Information encountering re-encountered: A conceptual re-examination of serendipity in the context of information acquisition

Abstract

Purpose: In order to understand the totality, diversity and richness of Human Information Behavior, increasing research attention has been paid to examining serendipity in the context of information acquisition. However, several issues have arisen as this research subfield has tried to find its feet; we have used different, inconsistent terminology to define this phenomenon (e.g., Information Encountering, Accidental Information Discovery, Incidental Information Acquisition), we have not clearly defined the scope of the phenomenon and we have not fully understood or fleshed-out its nature.

Design/methodology/approach: In this paper, we propose *information encountering* (IE) as the preferred term for serendipity in the context of information acquisition.

Findings: We present a re-conceptualized definition and scope of IE, a temporal model of IE and a refined model of IE that integrates the IE process with contextual factors and extends previous models of IE to include additional information acquisition activities pre- and post-encounter.

Originality/value: By providing a more precise definition, clearer scope and richer theoretical description of the nature of IE, we hope to make the phenomenon of serendipity in the context of information acquisition more accessible, encouraging future research consistency and thereby promoting deeper, more unified theoretical development.

Keywords: Information encountering, serendipity, passive information acquisition, information behavior, information seeking, models

1. Introduction

The phenomenon of serendipity has attracted much interest in scientific, management and creative scholarly disciplines; Many scientific discoveries, from Velcro to Viagra, have been attributed to a combination of accident and sagacity (Roberts, 1989), organizations have recognized the importance of creating fertile cultures and environments for facilitating 'accidental' idea-sharing (Cunha et al., 2010) and studies of creative practice have identified the importance of 'making one's own luck' by 'seeking serendipity' (Makri and Warwick, 2010; Makri et al., 2014). Serendipity in the context of information acquisition has also emerged as a highly important area in the field of library and information science (LIS). This has been fueled by broader research efforts to understand the totality, diversity and richness of Human Information Behavior (HIB) and to inform the design of physical and digital information environments that facilitate new ways of supporting passive information acquisition. However, despite attempts of LIS researchers to bring terminological clarity and a defined research agenda to this area– e.g., through the organization of international workshops such as the International Workshop on Opportunistic Discovery of Information (IWODI, Columbia MO, USA, 2010) and Serendipity, Chance and Opportunity in Information Discovery workshop (SCORE, Montreal, Canada, 2012) – the theory base on serendipity in the context of information acquisition grew organically. While this is perhaps understandable due to the 'slippery and subjective' nature of serendipity (Makri and Blandford, 2012a), organic growth has resulted in different, inconsistent terminology being used to define serendipity in the context of information acquisition - e.g., Information Encountering (Erdelez, 1995; 2004), Accidental Information Discovery (Race and Makri, 2016), Incidental Information Acquisition (Williamson, 1998; Heinström, 2006), parallel development of models that incorporate serendipity at different levels of conceptual granularity, lack of a clear scope of the phenomenon and an incomplete understanding of its nature.

In this article, we propose *information encountering* (IE) as the preferred concept for referring to serendipity in the context of information acquisition and for framing future LIS research on this topic. To provide gravitas to this proposal, we present several theoretical enhancements to IE as a concept; we position IE within a broader conceptual space of information acquisition by presenting a re-conceptualized definition and scope of the phenomenon. We also present a refined process model of IE - based on synthesized findings from the literature. This model integrates the contextual factors into the IE process and extends previous models of IE to include additional information acquisition activities pre- and post-encounter. By providing a more precise definition, clearer scope and richer theoretical description of the nature of IE, we hope to make the phenomenon of serendipity in the context of information acquisition more accessible, promoting greater terminological uniformity and greater standardization in how researchers conceptualize the phenomenon. We hope this will encourage more consistent theoretical development in the future.

The paper is organized into the following main sections:

- A **discussion** of prior research on the concept of serendipity and its study in LIS, focusing particularly on serendipity in the context of information acquisition. This includes an examination of terminological and definitional differences that appear in the literature (sections 2-4);
- A **re-conceptualized definition and scope of information encountering** categorized along dimensions of the 'information acquisition space' (sections 5-6);
- A **temporal model of IE** that illustrates presence of IE across multiple information needs and time dimensions (section 7);
- A **refined process model of information encountering** that integrates the IE process with contextual factors identified in the literature and extends previous models to include additional information acquisition activities pre- and post-encounter; (section 8);
- A **discussion on the importance of these theoretical contributions** to the sub-field of Human Information Behavior and the field of LIS more broadly (section 9);
- A concluding **reflection on the contributions of this work** and a **projection of further developments of information encountering researc**h (section 10).

