After Serendipity Strikes: Creating Value from Encountered Information

Stephann Makri  
City, University of London  
Northampton Square  
London EC1V 0HB, UK  
Stephann@city.ac.uk

Mina Ravern  
Telia Norge AS  
Netcom, Sandakerveien 140  
Postboks 444 Nydalen, 0484,  
Oslo

Dana McKay  
University of Melbourne  
Parkville, VIC 3010  
Australia  
danamckay@gmail.com

ABSTRACT

In recent years, serendipitous information discovery (or information encountering) has received increased research attention. But most of this research has focused on how people stumble upon information; how they go on to create value from information they encounter has been largely ignored. This study, an online diary study with follow-up interviews, provides an enriched understanding of the subjective value of these encounters and the motivators, barriers and actions involved in creating value from encountered information. Based on our findings, we discuss design suggestions for digital information tools to better assist information encounterers in leveraging their happy information accidents.

Keywords

Serendipity, information encountering, relevance

INTRODUCTION

Serendipitous information discovery (also known as information encountering, or IE) has recently received increased recognition as an important mode of information acquisition. Yet, compared to information seeking activities like search and directed browse, it has received relatively little research attention. IE happens when people are looking for information on a different topic, when they are not looking for any information in particular, or when they are not looking for any information at all. IE can facilitate connection-making between seemingly unrelated pieces of information; spark new insights, propel people forward in new directions and surprise and delight them along the way. The distinction between seeking and encountering can be thought of as the difference between people finding information and information finding them. However, this distinction is somewhat artificial, as encountering can occur when actively seeking information.

Most prior research on IE has focused on how people stumble upon information and how digital information tools can support this (e.g. through recommendations or information visualization). However, to benefit from encountered information, it is necessary to create value from it—e.g. by following up on it and applying it to one’s work or everyday life. IE therefore involves more than just stumbling upon information—it also requires action on the part of the finder to maximise the potential value of the information. Little is, however, known about what this involves.

The notion of ‘value’ has been examined in the context of whether or not users are likely to pursue acquired information (Barry, 1994) and incorporated into several models of serendipity (e.g. (Foster & Ford, 2003; Makri & Blandford, 2012a; McCay-Peet & Toms, 2015)). However, while we have some idea of why encountered information is considered valuable – e.g. when it is knowledge-enhancing, impactful, timely and/or time-saving (Makri & Blandford, 2012a), other aspects of value creation in the context of encountered information, such as the motivators, barriers and actions involved, are not well understood. This is an area of IE ripe for enhanced digital support. However, to our knowledge, no prior research has focused on better understanding it or how we can design for it.

We conducted an online diary study to find out how people currently create value from encountered information, and related motivators and barriers. Participants took screenshots of information they encountered and shared them (privately) with us in the cloud; these were used as probes in follow-up interviews. Interviews focused on whether and how participants found the encountered information valuable and whether or not they had subsequently followed-up on the information (or planned to) and why. A number of motivators, barriers and participant actions involved in value creation emerged. These elements form an empirically-grounded framework for discussing how people create value from their information encounters, and how they subjectively experience that value. The primary contribution of this
work is that framework and the resultant design suggestions for creating value from encountered information. Our method—an online diary study using standard cloud based tools—is a second minor contribution.

The remainder of this paper is structured as follows: first we discuss background literature, next we outline and justify our method. Following that we present results and build a framework that describes aspects of post-encounter value creation. We then discuss our results in the context of previous work and present implications for system design and finally we draw conclusions.

BACKGROUND
In this section we describe information encounters and situate them in the literature, discuss previous work on influencing IE. We then address the issue of value in information encountering, and finally examine the sparse literature on creating value from encountered information.

Information Encountering
Information encountering (IE) can be considered as serendipity in the context of information acquisition—a happy information accident. Erdelez coined the term IE, identifying it as an important form of information acquisition (Erdelez, 2005). While its original scope was limited to ‘accidental discovery during an active search for some other information’ (Erdelez, 2005), the concept has been adopted more broadly by other researchers (e.g. (Agarwal, 2015; Kefalidou & Sharles, 2016)); in this broader scope, information is accidentally discovered not only when actively searching but also when browsing with no particular aim or not actively looking for any information at all. Erdelez has referred to this broader scope as the ‘Opportunistic Discovery of Information’ (Erdelez, 2004). We adopt this scope, referring to it as information encountering as this is the specific term most commonly used to describe coming across information serendipitously. Our precise definition of IE is based on our previous empirical studies (Makri & Blandford, 2012a, 2012b; Makri, Blandford, Woods, Sharles, & Maxwell, 2014). It involves: unexpectedness finding useful or potentially useful information when looking for different information, not looking for any information in particular or not looking for information at all. Given this definition, IE sits outside traditional information-seeking models such as (Kuhlthau, 1991; Marchionini, 1997). Other models however, have implicitly incorporated IE; McKenzie’s model (McKenzie, 2003) focuses on social information-seeking, which is necessarily less directed than academic seeking and includes many of the active ‘open to discovery’ states that were later identified as important for serendipity (Makri et al., 2014). Although Bates’s Berrypicking model (Bates, 1989) assumes active search (through searching or browsing), it allows for a shift in search goal in response to encountered information.

IE has been identified as an important mode of information acquisition in several empirical studies (D’Antonio, Makri, & Blandford, 2012; Erdelez, 1997; Foster & Ford, 2003; Makri & Blandford, 2012a, 2012b; Makri & Warwick, 2010; McCoy-Peet & Toms, 2015). However, while some studies have sought to understand the ways in which IE can be influenced (e.g. (Heinström, 2006; Makri et al., 2014; McBirnie, 2008; McCoy-Peet, Toms, & Kelloway, 2015; McCoy-Peet & Toms, 2015)) and some have identified value creation as an aspect of IE that can be influenced (Makri & Blandford, 2012a; McCoy-Peet & Toms, 2015), to our knowledge none have focused specifically on understanding how people create value from encountered information (or related motivators and barriers).

