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Online information encountering: modeling the process and influencing factors

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Abstract

Purpose – Information encountering is the serendipitous acquisition of information that requires low or no involvement and expectation of users. The purpose of this paper is to model the explicit process and the implicit factors of online information encountering, i.e. how and why it occurs.

Design/methodology/approach – The critical incident technique was adopted to collect qualitative data from 16 interview participants. They contributed 27 true incidents of online information encountering which were used to identify the key phases of the encountering process. They also commented on the factors that they thought had an influence on the chance of the occurrence of encountering.

Findings – The macro-process of information encountering is composed of three phases. First, browsing, searching, or social interaction provides the context for encountering; second, the encountering occurrence consists of three steps – noticing the stimuli, examining the content, and acquiring interesting or useful content; and third, the information encountered will be explored further, saved, used, or shared. The 14 influencing factors of information encountering obtained divide into three clusters. User-related factors include sensitivity, emotions, expertise, attitudes, intentionality, curiosity, activity diversity; information-related factors include type, relevance, quality, visibility, and sources; and environment-related factors include time limits and interface usability.

Originality/value – This study engenders useful implications for designing information encountering experience. The changeable nature of some influencing factors suggests that encountering can be elicited through the purposive design of encountering support features or even encountering systems, and the macro-process depicts the natural occurring mechanisms of encountering for the design to follow.

Keywords Serendipity, Information encountering, Model, Process, Factors

Paper type Research paper

Introduction

Although serendipity is unpredictable, unreliable, and uncontrollable, its value has long been recognized. Everyone may experience the accidents of finding something good or useful while not especially searching for it. Serendipity has been widely explored in many different disciplinary areas. It is considered an integral part of the creative processes in arts and humanities, social sciences, and sciences (Foster and Ford, 2003). The essence of

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serendipity not only consists in the "accidental nature and the delight and surprise of something unexpected," but also the "breakthrough of discovery made by drawing an unexpected connection – the sagacity" (André *et al.*, 2009).

People often find information, notably, in virtue of serendipity. When information acquisition is not planned or anticipated, it is referred to as "information encountering": it is characterized by people's low or no involvement in looking for the information acquired and by their low or no expectation of acquiring such information (Erdelez, 1995). The encountered information may not only derive from information seeking activities, but also everyday routine activities (Erdelez, 1999). In the era of information explosion, the prosperity of web technologies makes an abundance of information easily accessible anywhere anytime. Humans' daily lives and professional work will be inevitably affected by the information that comes to them just by chance (Heinström, 2006).

In library and information science (LIS), the research interest in information encountering is more recent as compared to the overwhelming interest in people's information-seeking behavior, i.e. purposive acquisition of information in response to a recognized need or gap in their knowledge (Case, 2012). The past two decades witnesses a steady increase in the efforts devoted to investigate information encountering. LIS researchers have established a number of theoretical models (Erdelez, 1999, 2004; Lawley and Tompkin, 2008; McCay-Peet and Toms, 2010; Rubin *et al.*, 2011; Makri and Blandford, 2012a) and also provided respectable empirical evidence (Erdelez, 1995; Williamson, 1998; Ross, 1999; Toms, 2000; Foster and Ford, 2003; Heinström, 2006; Watson, 2008; McBirnie, 2008; Pálsdóttir 2010; Yadamsuren and Erdelez, 2010; Dantonio, 2010) for this specific area of investigation.

The field of information encountering is just in its infancy. A considerable portion of the literature was dedicated to the description of the notion of serendipity. Serendipity in scientific discovery was reviewed extensively to elicit serendipity in information acquisition (Foster and Ford, 2003; Rubin *et al.*, 2011). Some defining elements of information encountering have been agreed upon, such as unintentional actions or unexpected locations, sagacious discoveries or connection making, and fortuitous yet valuable outcomes (Erdelez, 1999; Toms, 2000; McKenzie, 2003; Lawley and Tompkins, 2008; André *et al.*, 2009). The connection between information encountering and information seeking was explored in a couple of studies (Williamson, 1998; Pálsdóttir, 2010). Until very recently, researchers were still identifying the facets of serendipitous encounters (Rubin *et al.*, 2011) or seeking a framework to classify examples of serendipity (Makri and Blandford, 2012b). Other empirical studies on information encountering made innovative attempts in terms of research focus and method (Erdelez, 2004; Heinström, 2006; Rubin *et al.*, 2010; Makri and Blandford, 2012a).

There is no denying that the existing achievements in this field contribute to our understanding of what information encountering is. However, previous explorations of how and why information encountering occurs have not engendered a comprehensive and in-depth insight. The essential questions of "how" and "why" has been expressed as the process-perception duality of serendipity: the process aspect is "the doing" and the perception aspect is "the trying to observe" (McBirnie, 2008, p. 608). Processes are seldom completed exactly the way they are planned due to chance, so the unexpected happens a lot. With perception applied, as affected by individuality and pressures, the unexpected will be turned into serendipity. The introduction of this duality provided a useful grounding for related research.

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This study aims at adding to the literature an integrated investigation of the explicit process as well as the implicit factors of online information encountering. In particular, we use "online information encountering" to refer to any situations in which information is acquired accidentally on the web. This for one thing emphasizes the pervasiveness of information encountering by removing the limitation of single contexts adopted in other studies, such as pleasure reading (Ross, 1999), music listening (Leong *et al.*, 2005), or social media using (Dantonio, 2010). For another, it is acknowledged that the web is a dominating information source or tool in modern society. Encountering increases the convenience of information acquisition on the web by deemphasizing a consciously existing need, but such convenience also leads to that people encounter much more information than they can actually use (Stewart *et al.*, 2012). It is worth reflecting on how to help people effectively identify value and meanwhile avoid unnecessary distraction in the flood of web information.

For the purpose of modeling online information encountering, this study addresses the following research questions:

RQ1. What are the major phases that constitute an information encountering process?

RQ2. What happens during each constituting phase in the information encountering process?

RQ3. What are the major factors that influence the chance of the occurrence of information encountering?

RQ4. How does each influencing factor act on the occurrence of information encountering?