2. History of serendipity

The term 'serendipity' was first used in the writings of English art historian and writer Sir Horace Walpole. In 1754 he wrote a letter to his friend, politician Horace Mann, and referenced an oriental fairytale The Three Princes of Serendip (former Sri Lanka) in which the main protagonists constantly made discoveries of things they were not searching for. Walpole used Serendip as a root to coin the new word *serendipity* and defined is as an instance of accidental sagacity. In his letter to Mann from January 28, 1754 Walpole provided examples of serendipity and explained that discovery of things that one is looking for does not fall under this concept (Merton and Barber, 2004). 'Serendipity' was rarely used until the mid-twentieth century. During this period, the term gained popularity appearing on the front page of The Times in 1949 to describe Alexander Fleming's discovery of penicillin and featuring in Merton's influential book 'Social Theory and Social Structure' (Merton, 1968). Merton identified what he termed a 'serendipity pattern' in empirical research, where unanticipated findings serve to advance theory development or enhancement. In serendipitous scientific discoveries, accident and sagacity combine, resulting in a scientific 'leap' or breakthrough.

Over the past centuries, the meaning of serendipity has evolved. For example, many dictionary definitions of serendipity focus on the luck and accidental aspect of serendipity but omit the concept of sagacity from Walpole's original definition. The current web-based edition of Merriam-Webster's Dictionary defines serendipity as an instance of or "the faculty or phenomenon of finding valuable or agreeable things not sought for." This definition omits sagacity – a key ingredient of Walpole's original definition (Van Andel, 1994). From the information behavior perspective, which is the serendipity context of focus in this paper, this definition focuses only on acquisition of information through seeking

and as such corresponds with the original definition of information encountering that we intend to re-define in this paper.

3. Early conceptual research on serendipity in the context of information acquisition

Since the mid-20th century, the body of research on serendipity has continued to grow and transcended the disciplinary boundaries of scientific research. It is now studied in fields such as Organizational Psychology, Philosophy, Computer Science and, most relevant to this article, Library and Information Science (LIS). In LIS, serendipity in the context of information acquisition has been researched since 1960, when Bernier published an article on 'serendipity, suggestiveness and display' (Bernier, 1960). This was the first research to highlight the importance of serendipity in the context of information acquisition and to begin to define its nature and scope. It occurs passively but can be facilitated by actively seeking information and does not involve chance entirely - as the information found unexpectedly is often somewhat related to the information being sought. It can also occur when looking for a specific known item, or not looking for any information in particular.

Since this early conceptual work, several models (some conceptual, others empirically-grounded) have been created to explain how people find information. Some models have expanded beyond search, to encompass other forms of active information seeking, such as through browsing (Bates, 2002). Others have expanded beyond information seeking, to encompass information *use* (e.g., Wilson, 2000) and broader information practices (e.g., McKenzie, 2003). Others still have expanded beyond *active* information acquisition to also encompass passive activities (e.g., Krikelas, 1983; Bates, 2002; McKenzie, 2003). This expansion of scope has resulted in some of these models beginning to incorporate aspects of information acquisition. It has been recognized that *"gradually, models of information seeking have recognized information encountering as a part of information seeking behavior…"* (Palsdottir, 2011; p. 227). Examples include:

- Krikelas's (1983) model of information seeking behavior, which recognizes that information can be found 'by chance,' in the course of other activities;
- Bates' berrypicking model (Bates, 1989), which recognizes that 'jumping around' digital information environments (e.g., when browsing) can reveal unexpected connections between information, forming the potential basis for serendipitous acquisition;
- Wilson's (1999) model of information behavior, which incorporates '*passive search*' and '*passive attention*' as key aspects of information behavior. Passive search involves finding unsought information while looking for other information. Passive attention involves finding unsought information when *not* looking for information (e.g., during everyday life activities);
- Foster's (2005) nonlinear model of information seeking behavior, which incorporates serendipity as a core approach for finding broad, diverse information;
- McKenzie's (2003) model of information practices, includes *"serendipitous encounters in unexpected places"* (p. 26).
- Hider's (2006) general model of information acquisition, which recognizes that information is not always purposively sought, but can be unexpectedly encountered.