Influencing Information Encountering
Researchers have examined whether and how IE can be influenced from various perspectives; the notion of ‘control’, the impact of individual differences and the impact of digital information tool design. Some work (e.g. (Cunha, Clegg, & Mendonça, 2010; Napier & Hoang Vuong, 2013) has examined IE from an organisational perspective; in particular, how organisations can best facilitate it. Where a study has examined serendipity in the context of information acquisition (rather than in general), we use the specific term ‘IE’ rather than the general term ‘serendipity’ when describing it.

On ‘control,’ findings have been mixed; Foster and Ford found academic researchers’ perceptions of control varied considerably; some thought encountering information was ‘almost deliberate randomness’ while others a result of persistence and hard work (Foster & Ford, 2003). McBirnie concluded from interviews with jazz improvisers and academics that ‘while seeking serendipity seems improbable, paradoxically, some degree of control may be possible’ (McBirnie, 2008). She argued that while it is possible to control the perception of IE (e.g. by being open and flexible during information acquisition), there is little potential to control the process, as it incorporates some unexpectedness. However, this assumes a process that ends right after information is encountered. We found the process continues post-encounter, encompassing value creation (see section 3.1.3) and that this part of the process can be influenced by taking actions to turn unexpected encounters into valuable ones (Makri & Blandford, 2012a).

Findings on the effects of personality, including individual differences, on IE have also been mixed—suggesting the need for future work to better understand the interaction between individual differences, and information task/environment. Heinström (Heinström, 2006) found that students who were outgoing, confident and took a strategic approach to information-seeking were more likely to encounter information. Findings of a recent study (McCay-Peet et al., 2015) were more modest; extroverts were more likely to report experiencing serendipity in general, but this did not extend to IE. No other individual differences (e.g. openness to new experiences, locus of control) were found to influence serendipity in general, or in digital information environments.

Some environments are notable for their ability to create opportunities for productive information encounters; the most obvious is the library shelves (Kleiner, Rädle, & Reiterer, 2013; Thudt, Hinrichs, & Carpendale, 2012). Semantic addressing is designed specifically to make it easier for information seekers to find other books that may pique their interest (Svenonius, 2000). In view of this, a number of digital tools have emerged to attempt to facilitate IE within the limited scope of the digital library (e.g. (Kleiner et al., 2013; Pearce & Chang, 2014; Thudt et al., 2012)). These tools have not been investigated in terms of whether and how users leverage the encountered information. How existing digital information tools facilitate IE has, however, been investigated (McCay-Peet et al., 2015; McCoy-Peet & Toms, 2015). Types of tools that influenced IE were those that provided opportunities for the following (McCay-Peet et al., 2015): 1) consumption of a variety of information, ideas or resources (‘trigger-rich’ environments), 2) connection-making between
information, ideas or resources and 3) unexpected interactions between information, ideas or resources.

Cunha et al. (Cunha et al., 2010) suggest an ‘organizational capability to make something good of the unknown’ (p. 320) can maximise the value of serendipity. They identified several factors that enable and constrain serendipity in organisations. Enabling factors included: mental alertness, a culture that values knowledge over expertise, the free flow of information, social networking and team working, lack of tight deadlines, physical and mental space to be creative and ‘play with ideas’ and working dynamics that value serendipitous discovery. Constraining factors included vested interests, power dynamics and lack of visibility or credibility of the person who made the discovery. In summary, these studies have examined how IE (or serendipity in general) might be influenced. But none, to our knowledge, have focused specifically on understanding the potential for influence post-encounter, after serendipity strikes.

**What ‘Value’ Means in the Context of Serendipity**

Traditionally the value of a given piece of information in an information seeking context has been ‘precision’, a measure of how well the textual content of a document matches a user’s text query (Baeza-Yates & Ribeiro-Neto, 1999). As Barry (Barry, 1994) pointed out more than 20 years ago, though, this approach requires the information seeker to accurately describe the information they need in terms the system reflects; a task Borgman noted to be notoriously difficult (Borgman, 1996). Barry offered a framework for user-, rather than system-determined relevance, however even this doesn’t address the issue of value in information encountering. Serendipity is, by definition, a happy accident; the value, therefore, is what makes the accident happy rather than just unusual or random. There are no relevance criteria to meet in this case, so value is entirely in the eyes of the user.

**Creating Value from the Encountered Information**

While not studied in depth, the importance of value creation for both IE and serendipity in general has been recognised (Cunha et al., 2010; Makri & Blandford, 2012a; Makri et al., 2014; McCoy-Peet & Toms, 2015; Napier & Hoang Vuong, 2013). Value creation is a component of our empirical model of the serendipity process [redacted]. In this model, when applied to IE, mental projections are made on the potential value of the information encountered. Actions are then taken to exploit the value and, through an iterative process of reflecting on the value and taking further action, value is maximised. Another empirical model of serendipity (McCay-Peet & Toms, 2015) combines these stages under the umbrella term ‘follow-up.’ Both Foster and Ford (Foster & Ford, 2003) and McKenzie (McKenzie, 2003) provide examples of value creation and allude to it in their models, but detail is minimal. Our study enriches the understanding provided by these models, by elaborating on the actions taken to create value and associated motivators and barriers.

Value creation is also a component of our framework for classifying potentially serendipitous experiences, including information encounters (Makri & Blandford, 2012a). Using the framework involves asking oneself, for a potentially serendipitous experience, how valuable or potentially valuable the outcome is. Experiences with greater perceived value (alongside greater perceived unexpectedness and insight) are considered more serendipitous than others. This study moves beyond understanding the level of perceived value of an information encounter and towards understanding the nature of value creation itself.