Obviously, the answers to the first two questions are important to clarifying the process aspect of the duality while the other two questions relate to the perception aspect. By taking both aspects into account in the same research framework, we are able to dive into the core of this specific human information behavior.

Literature review

Understanding information encountering

One basic aspect of information behavior is the way in which people find information, and encountering has always been among the ways mentioned by LIS researchers though with various terminologies. Kirkelas (1983) defined casual information gathering 30 years ago. The gathering of information refers to the activities dealing with deferred needs, and casual gathering lacks a goal or a purpose. Marchionini (1995) characterized different types of browsing according to the specificity of the object sought, with casual browsing showing the lowest specificity. Wilson (1997) identified passive attention as a mode of information acquisition that took place without intentional seeking. Undirected viewing, one of the four scanning modes in Choo (1999), featured scanning broadly a diversity of sources and taking advantage of what was easily accessible. Considering two dimensions – the degrees to which an individual sought information actively and directionally, Bates (2002) distinguished four information seeking modes. Being aware, the passive undirected mode, is simply absorbing random information that comes by. The model of information practices presented by MaKenzie (2003) also included the mode of non-directed monitoring that involved serendipitously encountering and recognizing a source in an unlikely place.

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Focussed research on information encountering have led to a clearer interpretation of this aimless and effortless pattern. What makes the acquisition of information serendipitous? This is probably the most thoroughly addressed question in the literature. Makri and Blandford (2012b) suggested three dimensions which jointly determined the strength of serendipity. They are the unexpectedness of the circumstances, the insightfulness of the connection making, and the value of the outcome. The first dimension had been explained in two different manners. One is "arriving at an unexpected destination": the information encountered is of unexpected value. The other is "arriving at the right destination by a wrong boat": the information is encountered in unexpected locations or places (Foster and Ford, 2003). The connection making in the second dimension comprises two steps. Connections need to be made first, with information sources (MaKenzie, 2003) and then between data and theory (Lawley and Tompkins, 2008). In addition to chance, a prepared mind and an act of noticing are indispensable to successful connection making (Rubin *et al.*, 2011). With respect to the third dimension, the value of the outcome consists in its potential to either reinforce or strengthen people's existing problem conception or solution or to take them in a new direction in which the problem conception or solution is re-configured in some way (Foster and Ford, 2003, p. 303).

What are the relationships between serendipitous and purposive information acquisition? This question has also aroused a lot of discussion among researchers. It is believed that a person always has multiple discrete problems at a certain time point and he or she has to assign priorities to the problems because of the limitations of human perceptual system (Erdelez, 2004). While information seeking attends to foreground problems, information encountering background problems. So the latter usually happens during the process of the former (Heinström, 2006). In digital information spaces, especially, browsing or searching activities provide the context for serendipitous information acquisition (Toms, 2000). Encountering occurrences are most frequently seen in serendipity browsing, and serendipitous findings are considered one of the consequences of browsing (Rice *et al.*, 2001). It is also possible that the purposeful searching on a given topic induces the encountering of information on another topic (Erdelez and Rioux, 2000), though there is a growing concern that the ever-improving search engines will reduce the chance of serendipitous encounters (Foster and Ford, 2003).

Modeling the process of information encountering

The earliest model of the information encountering process can be found in Erdelez (2000). It was proposed that a typical information encountering episode embodies five functional steps: noticing, stopping, examining, capturing, and returning. Assuming that information encountering is embedded within a high-level process of information seeking, this model describes a sub-process in which a person perceives information relevant to the background problem, interrupts the initial information seeking activity, assesses the usefulness of that information, extracts that information and saves it for future use, and reconnects with the initial activity for the foreground problem (Erdelez, 2004).

Another process model was developed by McCay-Peet and Toms (2010) in the context of knowledge work. It was adapted from Cunha's model of serendipity process that consists of four components, i.e. search for solution to Task A, precipitating conditions, a bisociation between previously unconnected pieces of information, and an

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unexpected solution to Task B. McCay-Peet and Toms (2010) added "triggers" to the model as a necessary element for activating the bisociation, though the triggers may be unseen or ignored. They further included an unexpected solution to Task A in the model to imply that both sought and unsought discoveries have their value. The precipitating conditions of serendipity were emphasized, especially active learning and social networks.

Lately Makri and Blandford (2012a) established a more abstract model according to interdisciplinary researchers' related experiences in their research work or everyday lives. The process begins with a mental connection made between a need and something with the potential to address the need. It is then followed by a cyclic sub-process of forward-facing projections of the potential value of the outcome, taking actions to exploit the connection and resulting in an outcome that addresses the need in an unanticipated way, and backward-facing reflections on the value of the outcome. Finally, the whole experience can be regarded as serendipity given both the value of the outcome and the involvement of insight. The authors made references to the perceptual model of serendipity by Lawley and Tompkins (2008) which used the confusing notion of "event" that might overlap "outcome."

As a matter of fact, information encountering by itself is often treated as an incident of information acquisition that merely occupies a transitory moment in time. Only active information seeking, i.e. searching and browsing, is deemed "process-oriented" information acquisition (Erdelez, 1999). According to McBirnie (2008), the process aspect of information encountering largely relies on the underlying process of information seeking or other routine activities. Hence researchers were apt to equate the process of encountering with the underlying process.

Identifying the factors behind information encountering

Erdelez's (1995) doctoral dissertation presents the first significant empirical study in the field of information encountering. Using qualitative methods, she characterized encountering from the dimensions of user, environment, information, and need. These four elements constitute her anatomy of information encountering experience (Erdelez, 1999). The chances that different users encounter information vary, so there are "non-encounterers," "occasional encounterers," "encounterers," and "super-encounterers." They encounter information in libraries, on the internet, during social interactions, or almost everywhere. The information encountered divides into two primary categories, problem-related and interest-related, and can be used to satisfy past, current, or future needs.