Finding information ~~unexpectedly~~ serendipitously has been integrated into these models of information acquisition, to a greater extent in some than others. Furthermore, several models of the broad phenomenon of serendipity have been proposed, some of which provide insight into the nature and process of serendipity in the context of information acquisition. However there has, to our knowledge, only been one model that has expressly focused on explaining serendipity *in the context of information acquisition* - the model of Information encountering originally proposed by Erdelez (1995; 2004) and further developed by subsequent researchers (e.g., Awamura, 2006; Jiang et al., 2015; 2019). This model is introduced and discussed later in this article.

4. Later empirical research on serendipity in the context of information acquisition

In the previous section, we reviewed early research into serendipity in the context of information acquisition and demonstrated that the concept has been integrated into some models of information acquisition. However, from the mid-1990s onwards, there has been an increasing number of empirical studies that have aimed to understand serendipity in both physical and digital information environments - including its nature, underlying process, influencing factors and how to observe it. Due to space limitations, we do not exhaustively review all these studies but instead present a selective synthesis of empirical research that has shed light on this phenomenon.

The first empirical research to focus directly on serendipity in the context of information acquisition was an interview-based study by Erdelez (1995), in which the term 'information encountering' was first used. She characterized encountered information as a: *"memorable experience of an unexpected discovery of useful or interesting information in the context of both information related and non-information-related activities."* (Erdelez, 1995, p. 146). By unexpected, Erdelez meant that information users have 'low or no expectation' (p.145) of finding the information that is encountered and highlighted the *passive* nature of encountering. However, Erdelez (1995) study also concluded that *"unexpected aspects of information encountering involve both the accidental discovery of information that had not been sought and the discovery of unforeseen characteristics of information that had been sought."* (p, 146). A similar aspect of serendipity (discovering something that *was* sought, in an unexpected way) has been referred to in the scientific discovery literature as *pseudoserendipity* (Roberts, 1989), or "*'right destination, wrong boat"* (Rosenman, 1988; p. 137).

Another contribution of Erdelez's early work is development of a conceptual framework for understanding IE experiences (Erdelez, 1996). This framework includes four factors: the characteristics of the information **users**; the information **environment** where information was encountered; the nature of the **information** encountered; and the **information need** addressed with the information encountered. This work focused on IE as an activity that is *embedded* within an active information seeking task. In this context she defines IE as the *"unexpected discovery of useful or interesting information… during the search for some other information"* (Erdelez, 2005, p. 179). While IE is usually framed as being occurring in the course of *searching* for information, Erdelez recognized it could also occur when *browsing* (Erdelez, 1995). The IE process is discussed further in section 8.

Recognizing that some information can be passively acquired outside the course of active information seeking, when not looking for information at all, Erdelez (2005) proposed a new, broader concept - *Opportunistic Acquisition of Information* (OAI). The OAI concept intended to incorporate various types of passive information acquisition, including information encountering during active information seeking. However, this concept was not widely adopted by subsequent researchers. This may be because 'opportunistic' loses some of the 'unexpectedness' of serendipitous information acquisition by emphasizing the potential to exploit information opportunistically. It may be due to difficulties identifying and scoping other types of passive acquisition.

Several other empirical studies have sought to better understand serendipity in the context of information acquisition. Due to space restrictions, we focus primarily on two that provide specific insights into the nature and scope of IE, by Foster and Ford (2003) and McBirnie (2008). One of the first and most cited empirical studies of serendipity in the context of information acquisition is by Foster and Ford (2003), who noted that 'serendipitous information encounters' played an important role in academic research. They highlighted that these encounters could either reinforce researchers' existing knowledge or send them in a new direction which could help create new knowledge. Foster and Ford (2003) highlighted *unexpectedness* (of finding the information) and *value* (of the information itself) as defining characteristics of serendipity in the context of information acquisition - characteristics that were also identified as important in subsequent empirical studies of serendipity (e.g., Watson, 2008; Makri and Blandford, 2012 a, b; McCay-Peet and Toms, 2015) and of IE more specifically (Jiang et al., 2015; 2019).