Creative professionals have been found to follow strategies to maximise their chances of experiencing serendipity (Makri et al., 2014). A strategy particularly relevant to value creation is ‘seizing opportunities’. Examples included striking up a conversation with someone they had unexpectedly met, walking into places they had stumbled upon and, most relevant to this study, making use of information they encountered. Several of the creatives regarded seizing potentially serendipitous opportunities as ‘high-risk-high-reward.’ They decided on a case-by-case basis how much time to invest in trying to create value from them. Our study examines the specific ways in which people make use of encountered information, identifying ‘time’ as an important barrier to value creation.

Creating value from encountered information has been most discussed in the field of organisational serendipity and is deemed ‘critical’ for organisations (Napier & Hoang Vuong, 2013). Napier and Quan say it is ‘...the ability to take unexpected information and create value that, before the information appeared, would not have happened’ (Napier & Hoang Vuong, 2013). They propose a conceptual framework that incorporates the notion of evaluation of encountered information in relation to its potential to create unintended value. They discuss two types of evaluation: 1) flash and 2) systematic. Flash evaluation involves making a rapid ‘gut feel’ assessment of the value or potential value of encountered information, which may result in greater awareness of whether connections can be made between it and information already known. Systematic evaluation involves analytical assessment that may result in a clearer confirmation of the information’s potential value. Decisions on whether to invest time and money in maximising the value of a particular serendipitous discovery are often ‘entirely politically pragmatic’ (Cunha et al., 2010) and made, rather than on the quality of the ideas, on factors such as stakeholder sponsorship.

Napier and Quan argue that the value creation process within organisations is affected by factors including: risk tolerance, uncertainty levels surrounding information and evaluation, timing, and finding more information that will help ‘confirm or dispute’ the information encountered. Like our empirical model of serendipity [redacted], they highlight the need to ‘take[e] action upon the information to generate that value’ (Napier & Hoang Vuong, 2013). Our work elaborates on the types of actions that might be carried out.
These studies recognise value creation as an important aspect of IE, but to our knowledge, no prior work has focused specifically on understanding how this value is created and related motivators and barriers. Our study fills this research gap.

**METHOD**

Interviews, mirroring McKenzie’s successful approach for identifying everyday information encounters (McKenzie, 2003). Our participants comprised 14 Masters students from one of the author’s social networks. The study was timed to coincide with their literature search, though many of the encounters they describe are social, rather than study-related. 13 students provided diary entries, however one did not give enough information to generate useful interview questions. As such, our study is based on data from 12 participants (4 female, 4 male), studying on various degrees including Human-Computer Interaction, Engineering and Economics. This section will describe the diary study and interviews and discuss our analysis approach and study limitations.

**Diary study**

Diary studies are useful for understanding behaviour that takes place over an extended time period. As information encounters are ‘regular but rare’ (McBirnie, 2008), we opted for a four week duration to coincide with participants’ likely information interaction to support their dissertation literature review. This was important as, perhaps unsurprisingly, information encounters happen when people are given enough opportunity to interact with information (Makri, Bhuiya, Carthy, & Owusu-Bonsu, 2015).

Diary studies can be used for feedback or ‘elicitation’; the latter typically includes cultural probe style prompts for images, text and other media (Carter & Mankoff, 2005). In common with a previous study of serendipity in everyday life (Sun, Sharples, & Makri, 2011) we used a combination of feedback and elicitation. Specifically, we asked participants to:

1. Take screenshots of useful or potentially useful information they found unexpectedly. The instructions explained this might be when:
   - Looking for different information (i.e. partly or seemingly unrelated information)
   - Looking for information with no particular aim in mind
   - Not looking for information at all (i.e. not actively seeking information)
2. Note down (a) why they thought finding the information was unexpected and (b) why they thought the information was useful or might be potentially useful.

This approach was designed to maximise the trade off between keeping data entry as simple as possible (highlighted as useful in (Carter & Mankoff, 2005; Sun et al., 2011)) and creating a useful prompt for memory during discussion (highlighted as useful in (Carter & Mankoff, 2005; Makri et al., 2015)). We used the word ‘useful’ rather than ‘valuable’ as we deemed it clearer and unambiguous the context of IE and due to the closeness of the two concepts (the OCED defines ‘valuable’ as ‘extremely useful or important’). As in previous studies of serendipity (e.g. (Makri & Blandford, 2012a; McCay-Peet & Toms, 2015)), we did not provide examples or definitions of ‘information,’ ‘useful’ or ‘unexpected’, as we did not want to restrict or bias participants’ responses.

To further ensure simple data capture and transfer, participants captured screenshots and entered notes directly into a Google Doc. The document was shared between the participant and researcher and participants were instructed to delete it after the study had finished. The document contained several template entries incorporating the date and feedback prompts related to unexpectedness and usefulness. Participants were told they could take the screenshots either on a computer e.g. (laptop, desktop) or a mobile device (e.g. phone, tablet)—whatever they were using at the time of the information encounter. They were encouraged to document screenshots as soon as possible after the encounter so they would be more likely to remember their unexpectedness and usefulness rationale. This type of online, cloud-based diary study is new, and was lightweight and simple for both participants and researchers. Its success as an approach means we advocate its use in future information behaviour studies.

**Follow-up interview**

At the end of the four-week diary study period, we conducted follow-up interviews using each diary entry as a prompt. We used each entry to begin to understand the context surrounding an information encounter, the participant’s rationale for experiencing the encounter as unexpected, the reason they thought the information was likely to be useful and the motivations and barriers to leveraging the information.