It is thought that the user element plays the most important part in information encountering (Heinström, 2006). A person is unable to seize the valuable information coming by if he or she lacks psychological, receptivity. Thus Heinström (2006) especially explored three psychological aspects, i.e. personality traits, studying motivation, and emotional states, to determine their impacts on information encountering. Her major findings, based on three independent surveys involving students from different populations, indicated that an energetic personality, high motivation, and positive emotionality would enhance the likelihood of encountering.

The role of the environment element has attracted some attention too. It is noted that social media conduces to social navigation and information exploration. According to Dantonio (2010), social media is also a favorable environment for encountering. She detected through the interviews with 15 post graduate students a correlation between the knowledge of social media tools and the chance of

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experiencing serendipity in such environment. The participants not only encountered information on social media for the benefit of academic research, but also frequently shared information to create serendipitous moments for others, including unknown people.

The discussion of the influencing variables of information encountering is only sporadic in the rest of the literature. For instance, Williamson (1998) stated that people had a strong desire to be informed about various topics in their everyday lives and this was mediated by their cultural backgrounds and physical environments as well as their personal characteristics such as lifestyles and socioeconomic situations. Other factors ever mentioned are mainly related to the user element, such as prior knowledge (Toms, 2000), attitudes, and cognitive styles (Foster and Ford, 2003).

There is no denying that some valuable efforts have been devoted to reveal the process of information encountering and the factors behind it. However, the quantity of pertinent studies is still very small. More importantly, it should be noticed that these studies present quite different research settings while the general use of the web has not been explicitly introduced as a specific setting for investigating related phenomena. As a result, former findings may have limited usefulness for understanding the "how" and "why" aspects of online information encountering.

Method

A wide variety of methods have been seen in previous research on information needs, seeking, and use (Case, 2012). In particular, the investigations of users' online information seeking behavior usually rely on web server logs or controlled experiments to capture the behavioral data. The former is an unobtrusive approach that records users' clicks, inputs, and other actions in sequence when they interact with the web (Jansen, 2009), whereas the latter assigns real or simulated tasks to users so that researchers can observe how they utilize the web to complete the tasks (Case, 2012). Neither of these data collection methods, however, is directly applicable to this study. Web server logs contain trace data that can be used to infer users' behavior, e.g. searching behavior represented by query submissions, but encountering is passive behavior which is not clearly represented by any type of data and thus not easily recognizable in log files. Controlled experiments of information encountering are confronted with many methodological challenges, especially the difficulty of imposing proper levels of control regarding the user, environment, and task variables, as evidenced by an unsuccessful attempt to create controlled research design for evoking an encountering episode (Erdelez, 2004).

Out of the above considerations, we employed the critical incident technique (CIT) to collect qualitative data from interview participants. As described by Flanagan (1954), the CIT "outlines procedures for collecting observed incidents having special significance and meeting systematically defined criteria." The CIT is a primary confessional method for collecting direct observations of human behavior in the information seeking literature (Davenport, 2010). More recently, it was used to study social search (Evans and Chi, 2008), collaborative information seeking (Reddy and Spence, 2008), high-school students' information seeking and evaluation (Julien and Barker, 2009), and university faculty's scholarly article seeking and reading (Tenopir *et al.*, 2009), etc.

We conducted critical incident interviews with 16 members (six males and ten females) of the Association of Information Literacy, Wuhan University. They had participated in digital information literacy skills training courses or competitions which

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endowed them with a better understanding of online information seeking. All of them were senior students, and their majors included information management and system, library science, and electronic commerce. Each interview proceeded in three steps. First, the researcher provided a brief description of information encountering according to Erdelez's (1995) definition of the concept. Second, the participant as requested spent some time recalling recent or impressive incidents of online information encountering and then recounted them in as much detail as possible. Third, the researcher made a semi-structured conversation with the participant in order to elicit the factors affecting the chances of encountering. The conversation was loosely guided by three questions: what the factors are, how they work, and why they work that way.

It turned out that the participants were quite interested in our research topic and many of them shared two or more encountering incidents. The 16 participants contributed 34 incidents in total (see the Appendix). The duration of the interviews ranged from 20 to 30 minutes, and all interviews were fully taped with the permission of the participants.

The first step is quite necessary in the whole process. It was found in our pilot study that the students seldom counted serendipity as a way of acquiring information, though they did come across information a lot on the web. So a definition and a couple of examples of information encountering were prepared to evoke the participants' memories of their own experience. This, however, could not ensure an accurate understanding of this concept due to limited time. Hence before data analysis we reviewed all of the 34 incidents to determine whether they were true encountering incidents. Our criteria consisted of the two basic characteristics of information encountering, i.e. low involvement and low expectation (Erdelez, 1995). Unfortunately, seven of the incidents were detected to be false, as attributable to the following reasons:

- The search results not according with one's expectation: I1 and I26. In these incidents, the participants explicitly indicated that they found the information through searching. They searched with articulable needs, but the results returned by the search systems were broader in coverage (I1) or better in quality (I26). The so-called "unexpected" results were pertinent to the initial needs. They were deemed to be unexpected largely because of the insufficiency of the participants' own expectations.
- Encountering problems instead of answers: I2, I3, and I13. While problems engender the need for information, answers satisfy such need. The participants confused them in these three incidents. What they encountered were actually single units of language (e.g. the word "OICQ") rather than information. Then their pursuit of the meanings of the language was accomplished through active searching or inquiring, rather than encountering.
- Unconscious expectations: I14. As P5 described it, "other hair accessories" were encountered when she was looking for a headband. It is common sense, however, that the headband is a type of hair accessories and usually sold together with other types. So the seeking of a headband implies the expectations of finding "other hair accessories," though not so obvious.
- Unexpected information content: I19. P8 joined the discussion about a movie just in hope of discovering interesting details of the movie, featuring high involvement and high expectation. But what these details were went beyond his expectation. He confounded the expectation of information acquisition with that of the content of the information acquired (Heinström, 2006).

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Results

Phases of the information encountering process

We analyzed the remaining 27 true incidents in order to identify the key phases of an information encountering process. Each incident was coded based on the facets of scenario, pre-activity, mid-activity, and post-activity. The scenario is the real-world context where information encountering takes place. The pre-, mid-, and post-activities, respectively, refer to the online activities that one engages in before, during, and after an encountering occurrence. Since multitasking is very common among web users, we carefully discerned the activities inherently connected with the occurrences. Table I shows the results of the multi-faceted coding.