Another study of serendipity in the context of information acquisition was conducted by McBirnie (2008), who interviewed academic researchers and jazz improvisers about their experiences of serendipity experienced during active information seeking. McBirnie found people occasionally 'stored' unexpected information for future use but more often the information was *"brushed aside and lost"* (p. 608). She notes that personal factors can influence people's ability and willingness to notice and act upon unexpected events. This is analogous to their ability and willingness to notice, examine and follow-up on encountered information. She found that some participants were much less willing to 'change direction' than others after encountering information - a finding supported more recently by Makri and Buckley (2019). Personality traits, specifically extroversion (Heinström, 2006; McCay-Peet et al., 2015), have been found to increase this willingness, while stress and anxiety have been found to decrease it (Heinström, 2006). McBirnie (2008) also notes contextual factors that can influence this willingness, including the environment and time pressures. These factors are present in some models of IE (e.g., Jiang et al., 2015; 2019). Certain types of physical information environment (e.g. libraries, bookshops) and digital information environments (e.g., Websites, search engines, social media sites) have been found to facilitate IE (Björneborn, L. (2017), as have those that are trigger-rich, enable connections and lead to the unexpected (McCay-Peet and Toms, 2015).

5. Broadening the definition and scope of information encountering

The above studies illustrate efforts towards a difficult task to "pin down" (Makri and Blandford, 2012 a, b) the nature and scope of serendipity in the context of information acquisition. To address this problem, Foster and Ellis (2014) provide a detailed exploration of the concept of serendipity and LIS research on it. Agarwal (2015) defines serendipity in the context of information acquisition as *"an incident-based, unexpected discovery of information leading to an aha! moment when a naturally alert actor is in a passive, non-purposive state or in an active, purposive state, followed by a period of incubation leading to insight and value."* Citing previous work by Van Andel (1994), Makri and Blandford (2012 a, b) discuss general patterns in which serendipity presents itself especially in the process of scientific discovery. They point to the upsurge of research interest in this area, but also a lack of consensus on the definition of serendipity.

Previous research has also demonstrated inconsistent and often confusing use of terminological labels for identifying serendipity in the context of information acquisition. Two main approaches can be noted; one approach uses term serendipity itself as an adjective for describing the related types of information acquisition. For example, some papers use serendipity in compound labels (such as "serendipitous information encounters" by Dantonio et al. (2012)) when referring to specific information acquisition behavior. Similarly, a recent study by Zhou et al. (2018) identifies *encountering serendipity* as a term to label related information acquisition activities. The other approach uses the exhibited characteristics of serendipitous behavior, e.g., its accidental, opportunistic, unexpected, incidental and chance-driven nature to create compound, descriptive labels of such information acquisition. For example, Williamson (1998) labeled such experiences *accidental* or *incidental information acquisition* (IIA) - where terms accidental and incidental are treated as synonyms. IIA is also a compound term of choice for Heinström (2006) who defined it as *"acquiring (useful or interesting) information while not consciously looking for it."* (p. 580). Palsdottir's (2011) work, interestingly, does not specifically reference the concept of serendipity. Instead, she uses the term *opportunistic discovery of information (ODI)* to refer to "finding information by chance". As described above, ODI and a similar term *opportunistic acquisition of information (OAI),* have been also used by Erdelez and colleagues (Erdelez, 2004; Million et al., 2013) as a broader concept that encompasses, and extends beyond, information encountering. As Jiang et al. (2015) point out *"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"* (p. 1136). However, overall, there has been a lack of conceptual and terminological consistency across research that has examined serendipity in the context of information acquisition.

Rather than incorporating IE within a broader concept such as ODI, we propose to broaden the definition and scope of IE itself to encompass *finding interesting, useful or potentially useful information when looking for ~~different~~ some other information, not looking for any information in particular, or not looking for information at all*. This broader definition of IE also takes an inclusive view of 'information'; the information that is encountered can be physical or digital, in various formats (e.g. textual, visual) and, in addition to traditional media, can also include people, objects and places.

We hope this broader definition of IE will encourage future research on types of passive information acquisition that do *not* occur during active information seeking. We think 'information encountering' is a particularly appropriate term for serendipity in the context of information acquisition, as it allows the broader concept of 'information acquisition' to be broken down into active *information seeking* and passive *information encountering*. This serves to clarify the scope of information behavior, highlighting that finding information extends beyond seeking. The boundaries between seeking and encountering are, however, not entirely clear-cut. Active seeking and passive acquisition, as well as directed and undirected acquisition operate along a continuum (see Figure 1 below). This means there will sometimes be 'gray areas' when classifying information behavior. However, we suggest that seeking and encountering provide a simple, yet powerful way of distinguishing between active and passive information acquisition and a means of unifying terminology; thus being adopted in place of other terms, such as ODI, incidental information acquisition (Heinström, 2006) and accidental information discovery (Race and Makri, 2016).