Interview questions to understand the participant’s goal or lack of thereof included ‘what were you doing when you took that screenshot?’ and ‘were you looking for any information in particular? If so, what?’ We asked ‘how was the information you found unexpected?’ and ‘was the information you found useful? If so, how? If not, why not?’ If the information was described as not useful, we asked ‘what is preventing it from being useful?’ We also asked probing questions to better understand the context surrounding each information encounter. These questions aimed to flesh out the ‘story’ of each encounter, to test our assumptions and to elicit more or more concrete detail. As there was overlap between the data collected in the diary study and interview, the interview acted as a form of method triangulation (Fidel, 1993), serving to enhance the validity of the findings. Without the interviews, it would not have been possible to faithfully and accurately interpret the diary data. Interviews were transcribed and anonymised on transcription.
Analysis
Interview data was analysed using an inductive grounded analysis approach based on the Grounded Theory method (Corbin & Strauss, 2015). The primary difference between our analysis approach and Corbin and Strauss’ method is that we analysed all data at once, rather than feeding data from one interview into questions asked of subsequent participants. We looked for patterns in each of the examples of information encountering. Analysis was supported by the use of cloud-based Qualitative Data Analysis tool Dedoose. The coding gave rise to a framework that classified each encounter according to the value created afterwards (e.g. ‘useful for a specific purpose’, ‘useful for a vague/unknown purpose’ and ‘not useful’), and the motivators and barriers to value creation.

We wrote each information encounter in the form of a ‘serendipity story’ (Makri & Blandford, 2012a)—a third-person account of each encounter. These stories describe participants’ goals (or lack thereof), the information they encountered, why they considered the encounter unexpected and (potentially) useful and any actions taken to create value from the encounter (encompassing both motivating factors and barriers to value creation). We present excerpts from these stories when reporting our findings. The stories illustrate the fine line between information-seeking and encountering; all involve IE in the course of some degree of active seeking (even if only browsing a social media feed). Some involve encountering information that was fairly related to the participant’s information-seeking goal. As judgements of ‘unexpected’ and ‘useful’ are subjective to an individual, we do not exercise any ‘serendipitous’ or ‘not-serendipitous’ editorial control here. Instead, we include all entries participants deemed both unexpected and useful (or potentially useful). This results in a broad and inclusive understanding of value creation.

Limitations
A key limitation of this study is that the act of capturing encountered information takes it from the ephemeral fleeting experience of piqued interest into something more concrete. Capturing information meant our participants were more likely to go on and use it than they otherwise might have been; the act of capture is an investment and therefore an explicit statement about the value of that piece of information, according to the framework presented in (Loizides & Buchanan, 2013). While the volume and perceived usefulness of encounters may be overrepresented in our study, the nature of these encounters is likely to be representative.

The four-week timespan of the diary study was relatively short for a longitudinal study. This meant the long-term value of the encountered information could not be fully evaluated. However only 7 of 31 diary entries fell into a ‘not yet happened’ category (see table 1) indicating that, for the majority of entries, the value had fully materialised. However, over time, participants’ subjective perceptions of value could potentially change. A longer study, over a period of months, might therefore provide additional insight.

McKenzie (McKenzie, 2003) has pointed out that studies of information use in academia may not be transferrable to everyday situations. While participants in our study are budding academics, many of the examples they gave are non-academic. Therefore our findings have broad applicability outside academia.

RESULTS
All participants made at least one diary entry (max 5, mean 2.6, s.d. 1.78). The relatively low number of entries is perhaps unsurprising given that information encountering is rare and that participants were working on multiple dissertation activities during the diary study period, not just their literature reviews. In this section we present our findings on value creation (4.1), motivators to value creation (4.2), barriers to value creation (4.3) and actions taken to create value (4.4). Each section includes a classification of that aspect of our emergent framework, and examples for each axis of the classification. We summarise our findings in section 4.5.

Value of information encounters
Participants’ experience of the value of their information encounters can be classified according to both their expectation of value and the reality—the perceived actual value. Value is a subjective assessment made by participants, and the classification we present here reflects participants’ views. The value gained from encounters was relatively modest (e.g. new insights or knowledge to inform a literature review or study approach). Participants noted their encounters as useful nonetheless, as they seemingly happened without much (or any) effort.

Participants expected the information might either be useful for a specific purpose or for a vague/unknown purpose. In reality, the information was either deemed useful for several specific purposes, for the specific purpose they initially thought it might be useful for or for a different specific purpose. Sometimes the information was deemed not useful after all, or value had not yet been created from the encounter (not yet happened).

Table 1 combines participants’ experiences of expectation of value (‘expectation’) and actual value (‘reality’) to show that expectations may be surpassed, met, not met yet or not met.

<table>
<thead>
<tr>
<th>Expectation</th>
<th>Reality</th>
<th>Nº of entries</th>
<th>Expectation met?</th>
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<tbody>
<tr>
<td>Useful for a specific purpose</td>
<td>Useful for several specific purposes</td>
<td>2</td>
<td>Surpassed</td>
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<tr>
<td>Useful for a specific purpose</td>
<td>Useful for that specific purpose</td>
<td>12</td>
<td>Met</td>
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<tr>
<td>Useful for a specific purpose</td>
<td>Useful for a different specific purpose</td>
<td>3</td>
<td>Surpassed or met</td>
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<tr>
<td>Useful for a specific purpose</td>
<td>Not yet happened</td>
<td>5</td>
<td>Not yet met</td>
</tr>
<tr>
<td>Useful for a specific purpose</td>
<td>Not useful</td>
<td>2</td>
<td>Not met</td>
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Specific purpose | Useful for vague/unknown purpose | Useful for several specific purposes | Useful for a specific purpose | Not yet happened | Not useful | Surpassed | Met | Not yet met | Not met |
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<tr>
<td>P1 encountered an interesting comic strip when browsing her Facebook feed</td>
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| Table 1: Expectations vs. reality |

**Expectations surpassed**

**Better book: useful for a specific purpose**—useful for several specific purposes: P1 was searching the library catalogue for a specific book recommended to her by her dissertation supervisor. Based on the publisher's description she was concerned about the readability of the book, and felt something more readable might be a better choice. While the library did not stock her target book, an ebook with a similar title caught her eye and by reading excerpts she decided it was a better match for her information need than her original target. The book provided a readable overview of her topic and was also useful for helping her to write her literature review and for designing her questionnaire-based studies. She commented: ‘I didn’t expect it to have interviews, I expected it to be just explaining concepts. Those interviews gave me practical knowledge for my methodology. It was really helpful for designing my approach.’ Her expectations were surpassed.