The participants' everyday life and study provided the context for their online information encountering. Life-related scenarios, such as reading news (e.g. I16), enjoying music or movies (e.g. I32), shopping (e.g. I18), social networking (e.g. I21), or just killing time, accounted for the absolute majority of the incidents, though we did not deliberately direct the participants toward these aspects during the interviews. In contrast, looking for relevant papers for one's research project (I8) and looking for the answer to a question in one's course assignment (I17) typified study-related scenarios and they were problem-specific. It should be mentioned that I9 and I10 were a little complicated. While the information encountered in these incidents was study-related (thesis writing), the scenarios were life-related because Qzone and Renren were popular social networking services for Chinese young people to connect with friends.

The activities preceding the encountering occurrences mainly divided into browsing, searching, and social interaction. The term "browsing" was used here in its broadest sense. It might refer to browsing through web sites (including social media), jumping from one link to another, consuming all kinds of content, and

Scenario	Pre-activity	Mid-activity	Post-activity	Incidents
Life	Browsing	Acquiring interesting information	Exploring it further	I5, I6, I12, I16, I18, I28, I31, I34
			Saving it for future use	I29
		Acquiring useful information	Saving it for future use	I10, I20, I25
			Using it for existing needs	I9, I15, I22, I25, I32
			Sharing it with others	I9, I22
		Acquiring worthless information	Discarding it	I27, I30
	Searching	Acquiring interesting information	Exploring it further	I24
		Acquiring useful information	Using it for existing needs	I4, I7, I11
	Social interaction	Acquiring interesting information	Exploring it further	I33
		Acquiring useful information	Sharing it with others	I21
Study	Searching	Acquiring useful information	Using it for existing needs	I8
	Browsing	Acquiring useful information	Using it for existing needs	I17

Table I.
Multi-faceted coding of the true incidents

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performing all kinds of tasks, etc. Random browsing, i.e. without a specific goal, was particularly conductive to encountering (e.g. I12, I18, and I28). Searching as the pre-activity was just found in two of the incidents, in contrast. The explicit goals occupying the searchers might be overridden by implicit ones that were closely related (I8) or totally different (I24). Social interaction was found in the life-related scenario only (I21 and I33). Instant messaging services such as QQ facilitated the exchange of information between web users when they were building or maintaining their social ties online.

The mid-activities of an encountering occurrence were ephemeral and subtle. It was not surprising to see the incidents described in different ways and with different specificity, so we could only look for their commonest characteristics. Most incidents included the direct or indirect reference to noticing stimuli. For examples, the keywords "Chinese mother gold investors" in I5 and "DAO model" in I17 are stimuli. The response to the stimuli could either be continuing with the pre-activity and ignoring the stimuli (e.g. I30) or accepting the stimuli and stopping the pre-activity (e.g. I32). If the latter, one would proceed to examine the information content represented with the stimuli to determine its value. The information might be determined useful (e.g. I8), interesting (e.g. I18), or worthless (e.g. I27). Usefulness means that the information can help solve one's problems, and interestingness means that it caters to one's interests or expands one's horizons. If neither of these applies, the information is worthless.

The participants' examination of the information had a direct impact on their activities following the encountering occurrences. As inferred from the 13 incidents involving the acquisition of useful information, such information might be used for existing needs (e.g. I15), saved for future use (e.g. I10), or shared with others (e.g. I21). In particular, I9 and I22 suggested that the concurrence of immediate using and sharing was possible. As for the interesting information acquired, the incidents indicated an overwhelming tendency to explore it further, with an exception ending with saving it for future use (I29). Worthless information, without a doubt, could only be discarded (I27 and I30).

Factors influencing the occurrence of information encountering

In the next stage of analysis, we conducted open coding on the comments provided by the participants and sought for the factors encouraging or discouraging information encountering based on the grounded theory approach (González-Teruel and Abad-García, 2012). In total, 14 free nodes were obtained as a result, and three major tree nodes in turn emerged from them, i.e. the user, the information, and the environment. These factors will be specified below with their descriptions and example related comments. Especially, the frequency (n) of each factor is the number of comments related to that factor, indicating its significance.

User-related factors. Users play a dominating role in the processes of information seeking, and some of their characteristics are also the leading contributors to the occurrence of information encountering. We extracted seven user-related factors from the participants' comments, including sensitivity ($n = 10$), emotions ($n = 7$), expertise ($n = 6$), attitudes ($n = 6$), intentionality ($n = 4$), curiosity ($n = 3$), and activity diversity ($n = 2$), which constituted the largest cluster.

Sensitivity to information, the most prominent factor in this cluster, was a new term that we coined on the analogy of sensitivity to emotional feelings. It is the ability to respond to information stimuli effectively, which is similar to Erdelez's (1999) standard

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to distinguish four types of encounterers. It was thought that different people had different levels of sensitivity to information and more sensitive individuals would encounter information more often:

> When I am browsing through websites or search results, I can identify the information that is irrelevant to my topic but may be useful in the future (P8).

> […] Maybe I've missed a lot of good stuff. I just didn't realize they were there (P4).

A few participants deemed one's current emotional condition a major factor determining whether he or she would encounter information at a certain time. They reflected on the effects of different emotions mainly in terms of valence. By and large, positive emotions favored encountering while negative emotions hindered it. One of the comments was very representative of this viewpoint:

> The sense of urgency or the pressure to concentrate usually force me to ignore the trivial information; but if I'm at ease and feel relaxed, I will be more ready to encounter information (P1).

Search expertise is an ability that is more familiar to us. It in general encompasses choosing right search systems, formulating appropriate queries, and identifying relevant results. A high level of search expertise is always desirable in order to achieve better search performance. Interestingly, the lack of expertise instead could lead to one's reliance on encountering for information:

> […] Maybe they just had to obtain information through browsing or encountering. I've seen someone who didn't know how to search (P14).

> A friend of mine said she seldom searched. But she was able to collect jokes here and there (P5).