6. Situating information encountering within the 'information acquisition space'

While the original scope of information encountering was restricted to *"accidental discovery during an active search for some other information*" (Erdelez, 2005, p.180), some researchers have begun to extend its scope to include the unsought finding or interesting or useful information by means other than search (e.g., browsing; Makri et al., 2015; 2017) and when actively seeking information, but without a particular aim (Bawden, 2011; Jiang et al., 2015; 2019). This highlights the potential to extend the scope of IE further by considering the situations in which it can occur beyond active searching.

A potentially useful framework for considering the range of information behavior that can facilitate IE is provided by Bates' (2002) 'modes of information seeking' (adapted in Figure 1). The diagram represents various modes of information acquisition across two continuous dimensions – user initiative (ranging from active to passive) and user goal-directedness (ranging from undirected to directed). By presenting these as continua, this diagram appreciates that levels of activeness and directedness can vary during and across information acquisition sessions. This conceptual *space*, which we refer to as the *information acquisition space* (IAS), goes beyond information *seeking* to also cover forms of passive acquisition such as monitoring (e.g., through notifications or alerts) and awareness.

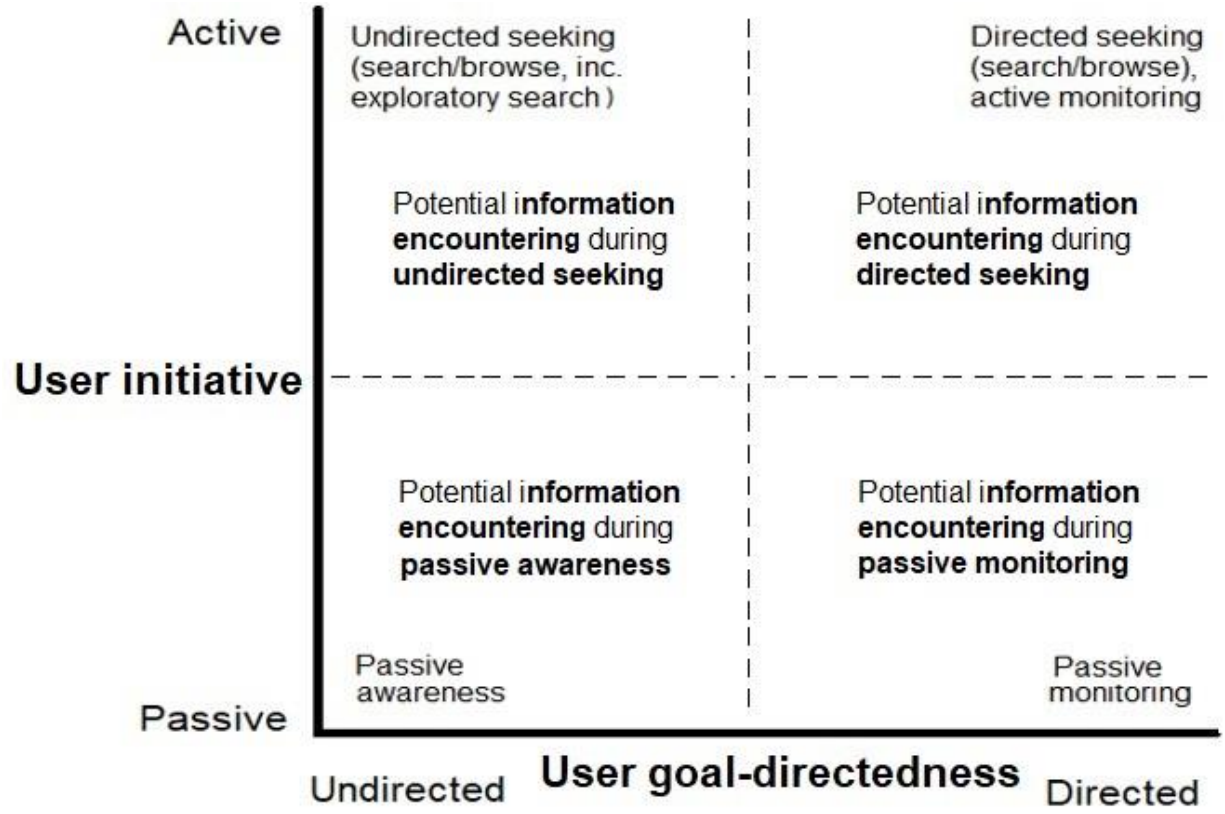

Figure 1: The 'information acquisition space'

In the above areas of the IAS possible forms of information acquisition include:

- Active, directed: **Directed seeking** (encompassing both searching *and* browsing), including known item searching and searching or browsing for information in a well-specified topic area (whether broad, specific or somewhere in-between) and **active monitoring**, on a specific entity (person, place etc.) or topic area;
- Passive, directed: **Passive monitoring** (e.g., push-based notifications or e-mail alerts);
- Active, undirected: **Undirected seeking** (also including both searching and browsing). This also encompasses exploratory search (Marchionini, 2006), which is typically loosely directed (at least at the outset);
- Passive, undirected: **Passive awareness**. Awareness is a term used by Bates (2002) to describe the activity of passively maintaining a peripheral awareness of information without actively monitoring it. It is an undirected activity as it does not involve looking for any information in particular (although background interest can play a role in identifying information of interest in one's field of awareness).

This categorization is generally consistent with Bates' original 'modes' (Bates, 2002) and subsequent leveraging of the concept to elaborate the conceptual space of phenomena related to information seeking (Savolainen, 2016). However, some minor differences exist; our categorization considers that while most active, directed information seeking is search-based, it can also be browse-based. Similarly, while most active, undirected seeking is browse-based, it can also be search-based (although, by their very nature, searches cannot be *entirely* undirected).

Information encountering is possible throughout the IAS rather than only a specific part of it (e.g., in the passive, undirected area). This is because, although information that is encountered is always done so with low user expectation of an involvement in finding it (Erdelez, 1997), the encounter itself is often *embedded* in another form of information acquisition. That is, information is unexpectedly found during the course of another type of information acquisition activity (such as actively searching for information

on a seemingly unrelated topic, or passively monitoring a topic area). Or, to put it another way, if considered from the perspective of what the user was doing at the time of the encounter (e.g., directed search, semi-directed browse), IE can happen during all modes of information acquisition. If considered from the perspective of the encounter itself (as a discrete rather than embedded event), encountering is usually passive and undirected - as the encountered information was not sought and is seemingly unrelated to the user's information seeking goal (if they have one).

7. A temporal model of information encountering

The information acquisition space (IAS) presented in Figure 1 highlights that people can engage with information along a continuum of activities with various levels of user initiative and goal-directedness. These activities in turn are motivated with information needs that range from broad interest areas to very specific problems, in diverse domains. Humans perform multiple roles in their daily lives and consequently have many parallel areas of interest and problems that can generate information needs, which then result in different interactions throughout the IAS. If we observe these information needs from a temporal perspective, we notice they are not static. They evolve over time, appear and disappear as people's roles and situations in their lives change. The experiences of information encountering, as pointed out by the early work of Erdelez (1995), connect people to various needs and interest areas and also enable them to "travel" across the time dimension of their information needs, often engaging with their interests along the way.

In a contrast to the diversity and complexity of information acquisition in its natural form, models of information acquisition typically focus on only one of the components from the IAS. For example, the LIS literature has historically focused mostly on directed seeking (searching or browsing) as an example of active and directed information acquisition. More recently, with the emergence of web-based technologies (especially social media and recommender systems), there has been also interest in other quadrants of the IAS. However, our examination of information encountering suggests that a more holistic perspective of information acquisition is needed. This perspective captures the movement of users' interactions with information while in any of four IAS quadrants, across problem and interest areas and across time – tracing the attempted resolution of their information needs.

Figure 2 presents such a holistic perspective in a temporal model of IE. For illustrative purposes it shows 5 out of n possible problem and interest areas (identified with letters *a* to *e* on the y axis) that an information user may have. The time dimension (x axis) captures the evolvement of these areas from past, through present to the future. For example, some interest areas (i.e., area labeled with *a*) remain interests over long period of time, some disappear (area e) and appear (area c). Some areas go beyond interest and can be also identified as "problems" that need to be solved through engaging with information (e.g., b, c, d, e), while some other involve situations where at some point in time an interest area may turn into a problem (areas c and d). These examples illustrate the richness of information needs, which can evolve over time and be addressed with various levels of user initiative (from passive to active) and user goal-directedness (from undirected to directed) – the two dimensions of the information acquisition space (IAS) (See Figure 1 above).