**Comic connection: useful for vague/unknown purpose**—useful for several specific purposes: P1 was ‘aimlessly’ scrolling through her Facebook feed when she noticed a post by Joseph Gordon-Levitt. The post contained a comic strip with a distinct, familiar style of illustrated characters (Figure 1). Upon zooming, she discovered it was signed by an artist she knew and contained a link to his website. This pleased her: ‘the useful bit is that it gave me the actual link of the artist’. While browsing his website, she discovered the artist had an online shop. This delighted her as she had previously seen his work on Tumblr and wondered how to buy it. She considered printing comic strips of the website or buying them, but did not have the spare money. P1 did not know exactly how the comic strip would be useful when she first saw it, but after examining it in more detail and visiting the artist’s website and e-shop, she found it useful for several purposes.

| Figure 1: P1 encountered an interesting comic strip when browsing her Facebook feed |

**Expectations met**

**High School musical: useful for a specific purpose**—useful for that specific purpose: P5 was browsing an events website looking for Cirque du Soleil tickets as an anniversary present for her boyfriend. While there, she noticed Kadanza, a featured junior musical; she thought tickets would make an excellent eighth birthday gift for her niece: ‘there’s a different junior musical each year. My niece liked it so much last year she bought the DVD. So that’s why I thought we could go again.’ Before examining the encountered information on Kadanza in detail, she found Cirque du Soleil tickets and booked them. She then returned to the Kadanza page, read the show description, and booked tickets. When she encountered the information on Kadanza, she immediately thought it might be useful as a gift for her niece and this turned out to be the case. P5’s expectations of the usefulness of the encountered information were met.

**Elusive equation: useful for a specific purpose**—useful for a different specific purpose: P7 needed help solving a complex mathematical equation; although he did not expect to find a solution online, he did hope for guidance. While looking for papers and books that might help, he found a reply to a blog post asking for help on a similar equation. While the reply only mentioned literature P7 had seen, the reply also mentioned its author was trying to solve exactly the same equation as P7. P7 contacted the author of the reply via LinkedIn; he had not solved the equation but shared a Dropbox folder of papers with P7. P7 had previously been unable to access many of the papers in the folder and found them useful for his literature review. While P7 thought the encountered blog post may help him solve the equation, instead it helped with his literature review—a different outcome than he anticipated, but useful all the same.

**Olympic beach: useful for a vague/unknown purpose**—useful for a specific purpose: P7 noticed new barriers going down the staircases at Queen Elizabeth Olympic Park in London. This led him to wonder whether there were to be any events at the venue in the near future: ‘maybe there will be a concert, maybe something interesting.’ When he got home, he checked the Olympic Park website and noticed there was to be a cycling race soon. His eye was caught by a snippet of information about turning part of the park into a temporary beach. He clicked the link above the snippet to find out more and thought to himself ‘it’s been here for three months and I didn’t notice!’ One weekend, he visited the beach and enjoyed it, sending photos to friends back home in Italy to
show them he also has a beach in London. He thought the urban beach would be worth visiting and his expectations were met.

1.1.1 Expectations not yet met

Passport to London: useful for a specific purpose—not yet happened: While booking tickets from Brussels to London on the Eurostar rail website, P5 noticed a carousel advertising free entry to a number of London museums with the purchase of a train ticket. As she likes to visit museums, P5 clicked for more information and discovered ‘you can go to galleries that I didn’t even know existed in London. So it was pretty interesting to know.’ The page mentioned a few attractions she would like to visit, but she was not sure if she would have time; she made a mental note of these attractions and booked her train tickets. The information she had encountered had the potential to be useful but this potential had not yet been realised.

Storyboard studies: useful for a vague/unknown purpose—not yet happened: P2 was searching for a basic overview of the HCI storyboard technique on the web. She clicked on the ‘Usability Body of Knowledge’ website which contains an overview of many HCI topics, including storyboards. While browsing the site, she noticed a section on ‘published studies’ on storyboards. She commented ‘I was really generally looking for information on storyboards to get a basic overview. So I didn’t expect it to have other public [sic] studies in there. That’s why I thought it was kind of serendipitous, because I wasn’t seeking out academic papers.’ P2 followed the links from the website to several of the published studies and made notes on one paper in particular. She commented ‘I don’t know how much I’ll actually end up using it, but it was an interesting paper to read. It may feed into my literature review.’ There is still potential for the encountered information to be useful, but in this case, time will tell.

The encounter did lead to information of potential objective value - P2 was able to tell her friend the movie was not real. But her expectation of seeing a movie she would enjoy was not met.

False Identities: useful for a vague/unknown purpose—not useful: P2 was ‘mindlessly’ browsing her Twitter feed when she noticed an article by Patrick Smith, an online journalist. The post was entitled ‘this is why people create false identities on the Internet’ and included a link to a BuzzFeed article on the topic (figure 3). A month earlier, P2 had read an interesting blog post about false identities and commented that this was one of the reasons she clicked on the link. She stated ‘it wasn’t anything I was looking for, but it was an article that looked like it may be interesting, without me seeking it out particularly.’ She started reading the article, but soon ‘lost interest’ and commented that this article was not as interesting as the blog post she had read a month ago. Her expectations of usefulness were not met.