Another factor originating from our analysis was the attitude toward information or information acquisition, a notion similar to McBirnie's (2008) "serendipity filter." The participant's wording in one of the comments directed our attention to this factor:

> […] It depends on your attitude. As far as I'm concerned, looking for information is one of my hobbies (P8).

This participant showed an obvious tendency to pursue information. With a highly positive attitude he would enjoy the acquisition of information, purposefully or accidentally. In contrast, there also existed a tendency to avoid information:

> I have to admit that I'm a lazy person, and I don't bother about random information (P9).

The impacts of intentionality, curiosity, and activity diversity were less widely recognized. Intentionality and curiosity are two kinds of human cognitive characteristics. The former makes people stay focussed on the original intention, while the latter impels them to explore the unknown. The two characteristics were said to be associated with the occurrence of information encountering in opposite directions, with stronger intentionality reducing the chance and stronger curiosity increasing the chance:

> In literature search I always go straight to my topic, considering nothing else (P7).

> If many people talk about the same thing, I will be curious to know what it is (P8).

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The last factor in this cluster considers the diversity of the information activities that one often involves in online rather than the nature of any specific activities. There were two pertinent comments to this factor:

> I encounter information a lot because I like browsing broadly (P1).
>
> People who use the Internet mostly for watching videos should encounter information much less frequently (P12).

That is to say, information encountering would happen more frequently to those whose habitual activities were different from one another in content or form.

Information-related factors. While users with certain traits are more likely to encounter information than others, information that exhibits certain features also stands a better chance of being encountered than the rest. The primary information-related factors identified in the analysis are types ($n = 15$), relevance ($n = 9$), quality ($n = 8$), visibility ($n = 5$), and sources ($n = 2$). The type of information mainly refers to the topical category that the information belongs to. It was the most frequently mentioned factor across all the clusters, and many participants added comments like:

> I encounter this type of information very often.

According to our participants, the most readily encounterable information for Chinese young people included social events and news, entertainment news and celebrity gossips, and advertisements for shopping, and these categories were followed by various sorts of knowledge or creative ideas:

> Encountering news seems inevitable now (P15).
>
> […] entertainment news and something you glimpse on a page. My encountering usually happened in these two areas (P13).
>
> Taobao (a C2C E-commerce platform) ads pop up a lot. They are embedded in all kinds of webpages or applications (P6).
>
> I know an interest website. You will encounter much encyclopedic knowledge there (P1).

The next two factors, relevance and quality, are more dependent on users' personal judgment. The meaning of relevance here is somewhat different from our traditional understanding that involves a clear need. It was a little surprising to find related comments approaching, respectively, the two extremes of relevance. While some individuals might only notice information relevant to their current or usual situations, some others were particularly open to irrelevant information:

> Any information about the employment or entrepreneurship of university graduates is welcome, because I'm going to graduate (P10).
>
> I'm a student of arts but I like to encounter scientific or technological knowledge. It's interesting to explore the unfamiliar and novel (P3).

The quality of information is often assessed in terms of its authenticity, accuracy, timeliness, and so on. The use of words like "look," "feel," "guess," etc. in related comments showed that the assessment of information quality here was only based on superficial evidence. Information encountering might happen with a rough perception of high quality:

> The information should look good enough for me to make that click (P8).
>
> […] I guess the new information will be more helpful (P4).

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Type, relevance, and quality are typical internal attributes of information. In contrast, visibility and source are external attributes. Visibility is the extent to which the information is present in a way that is able to attract general attention. More visible information has natural priority in encountering. It usually, as noted by some participants, located toward the surface of a hierarchical structure or took the central position in the current view:

> Information shouldn't hide itself deeply (P5).

> The information at people's visual focus will be seen more easily (P11).

The visibility of textual information could be enhanced by attaching it to more visually significant items:

> I will click on the information that comes together with pictures (P11).

Information sources are the individuals who create or provide the information. A couple of participants reported a tendency to encounter information from their social connections, especially those trustworthy or popular ones, and the prosperity of social media nowadays made such information even more available:

> I will notice what particular persons say, such as my good friends or the celebrities I like. […] reading their Weibo (a microblogging service) tweets before sleep is a habit now (P2).

Environment-related factors. The last cluster contains two factors rising from the physical environment where users encounter information. One is time limits ($n = 11$), the other being interface usability ($n = 7$). The limit on time can be understood as the efforts one is allowed or willing to expend measured in terms of time. Most related comments referred to the time limit as posed by the main activities in which users were involved: task-oriented activities would set a tight limit yet leisure-oriented activities a loose limit. They implied that the abundance of time was conducive to information encountering:

> Sometimes you just don't have enough time to examine the search results one by one and you may miss something good (P8).

> I would visit Renren and Weibo in my spare time and I encountered information there from time to time (P12).

There was one special comment that mentioned time but fell into the scope of interface usability:

> […] I will give up if the information takes more than 3 seconds to load (P1).

One of the main goals of interface design is to achieve usability including the ease of use and learnability. Several participants agreed that badly designed web sites would drive users away or ruin their experience, let alone facilitating information encountering. In addition to the response time, they also took into consideration other usability principles, such as aesthetic design and information architecture:

> No one likes disordered webpages. I don't want to stay there for long even if they have what I need (P7).

> The layout of the website should be reasonable (P4).

> Interface is part of information. Information is more than texts, and it also includes the way it is presented. Or you won't look at it at all (P10).

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An integrated model of online information encountering

Based on the above findings, we established an integrated model of online information encountering (Figure 1). This model reflects the process-perception duality of serendipity (McBirnie, 2008). The process aspect is presented with the top half. It divides into three phases which embody the pre-, mid-, and post-activities of information encountering, respectively. The perception aspect is presented with the bottom half. It demonstrates three clusters of factors influencing the occurrence of encountering, with constant and dynamic factors separated on different sides. Such integrated model helps reinforce and expand the previous knowledge that has been accumulated in the field of information encountering.

