natural conversations. *Human Communication Research, 14*(2), 203-229. https://doi.org/10.1111/j.1468-2958.1984.tb00024.x

Stevenson, C. E. (2017). Role of working memory and strategy-use in feedback effects on children's progression in analogy solving: An explanatory item response theory account. *International Journal of Artificial Intelligence in Education*, *27*, 393–418. https://doi.org/10.1007/s40593-016-0129-5

Stoate, I., Wulf, G., & Lewthwaite, R. (2012). Enhanced expectancies improve movement efficiency in runners. *Journal of Sports Sciences*, *30*(8), 815-823, https://doi.org/10.1080/02640414.2012.671533

Stodter, A., & Cushion, C. J. (2019). Evidencing the impact of coaches' learning: Changes in coaching knowledge and practice over time. *Journal of Sports Sciences*, *37*(18), 2086-2093. https://doi.org/10.1080/02640414.2019.1621045

Stone, R. J. (2000, August). Haptic feedback: A brief history from telepresence to virtual reality. In S. Brewster & R. Murray-Smith (Eds.), *Haptic Human-Computer Interaction* (pp. 1-16). Springer.

Stoszkowski, J., & Collins, D. (2016). Sources, topics and use of knowledge by coaches. *Journal of Sports Sciences*, *34*(9), 794-802. https://doi.org/10.1080/02640414.2015.1072279

Swinnen, S. P., Walter, C. B., Lee, T. D., & Serrien, D. J. (1993). Acquiring bimanual skills: Contrasting forms of information feedback for interlimb decoupling. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *19*(6), 1328. https://doi.org/10.1037/0278-7393.19.6.1328

Tannenbaum, S. I., & Cerasoli, C. P. (2013). Do team and individual debriefs enhance performance? A meta-analysis. *Human Factors*, *55*(1), 231-245. https://doi.org/10.1177/0018720812448394

Teixeira, P. J., Carraça, E. V., Markland, D., Silva, M. N., & Ryan, R. M. (2012). Exercise, physical activity, and self-determination theory: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 9,* 78-108, https://doi.org/10.1186/1479-5868-9-78

Tenenbaum, G., & Goldring, E. (1989). A meta-analysis of the effect of enhanced instruction: Cues, participation, reinforcement and feedback and correctives on motor skill learning. *Journal of Research and Development in Education, 22*, 53–64. https://psycnet.apa.org/record/1989-41255-001

Tharp, R., & Gallimore, R. (1976). What a coach can teach a teacher. *Psychology Today, 9*(8), pp.74-78.

Travassos, B., Araujo, D., Davids, K., Vilar, L., Esteves, P., & Vanda, C. (2012). Informational constraints shape emergent functional behaviours during performance of interceptive actions in team sports. *Psychology of Sport and Exercise*, *13*(2), 216-223. https://doi.org/10.1016/j.psychsport.2011.11.009

Tinning, R. (1982) Improving coaches' instructional effectiveness, *Sports Coach, 5*(4), 37–41.

Tomlinson, C. A., Brighton, C., Hertberg, H., Callahan, C. M., Moon, T. R., Brimijoin, K., Conover, L.A., & Reynolds, T. (2003). Differentiating instruction in response to student readiness, interest, and learning profile in academically diverse classrooms: A review of literature. *Journal for the Education of the Gifted*, *27*(2-3), 119-145. https://doi.org/10.1177/016235320302700203

Trudel, P., Côté, J., & Bernard, D. (1996). Systematic observation of youth ice hockey coaches during games. *Journal of Sport Behavior, 19*(1), 50-50.

Van der Kleij, F. M., Feskens, R. C., & Eggen, T. J. (2015). Effects of feedback in a computer-based learning environment on students' learning outcomes: A meta-analysis. *Review of Educational Research*, *85*(4), 475-511. https://doi.org/10.3102/0034654314564881

Walsh, J. A., & Sattes, B. D. (2005). *Quality questioning: research-based practice to engage every learner*. Sage Publications.

Walsh, J., & Jureidini, J. (2018). Language as a key resource for the football coach: A case study of in-game coaching at one Australian rules club. In D. Caldwell, J. Walsh, E.W. Vine, & J. Jureidini (Eds.), *The discourse of sport: Analyses from social linguistics* (pp. 13-33). Routledge.

Ward, G., Tan, L., & Grenfell-Essam, R. (2010). Examining the relationship between free recall and immediate serial recall: The effects of list length and output order. *Journal of Experimental Psychology: Learning Memory and Cognition, 36*(5), 1207-1241. http://doi.org/10.1037/a0020122

Webster, C. A., Hunt, K., & LaFleche, M. (2013). Are winning coaches more autonomy-supportive? Examining the context of varsity boys' soccer. *Journal of Sport Behavior*, *36*(2).

Werner, P., & Almond, L. (1990). Models of games education. *Journal of Physical Education, Recreation & Dance*, *61*(4), 23-30. https://doi.org/10.1080/07303084.1990.10606501

Wilkinson, S.S. (1981). The relationship of teacher praise and student achievement: A meta-analysis of selected research. *Dissertation Abstracts International, 41*(9-A), 3998.

Williams, J.K. (1978). *A behavioral analysis of a successful high school basketball coach* [Unpublished Masters thesis]. Arizona State University.

Williams, S.E. (1997, March). Teachers' written comments and students' responses: A socially constructed interaction. *Proceedings of the annual meeting of the Conference on College Composition and Communication,* Phoenix, AZ. https://eric.ed.gov/?id=ED408589

Wooden, J. R., & Jamison, S. (1997). *Wooden: A lifetime of observations and reflections on and off the court.* Contemporary Books.

Woods, C. T., McKeown, I., Rothwell, M., Araújo, D., Robertson, S., & Davids, K. (2020). Sport practitioners as sport ecology designers: How ecological dynamics has progressively changed perceptions of skill "acquisition" in the sporting habitat. *Frontiers in Psychology, 11*, 654. https://doi.org/10.3389/fpsyg.2020.00654

Wrisberg, C.A. (2007). *Sport skill instruction for coaches.* Human Kinetics.

Wulf, G., & Weigelt, C. (1997). Instructions about physical principles in learning a complex motor skill: To tell or not to tell…. *Research Quarterly for Exercise and Sport*, *68*(4), 362-367. https://doi.org/10.1080/02701367.1997.10608018

Zanone, P.G. and Kelso, J.A.S. (1997). Coordination dynamics of learning and transfer: collective and component levels. *Journal of Experimental Psychology: Human Perception and Performance, 23*(5), 1454-1480. https://doi.org/10.1037/0096-1523.23.5.1454

Zetou, E., Amprasi, E., Michalopoulou, M., & Aggelousis, N. (2011). Volleyball coaches behavior assessment through systematic observation. *Journal of Human Sport and Exercise, 6*(4), 585-593. https://doi.org/10.4100/jhse.2011.64.02