Figure 2: The poster for a fake movie P2 wanted to see

Expectations not met

True or Hocus Pocus?: useful for a specific purpose—not useful: P2 saw a poster advertising a movie—Hocus Pocus 2—on Facebook (figure 2). She was excited, as she had enjoyed the first film: ‘the poster popped up on my feed and I really, really liked the first movie. So immediately I was very excited when I saw that.’ When she investigated further, however, she discovered it was a hoax. Later that day, her friend texted her the very same poster (as she had also encountered it online). P2 broke the news to her friend that the poster was a fake. P2 expected the encountered information to lead to her watching a sequel to a beloved movie but her expectations were not met. Interestingly, the encountered information was deemed to be more potentially useful than continuing to pursue the initial information goal.

Figure 3: P2 encountered an article on false identities (right), linked from a Twitter post (left) but soon lost interest in it

Motivators for value creation

We identified several motivators for creating value from encountered information. These are described in Table 2 and, like in the previous section, illustrated with serendipity stories.

<table>
<thead>
<tr>
<th>Motivator</th>
<th>Explanation</th>
<th>Nº of entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>More promising than initial goal</td>
<td>The encountered information was deemed to be more potentially useful than continuing to pursue the initial information goal</td>
<td>2</td>
</tr>
<tr>
<td>Likely to address existing goal</td>
<td>The encountered information was deemed to have potential to address an existing (but not the initial) information/life goal</td>
<td>5</td>
</tr>
<tr>
<td>Likely to enhance knowledge</td>
<td>The encountered information was deemed to have potential to provide new knowledge or enhance existing knowledge</td>
<td>8</td>
</tr>
<tr>
<td>Likely to be useful for someone else</td>
<td>The encountered information was deemed to be potentially useful to someone else, based on knowledge of their interests</td>
<td>2</td>
</tr>
<tr>
<td>Relates to existing interest</td>
<td>The encountered information was deemed to be related to one of the participant’s existing interests</td>
<td>13</td>
</tr>
<tr>
<td>Likely to be</td>
<td>Participant expected pursuing the</td>
<td>5</td>
</tr>
</tbody>
</table>
More promising than initial goal: P7 initially searched for a book on non-linear acoustics for his dissertation but stumbled upon an interesting paper that provided an introduction to acoustics. He decided to stop searching for the book and to make use of the encountered paper in his literature review.

Likely to address existing goal: P2 needed some new outfits. She noticed an ad for clothing shop Topshop on her mobile Facebook feed, which appeared because several of her friends had ‘liked’ Topshop on Facebook. The ad featured a ‘limited edition’ clothing line which she was not previously aware of. As the link did not work on her mobile, she visited the Topshop website when she got home and looked at various products. She bought a dress from the clothing line in the ad and, when it arrived, liked it so much she ordered several other items from the same line. This addressed her existing life goal of needing new outfits (in an unexpected way).

Likely to enhance knowledge: P1 was searching the web for information on designing web pages for emotion and stumbled upon an article entitled ‘10 Cool Things that HTM Tags Can Do’ (entry 2). She commented that in her future career as an HCI designer ‘I may have to brief developers on website design, so I should know what basic HTML can do. Maybe it will be helpful to me in the future at some point.’

Likely to be useful for someone else: P7 had a friend in Switzerland whose office was relocating to London. Her friend was trying to decide if she should relocate or not and wanted to gain an overview of how the UK tax system worked. P7 offered to help find this information out and searched the web for general information. Although she was not looking specifically to estimate the amount of tax her friend was likely to pay if she decided to relocate, she came across a UK tax calculator website. Her friend found the calculation from the site useful for making her decision.

Relates to existing interest: P2 came across both a news article on false identities, which was a topic she had previously read about and a fake poster advertising a sequel to a movie she loved.

Likely to be enjoyable: P11 came across information on a band he had heard of but not listened to before, as it was only partially related to his musical tastes. Although he said he may not end up listening to them again, he ‘ended up listening to that band for the next hour’.

Barriers to value creation
Three barriers to value creation from encountered information emerged from the data (Table 3). These were: insufficient time to pursue the encountered information, no current use for it and the information not being as useful as they first thought.

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Table 2: Barriers to Value Creation

<table>
<thead>
<tr>
<th>Barriers</th>
<th>Explanation</th>
<th>Nº of entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient time</td>
<td>Participant did not feel they had sufficient time to pursue the encountered information</td>
<td>10</td>
</tr>
<tr>
<td>No current use</td>
<td>Participant could not currently think of a use for the encountered information</td>
<td>3</td>
</tr>
<tr>
<td>Not as useful as</td>
<td>After examining it in more detail, the participant did not think the encountered information was as useful</td>
<td>5</td>
</tr>
</tbody>
</table>

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Table 3: Motivators for Value Creation

More promising than initial goal: P7 initially searched for a book on non-linear acoustics for his dissertation but stumbled upon an interesting paper that provided an introduction to acoustics. He decided to stop searching for the book and to make use of the encountered paper in his literature review.

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Barriers to value creation
Three barriers to value creation from encountered information emerged from the data (Table 3). These were: insufficient time to pursue the encountered information, no current use for it and the information not being as useful as they first thought.
Participants examined the information they encountered, reading text and viewing images and video. They examined text in various levels of detail, ranging from reading every word to skimming. Referring to her ‘morning routine’ of reading the BBC News site, P5 explained ‘I don’t read the entire website, I just go through the whole website reading the titles.’

In many cases, participants gathered additional information related to the encountered information to determine if it would actually be useful and how by searching or browsing. For example, P11 browsed the biography of a new band he encountered information on before listening to them.

P7 contacted someone who replied to a blog post he encountered, resulting in sharing resources (see section 4.1.2. for more detail). Some participants bought a product they encountered or added it to a wishlist; e.g. P2 bought the ‘limited edition’ dress featured in the Facebook ad she encountered (along with several other items from the same clothing line). P1 saved an offline copy of the eBook she encountered on ‘designing for emotions’. P7 shared the tax calculator site she encountered with her friend in Switzerland who wanted to understand the UK tax system. Several participants bookmarked the encountered information for later review (e.g. P13 bookmarked a wedding gift for a friend).