Unlike the process models created by McCay-Peet and Toms (2010) or Makri and Blandford (2012a), this new model shows a three-phase physical process that places emphasis on users' behavioral characteristics that can be captured and measured. In this sense it is more similar to Erdelez's (2000) model, and we even adopted two of its five functional steps: "noticing" and "examining." While Erdelez treated the encountering occurrence as an interruption during the information seeking process, we center our model on the micro-process (mid-activities) of information encountering. And meanwhile, it provides a global view of the macro-process that reveals the causes (pre-activities) and effects (post-activities) of the encountering occurrence.

In addition, our model incorporates an independent component which acts on the micro-process of information encountering. This composite component embodies three arrays of factors that jointly engender the encountering behavior, showing broader coverage than Heinström's (2006) exclusive consideration to users' psychological factors. Our division of factors basically echoes Erdelez's (1999) anatomy of information encountering experience, and the clarification of individual factors allows for a better prediction of behavior. We should admit, however, that such component is still in immature shape and the inclusion of the current factors is subject to refinement.

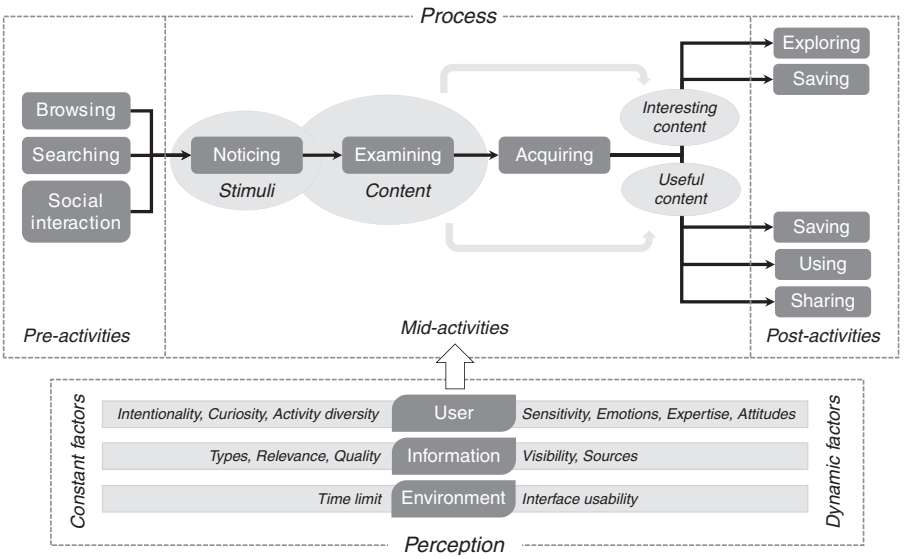

Figure 1.
An integrated model of online information encountering

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Discussion

Implications of the phases in the process

As demonstrated in the above model, this study contributed three significant additions to the traditional understanding of the information encountering process. First, social interaction can act as the foreground activity that accommodates the occurrence of information encountering, just like online browsing and searching activities. Second, information is composed of stimuli and the content, and an encountering occurrence begins with paying attention to the former. And third, what to do with the encountered information is inseparable from encountering.

Social interaction as the underlying activity. People encounter information in various physical and digital environments (Erdelez, 1995). It has been widely agreed that information encountering occurs most frequently during browsing and during searching at times. Searching and browsing are information seeking with and without an articulable goal, respectively (Heinström, 2006). Our study identified encountering occurrences during social interaction besides browsing and searching, which was a natural consequence of the rise of social software applications.

Users register with a social software application so that they can share digital assets, make conversations, collaborate on projects, and engender collective wisdom (Wodtke and Govella, 2009). Most of these activities are labeled "social interaction" that aims at networking, learning, problem solving, decision making, and so forth (Cross and Parker, 2004). Such goals are generally achieved through the exchange and use of information and sometimes accompanied by the production of new knowledge. The social software application, that is to say, is also an information-intensive environment where the acquisition of user-contributed information, purposefully or accidentally, is interwoven with social interaction.

Information stimuli vs content. In the field of information encountering, researchers have been making great efforts to clarify "encountering" yet seldom probe into "information" or realize the necessity to do so. If we deem information as a primitive concept that follows basic human understanding (Case, 2012), many encountering incidents may be difficult to describe. For example, we can say that one encounters a phone number or an address, but encountering a 1,000-word article or a two-hour video is very problematic.

As a matter of fact, the information we acquire in most cases is far beyond single facts and cannot be identified and consumed at one place in an instant. For information to be encountered hence, its navigational representation must be noticed at first. It is the stimuli contained in the hyperlink labels that attract users' attention. As can be found in certain incidents, the keywords of large chunks of texts are typical stimuli. If the stimuli connect to users someway, they will be motivated to click on the hyperlinks to access the content, which signals their acceptance of the encountering occurrence. But whether the encountered information will be accepted depends on their subsequent examination of the content.

Encountered information being handled. An under-researched aspect of information encountering is one's interaction with the information after it is encountered. The literature only presents a couple of exploratory studies on how people share, save, and use the information they encounter in everyday reading (Marshall and Bly, 2004, 2005). The handling of encountered information may be challenging, but this act is helpful for understanding the information better (Marshall and Jones, 2006). We identified four

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possible actions from the participants' descriptions of how they dealt with the encountered information, i.e. exploring, saving, using, and sharing.

An intriguing phenomenon is that exploring happened exclusively to interesting information whereas using happened exclusively to useful information. The interestingness can be attributed to that users have little previous knowledge of the encountered information. That is, the finding of information is unexpected because its existence is unexpected (Foster and Ford, 2003). This will naturally arouse the exploration of the unknown to cater for their instinctive desire for learning. Also the unexpected finding of information may be due to its unexpected location (Foster and Ford, 2003). Encountering helps users out when they keep an eye on an existing problem because they do not know where to find the answer. The information encountered is deemed useful for its relevance to certain needs. Once acquired, it will be ready for using to address the needs. Saving the encountered information for future use is actually an intermediate action that permits users to defer the real actions they may want to take, and the sharing of encountered information with others is more like an accompanying action.