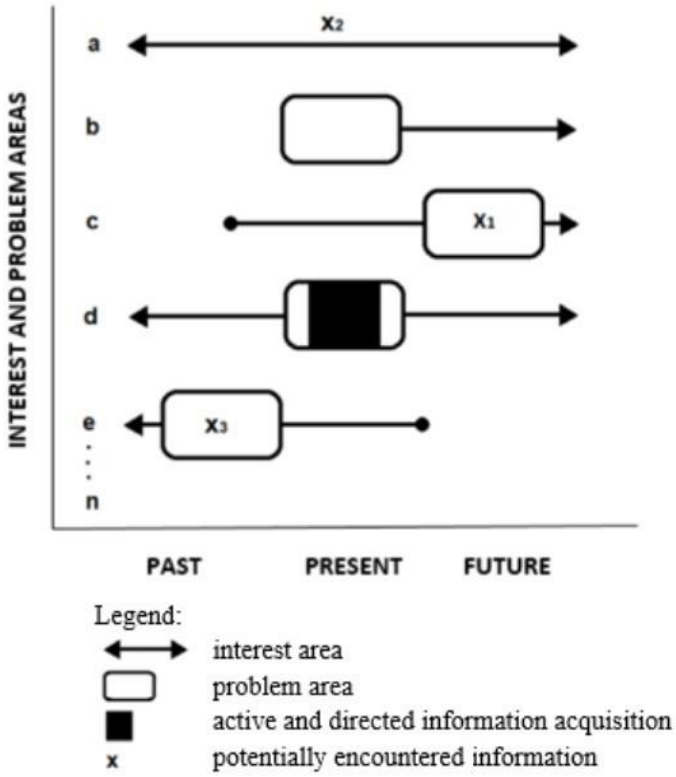

Figure 2: Temporal model of IE

At the time of an information encounter, a person can find her/himself engaged in any of the quadrants of the IAS as a foreground activity. However, the model depicted in Figure 2 places the user in the mode of active and directed information acquisition to address a particular problem. The experience of information encountering connects the user with information needs from interest and problem areas that are in the *background* (i.e., not the current focus of their active, directed information acquisition activities). These needs can be present, past of future needs. In Figure 2, several (but not all) possible options for encountering information are identified (see x1 to xn). For example, x1 is an information encounter that triggers recognition of a need related to a future problem area, x2 triggers recognition of a need related to a present interest that is not being currently pursued and x3 triggers recognition of a need related to a past problem (which may or may not still be useful to address).

The model uses the lens of information encountering to enrich understanding of information acquisition as a temporal activity. It captures users' movement across problem/interest areas as they interact with information with different levels of user initiative and goal-directedness. The model also provides a framework for better understanding of the temporal dimension of information acquisition, which has been traditionally under-emphasized in HIB research (Savolainen, 2006). A strength of the model in terms of explaining the nature of information encountering is its flexibility to illustrate various examples of IE from across the information acquisition space. The model is also potentially expandable to depict connections with other types of information behavior. For example, it can be enriched with the addition of information sharing and personal information management of encountered information.

8. Information Encountering as a process: Existing process models and our new, refined model

The few existing studies on IE have focused on defining encountering as a descriptive *process*. This process comprises a set of stages that describe what happens when someone finds information, they consider to be unexpected *and* interesting, useful or potentially useful.

8.1. Erdelez's original (1995) IE process

The original IE process, as presented by Erdelez (2005), is embedded within an active, goal-directed information seeking task (for example, looking for information on a specific topic). Erdelez referred to this as a *foreground task* and suggested that, rather than being related to the foreground task, the encountered information is related to a *background* task, problem or interest, as illustrated above. Björneborn (2017, p. 1067) refers to these tasks using the related terms of "foreground serendipity" and "background serendipity".

The IE process, as originally identified from interviews by Erdelez (1995) (see Figure 3), firstly involves *noticing* an unexpected informational stimulus (such as some text or an image) that gives off an *information scent* (Pirolli & Card, 1999; Spool et al., 2004) suggesting the information may be potentially interesting or useful. It then involves temporarily *stopping* the active (foreground) information seeking task in order to *examine* the encountered information. Note that the informational stimulus and the encountered information may or may not be one and the same (Jiang et al., 2015); a hyperlinked Webpage or article title, an image or video thumbnail or search result snippet (informational stimulus) may entice the encounterer to examine the information itself (e.g., Webpage, article, image, video) in detail. If considered interesting, useful or potentially useful for one's self or someone else, the encountered information is *captured* - for example by downloading and saving or bookmarking it. Subsequent IE researchers use the terms *storing* (Awamura, 2006), *acquiring* and *saving* (Jiang et al., 2015) instead of 'capturing,' but all cover the activity of keeping a record of the encountered information. The original IE process concludes by *returning* to the original foreground task.