Some participants continued to monitor the source of encountered information to see if it would result in additional interesting information. For example, P5 made it part of her morning routine to browse the BBC Food website in addition to BBC news, after encountering a tapas recipe that ‘went down well’ with her friends.

Some participants also opened the encountered information in a new browser tab for later review, continuing their original information task in the meantime. For example, P2 opened the paper she encountered on storyboarding in a new tab, skim-reading it after she finished browsing the ‘Usability Body of Knowledge’.

Several participants made a mental note to make use of the encountered information at a later time. For example, P1 encountered information about design and innovation consultancy firm IDEO when browsing a Wikipedia article on her dissertation topic of ‘empathetic design’. She was pleased to find out from the article that IDEO were also interested in the topic, as she had considered applying for a job with them. She made a mental note to incorporate the encountered information into a cover letter when applying for a job at IDEO, which she did a few days later.

Bringing it all together: Expectation vs. reality, motivators, barriers and actions
Some information encounters involved multiple motivators, barriers or actions. For other encounters, participants did not identify explicit motivating factors, barriers or actions (perhaps because some time had passed between the encounters and the follow-up interview). Across these axes, many combinations of expectation and reality can and do exist. We illustrate these complexities with an example from our interviews.

Information intersection: P6 was hoping to develop a collaborative information visualization tool for his dissertation, but had not yet chosen a domain to focus on. While searching online for collaborative InfoVis tools, P6 remembered he had previously taken a class with InfoVis researcher Marian Dörk. He decided to look for articles by Dörk in the hope they would provide examples of tools. He came across a paper entitled ‘Urban Co-Creation’ by Dörk and Monteyne, on digital tool support for urban civic participation. He stated ‘weirdly enough I found this paper which isn’t really about visualization as such, but about urban planning and how urban co-creation can be supported by digital tools.’ P6 did not read the paper in detail, but had the idea of adopting the domain of urban planning for his collaborative InfoVis tool. He commented: ‘I thought about urban planning as a domain to place my interest in and that the article supported me in that idea.’

P6’s expectation was that the article would be useful for the specific purpose of informing his domain choice. In reality this had not yet happened, as he did not have sufficient time (barrier) to read the paper in more detail. However, he took the action of making a mental note to read it thoroughly when writing his literature review as it had the potential to enhance his knowledge (motivator) and to address his existing goal (motivator) of choosing a domain to focus on.

As highlighted by this example, information encounters are complex and context-sensitive. Factors such as time, available tools and mindset interact to determine whether, for an individual encounter, the encounter’s expectations of value will be met. What is consistent is information encounters do not end when serendipity strikes, they are only beginning; after a ‘happy information accident’, information seekers must work to generate value from the encounter.

DISCUSSION
In this section we will relate our findings to previous work (and discuss design implications).

Relation to previous work
Previous work on serendipitous information acquisition has emphasised that the most successful information encouters ‘make their own luck’ (Foster & Ford, 2003; Makri et al., 2014). Our work has emphasised that the desire to make one’s own luck is not just a precursor to serendipity, it is also a determinant of it. This study has shown that to get value out of information encounters that are deemed post-hoc serendipitous (Makri & Blandford, 2012a, 2012b), encounterers need to work for it. Not one participant in this study had an experience where an encounter generated value without some effort on their part; in some cases, the effort expended was considerable -

| Monitor | Participant continued to monitor the encountered information source in the hope of additional value creation | 4 |
| Open in new tab | Participant opened the encountered information in a new browser tab for later review, continuing their original information task in the meantime | 3 |
| Make mental note | Participant made a mental note to make use of the encountered information later | 4 |

Table 4: Actions Taken to Create Value
spanning multiple digital information tools and even involving personal contact.

Expending effort was no guarantee of success, however; many encounters resulted in expectations that remained unmet. Conversely, some encounters resulted in information or experiences that exceeded participants’ expectations. The concept of ‘expectation’ during information acquisition has been highlighted as important by both Kuhlthau and Marchionini. Kuhlthau (Kuhlthau, 1991) explains that people develop expectations of information as they interact with it, making predictions of potential relevance. This implies that users must also test their predictions to see if they are borne out in reality. Marchionini (Marchionini, 1997) explains that people may not always know what the precise information to satisfy their information need will be, but will have an expectation of what it might ‘look like’—e.g. a fact, idea, interpretation. In both of these models, people have pre-defined information needs and their assessment of whether their expectations are met involves making relevance judgments. McKenzie’s model (McKenzie, 2003) alludes to both this more formal relevance assessment, and a less structured approach where information seekers do not know what they will find. But these previous models do not account for how value is determined.

Our work identifies a similar judgement process for information encounters; sometime after encountering information, people will make a decision on whether their expectations of value are met. Consistent with a previous study [redacted], we found participants’ assessment of usefulness of information encountered was highly subjective. Even in instances where an encounter could be objectively considered to have delivered value—such as knowing the Hocus Pocus 2 poster was fake—participants’ own assessments were what determined the value to them.