Implications of the influencing factors

This study identified 14 factors that had an influence on the chance of information encountering. They were further recognized as user, information, and environment factors in view of their relationships with the encountering occurrence. A closer look at the essence of these factors will lead to the discovery that some of them are intrinsic and thus stable while others are changeable or controllable. In other words, whether information encountering happens is only partially predetermined. This allows us to improve the likelihood of happening through some external intervention.

Encountering is partially predetermined. Among all the factors we identified, half of them can be considered constant factors that are immune to manipulation or adjustment, including users' intentionality, curiosity, and activity diversity, information type, relevance, and quality, as well as the time limit from the environment. Under certain circumstances in which these factors stand out, it will be very difficult to make deliberate arrangements for information encountering.

Intentionality and curiosity are instincts in every human being. Intentionality can reflect in cognitive styles: field-dependent individuals are apt to be affected by the environment while field-independent individuals adept at overcoming the influences of the environment (Kim and Allen, 2002). The latter seldom become encounterers because they tend to immerse in the foreground activities and neglect the potential acquisition of information from the background. Curiosity is a typical internal desire to know, to see, or to experience that motivates exploratory behavior directed toward the acquisition of new information (Litman, 2005). Diversive curiosity that takes the form of ill-defined goals usually arouses more general seeking of stimulation or novelty (White and Roth, 2009), thus resulting in serendipitous information acquisition.

Likewise, type, relevance, and quality are fundamental to any pieces of information. Type is a native attribute that originates from the creation of information. Different types of information are communicated via different channels, so they differ in pervasiveness. And different types of information cater to different audiences. Relevance and quality, in contrast, are posterior attributes, which will not be determined until the occurrence of information encountering. People tend to ignore or abandon the encountered information that they think lacks relevance and/or quality.

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Last, activity diversity and time limit are both further determined by the contextual tasks in which people are involved. As Li (2009) indicated, goal and urgency are two basic task facets. When one is dealing with distinct goals, he or she must resort to multiple information sources. As the number of sources increases, the quantity of encounterable information increases. The urgency of a task can range from high to low. High urgency of the current task does not reduce the availability of the information to be encountered; but it reduces the possibility of users noticing such information.

Encountering is cultivatable or designable. The remaining factors we identified, i.e., users' sensitivity, emotions, expertise, and attitudes, information visibility and sources, as well as interface usability, are dynamic ones. Their existence endows us with the power to weaken the strength of serendipity in some degree and elicit the behavior of information encountering intentionally when desirable. This also justifies the practical value of related research studies.

Interestingly, three of the user factors, i.e. sensitivity, expertise, and attitudes, correspond to the need, locating, and awareness components of information literacy (American Library Association, 2000; Obama, 2009), respectively.

According to the signal detection theory (Green and Swets, 1966), with information stimuli present, good sensitivity refers to both accepting stimuli relevant to the need (signals) and rejecting irrelevant ones (noises). The former describes the noticing phase of encountering; and the latter is also very important since we have to deal with information overload, staying relatively focused, and avoiding endless encountering.

Searching is the most widely recognized approach to locating information. In general, expert searchers will outperform novice searchers in terms of both search efficiency and effectiveness (Lazonder *et al.*, 2000). Because of their inability to implement the analytical searching strategies, novices are more likely to depend on opportunistic encountering strategies that make a complement or substitution with the lowest threshold.

Users' attitudes toward information seeking is not a frequently seen subjective factor. Information pursuers are alert to information and open to all kinds of information. They are ready for the acquisition of any information, and encountering is a low-cost alternative to accomplish this. However, information avoiders will concern themselves about the currently needed information at most, often too indolent to absorb any extra information.

Information literacy is a cultivatable ability of individuals. A lot of efforts have been devoted to improve students' information literacy in higher education and K-12 education, as guided by various standards that describe the requirements for information literate persons to meet. Given the above discussion, as a result, encounterers can be cultivated through purposefully training their information literacy in particular aspects.

Personal abilities take time to develop, but emotions are momentary. Emotions have a great impact on users' behavior and performance in information seeking (Gwizdka and Lopatovska, 2009). The specific emotions enumerated in this study as affecting information encountering, such as relaxation and pressure, were basically aroused by the absence or existence of dominant tasks. The connections between tasks and users' emotions have been investigated in the context of online searching (Arapakis *et al.*, 2008). Although we cannot change the level of pressure associated objectively with users' tasks, it is possible to enhance subjectively their optimism and enjoyment by creating in virtue of sensory design a relaxing environment where they perform tasks.

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Also designable are the presentation of information and the usability of user interfaces. For the sake of effective communication with users, it is necessary to emphasize which information is important. And such emphasis can be laid by use of appreciable visibility and credible sources according to information design principles (Garrett, 2010). Interface design, another key aspect of user-centered design, aims to achieve usability and findability. The designing for information encountering, evidently, is more closely related to the latter, aiming at engendering clear and smooth navigation so that users can navigate through the information architecture to find information (Garrett, 2010).

Conclusions and future research

Online information encountering has become a common mode of information acquisition on the web. This study played a role in clarifying the "how" and "why" questions of information encountering which lacked in-depth empirical research in the literature. Our integrated model of online information encountering provides reasonable answers to these questions. The macro-process of information encountering is composed of three phases. First, browsing, searching, or social interaction provides the context for encountering; second, the encountering occurrence consists of three steps – noticing the stimuli, examining the content, and acquiring interesting or useful content; and third, the information encountered will be explored further, saved, used, or shared. The 14 influencing factors of information encountering obtained divide into three clusters. User-related factors include sensitivity, emotions, expertise, attitudes, intentionality, curiosity, activity diversity; information-related factors include type, relevance, quality, visibility, and sources; and environment-related factors include time limits and interface usability.

We established the model based on a qualitative analysis of the critical incidents and related comments collected from the interviews of 16 participants. This effort was exploratory yet fruitful, engendering a couple of useful practical implications. On the one hand, since purposive intervention is possible in raising the chance of information encountering, we may embed encountering support features within information seeking environments or even build encountering systems that essentially require low involvement and expectation from users. On the other hand, the design of such features or systems should follow the natural occurring mechanisms of information encountering, incorporating requisite elements that, respectively, address the demands of pre-, mid-, and post-activities.

Given the importance of the model in guiding the attempts to design for encountering, we plan to verify and/or improve it though further research in the near future. It is necessary to employ more quantitative methods for collecting and analyzing a considerable number of online information encountering incidents. Moreover, the relationships between some factors and the likelihood of occurrence can be explored statistically. The increase in research validity will enhance the robustness of our model.

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Appendix

Incident	Participant	Brief description of the incident
I1	P1	I searched for the TV series *Amazing Detective Di Renjie* on Qiyi (a video sharing site), but unexpectedly found the movie *Detective Dee: Mystery of the Phantom Flame* in the search results
I2	P1	I encountered an unfamiliar word "OICQ" when listening to a song by Xu Song. After searching for its meaning, I found that it was the former name of QQ (an instant messaging service). It was good to know QQ's history
I3	P1	I happened to see a friend's WeChat (a mobile text and voice messaging service) signature and asked him what it meant on WeChat. His explanation was funny
I4	P1	I searched for Internet news, but found a site for Internet product managers, Yuewe. It aggregated a lot of Internet product information so that I didn't need to look for it elsewhere
I5	P2	I saw a short news article about the Chinese mother gold investors on Weibo (a microblogging service). I was quite interested in such topic and couldn't wait to read it
I6	P3	I saw a celebrity had retweeted someone's post on Weibo. The post was very interesting, so I visited that person's Weibo homepage and browsed his other posts. I liked them very much and decided to follow him
I7	P3	I searched for the recent updates on digital media topic mining, but accidentally found a site about the internet TMT industries, 199IT. It had some data analysis reports that I could use
I8	P3	I searched for research papers and noticed that one of the results was from All Journals, an academic search engine. I tried this search engine. It was very useful for my research
I9	P4	I saw a valuable Excel tutorial on Qzone (a social networking service) by chance and reposted it to my own blog immediately because I needed to use Excel for my thesis
I10	P4	I saw a blog post talking about thesis formatting on Renren (a social networking service). It would be a while before I started to format my own thesis at that time. So this could be saved, and I would refer to it if formatting problems really happened
I11	P4	I searched for related papers to my original thesis topic, clicked on the results one by one, and suddenly a result led me to the papers on another topic. My research direction thus changed
I12	P5	I stumbled on Guokr, an interesting site, when browsing through the posts on Weibo. The site has so much technology knowledge, really worth your time
I13	P5	A friend's Renren username was suffixed by the unknown word "bilibili." I searched for its meaning on purpose. It turned out to be a cartoon video sharing site
I14	P5	I shopped for a headband on Taobao (a C2C e-commerce platform). The shops selling headbands also sold many other hair accessories to my surprise. I just couldn't help myself and purchased a lot
I15	P6	I saw some shopping information from Taobao when viewing documents on Baidu Library (a document sharing service). The product happened to be what I needed

(*continued*)

Table AI. Online information encountering incidents reported by the interview participants (incident descriptions translated from Chinese)

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Incident	Participant	Brief description of the incident
I16	P7	I read the news of the Fudan University poisoning case on Sina (a news portal), and unexpectedly found the video of the Zhu Ling case in the "similar news." The video collected a series of doubtful points in the case
I17	P7	I had had a problem about establishing database connections. I searched for relevant posts on CSDN (a virtual community for IT technicians), but couldn't find any satisfactory results. Later I encountered a post introducing the DAO model when reading about Java. It gave a clue to my problem
I18	P8	You can stumble on interesting books in the new book recommendations when you shop on Dangdang (an online bookstore). I will examine the recommendations from time to time
I19	P8	I discussed the movie So Young with my Renren friends and discovered other interesting details of the movie during our opinion exchange. I had not noticed these on my own
I20	P8	The system-recommended information I got on Weibo might not be within the original scope of my attention. But some information was useful, like the tips for traveling to Europe. I always dream of traveling to Europe
I21	P9	When we chatted on QQ, my best girlfriend told me a good way of decreasing the internal heat that she saw somewhere by accident. I had had the problem of excessive internal heat for quite a while
I22	P10	Yesterday I forwarded some industry news encountered on Weibo to friends or classmates who might need it. We are preparing for job hunting
I23	P10	If you searched for a specific song, others songs of the same type or by the same artist would appear in the results. Some of these songs were beyond my expectation, but I liked them very much
I24	P10	I once found a song via searching. I listened to another song recommended together with it. This song was very different from the original one. I was curious about its genre
I25	P11	I saw a friend had reposted a link to a travel journal from Mafengwo (a social guide system) on Renren. I clicked on the link and visited the homepage of Mafengwo, and browsed through the travel tips. The site had very useful information. It was a big surprise! So I bookmarked it immediately
I26	P11	I searched for the song The Rose and accidentally found in the search results that it had been sung by another artist. This version was even better than the one I was searching for. I liked it from the bottom of my heart
I27	P11	I encounter ads all the time but don't need them. Some video ads can last for one and half minutes. Really annoying!
I28	P12	I occasionally see interesting stuff on Renren. Funny pictures and videos are the commonest
I29	P12	Last week I noticed that many people talked about the TV series *Mischievous Kiss: Love in Tokyo* on Tianya BBS (an Internet forum). They said it was good, so I planned to watch it during the summer vacation
I30	P12	Most of us will automatically ignore the ads encountered
I31	P13	I often glimpse entertainment news, gossips, society news, and shopping information on video-sharing sites or social networking sites. But I will only click on the interesting links

Table AI.

(*continued*)

Incident	Participant	Brief description of the incident
I32	P14	Once Taobao ads appeared beside the video I was watching. Since I liked the products advertised, I clicked on the ads and finally made a purchase. QQ and Renren also offered such shopping recommendations
I33	P15, P16	I would click on the news popping up during QQ chat if it was interesting enough
I34	P16	Online game ads often pop up from the download client I use. I clicked on them may be once or twice

Notes: I1, I2, I3, I13, I14, I19, and I26 were detected to be false incidents which failed to present the basic characteristics of information encountering. Reasons are specified in the Method section

Table AI.

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