The motivators, barriers and actions identified in our study are not new; all have been discussed in the context of information-seeking and some in the context of information encountering. For example, information and entertainment have been discussed as intrinsically linked (Cermak, 1996). IE has been found to result in knowledge enhancement (Makri et al., 2015; Makri & Blandford, 2012a, 2012b), time has been discussed as important context for information-seeking behaviour (Savolainen, 2006) and monitoring sources has been identified as an important information behaviour (Ellis, 1989; Makri, Blandford, & Cox, 2008; Meho & Tibbo, 2003) and a means of encountering information (Makri & Warwick, 2010). Gathering more information to determine usefulness is similar to the notion of ‘confirming’ or ‘disputing’ the encountered information (Napier & Hoang Vuong, 2013). What is new in our work is that we discuss these features in relation to the value gleaned from an information encounter. The actions we identified complement and extend Erdelez’s model of information encountering (Erdelez, 2005). In this model, after encountered information is noticed and examined, it is captured. We found users both saved and bookmarked encountered information, as well as ‘capturing’ it mentally. Other actions we identified (e.g. gather, buy, monitor, contact, open in new tab) are alternative routes users might follow other than, or in addition to, capturing. Encountering information that might be useful for others (and sharing it) has been identified in previous studies (D’Antonio et al., 2012; Erdelez & Rioux, 2000), but to our knowledge has not been discussed as a motivator for value creation.

Finally, our study crosses a crucial boundary in information behaviour research: many information behaviour studies are of academics (e.g. (D’Antonio et al., 2012; Foster & Ford, 2003; Kleiner et al., 2013; Sun et al., 2011)). McKenzie (McKenzie, 2003) notes that academic or work-related information behaviour is likely to be notably different from ‘social’ information seeking, and presents a model of non-professional information seeking that is quite different from traditional models of information behaviour (e.g. (Bates, 1989; Kuhlthau, 1991; Marchionini, 1997)). Our work captures information encounters in both contexts, and there is not a notable difference between them in terms of value creation behaviour. This is, in and of itself, a notable finding.

**Design implications**

Digital information tools are beginning to offer support for information encounters in dedicated and meaningful ways (e.g. (Kleiner et al., 2013; Thudt et al., 2012)). However, most existing tools are focused on facilitating serendipitous information discovery, not use (and thus value creation).

Our value creation framework of value creation can be leveraged by designers of digital information tools on all four axes: the reality/expectation gap, motivators and barriers, and (perhaps most readily) actions. Tools could support users in reasoning about the subjective value created from their information encounters; they might encourage users to reflect on whether and how their subjective expectations of value match reality, by asking themselves questions such as ‘do I (still) think this information is likely to be useful? For what purpose(s)?’ ‘are there any actions I can take (now or in the future) to create some or more value from this information encounter?’ and ‘did this encounter meet my expectations?’

Technology can also support users in tracking and exploiting the value created from the information encountered—enabling them to review and reflect on encountered information. This is with the aim of supporting them in bridging the gap between expectation and reality (where feasible, desirable and practical). Tools might support users in the capture of encountered information (e.g. by saving it on the cloud) and in reviewing it to decide whether to follow-up on it, discard it or decide later. When capturing encountered information, tools might allow users to annotate and highlight it to remind themselves of its potential value and, when users are deciding whether to follow-up on it, tools might present them with useful contextual information (such as the date and time the information was encountered, links to the other documents or webpages they accessed during the same information interaction session and their own and other users’ annotations and highlightings).

To augment some of the motivators for value creation we identified, tools might support users in sharing encountered with others when they think it is likely to be useful for someone else. They might also support users in relating the encountered information to their existing interests by suggesting previously accessed documents or webpages that are to some extent topically
related to the encountered information or by allowing users to categorise, sort and review encountered information by interest.

To overcome some of the barriers we identified, tools should enable quick and easy capture and review of encountered information. This would address the time barrier, as the more effortless the process the more likely users will invest their limited time. Facilitating the review of encountered information can also support users in determining if there is current use for it (in which case, they should be supported in following up on it), potential future use for it (in which case, they should be able to set up alerts to review the information again later) or no use for it (in which case, they should be able to rapidly discard it).

While it is not possible to ‘force’ value from an information encounter, digital tools can assist users in taking both the information management and information assessment actions required for an encounter to become valuable. As mentioned above, tools can support users in easily capturing information. They should also make it easy for users to review and discard captured information. In terms of information management, digital information tools can help with contacting authors of encountered information, monitoring information sources, annotating information and deferring consumption (thus avoiding the need for a new tab). Many of these facilities already exist in some information tools, but bringing them together to create (for example) one click capture, review, highlighting and annotation would minimise the time that users spent distracted from whatever they were doing when serendipity struck and could potentially justify a time investment in pursuing the encountered information.

A capture tool for encountered information is most likely to be successful if it balances simplicity of capture with ease of review. Users should not be required to categorise or annotate information by default, but it should be easy for them to do so (and to edit their categorisation schemes and annotations) if desired. Design inspiration can be sought from existing web capture tools - from browser extensions (e.g. Evernote Web Clipper) to annotation tools (e.g. Microsoft OneNote and Google Keep).

CONCLUSION
Information encountering is a richly satisfying information experience. It happens unexpectedly and seemingly without effort. It can facilitate new connections and spark ideas. It is an exciting, delightful experience, even for relatively modest information gains. However, for an information encounter to be experienced as serendipitous, the encounter must take action to generate value from it (Makri & Blandford, 2012a); this paper is the first, to our knowledge, that considers in detail what happens after serendipity strikes. It is clear from our work that users’ efforts post-encounter can be either simple (making a mental note) or complex (making a new contact or interacting with several digital information tools). These processes occur within a framework of expectations and outcomes, motivators barriers and actions. This empirically-grounded framework is the major contribution of this paper.

This framework can be leveraged not only to describe information encounters and reason about their subjective value, but also to relate information encountering to other types of information acquisition and to make suggestions for the design and improvement of digital information tools.

Such tools could support users in: bridging the gap between their expectations of value and the reality, augmenting the factors that motivate value creation, overcoming barriers to value creation and supporting actions associated with value creation. By designing tools that more adequately support the creation of value from encountered information, we can maximise opportunities for users to make the most of their ‘happy information accidents.’

ACKNOWLEDGMENTS
Our warmest thanks go to our participants.

REFERENCES


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