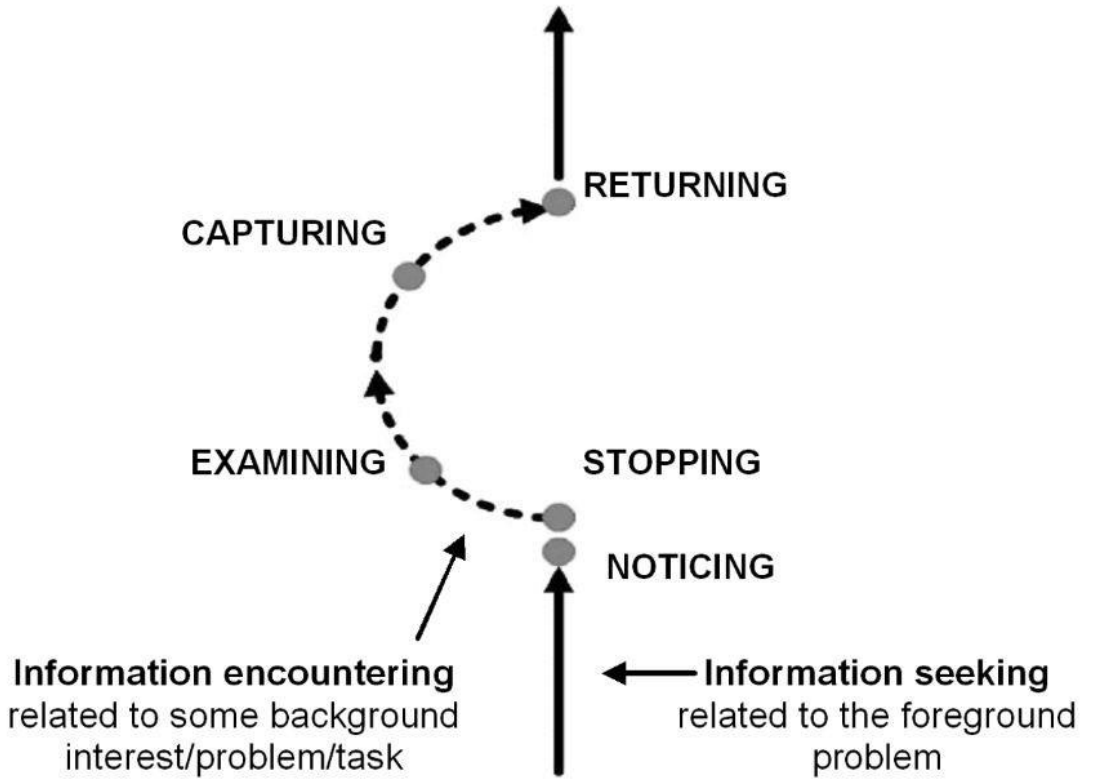

Figure 3: Reproduced with permission from Erdelez., S. (2005). Information encountering, In Fisher, K. E., Erdelez, S., & McKechnie, L. (Eds.). (2005). Theories of information behavior. Information Today. NY, USA.

Some IE researchers have noted that the encounterer does not necessarily 'return' to the original information seeking task after the encounter (Awamura, 2006; Makri and Warwick, 2010). For example, Makri and Warwick found when observing Architectural and Urban Design students' information behavior that in some cases, the students used the information they encountered to adjust the focus of their subsequent searches, similar to Bates' (1989) berrypicking. For example, one participant searched Google for the phrase "imagination of the city" to fulfill a brief of designing a future city. After encountering interesting artwork by installation artist Janet Cardiff, she reformulated her search to "Janet Cardiff London" to find more examples of Cardiff's artworks, which included some video clips. Then, rather than return to the original search, she decided to search for more videos, this time using the terms "Paris illustration." In this example, the student did not return to her "imagination of the city" search and, instead, leveraged the information encounter to help advance her exploratory search.

8.2. Jiang et al.'s (2015) empirical refinement of the information encountering process

The most comprehensive enhancement to the IE process to date has been by Jiang et al. (2015). As with Erdelez's original model, their refinement was based on interviews with encounterers. However, while Erdelez's interviews focused on understanding encountering in general, those by Jiang et al. focused on eliciting and probing *memorable examples* of encountering on the Web. One of the key contributions of this refined model was the articulation of pre- and post-encounter activities. Jiang et al. (2015) assert that *"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… meanwhile it provides at global view of the macro-process that reveals the causes (pre-activities) and effects (post-activities) of the encountering occurrence "* (p. 1147) While Erdelez's (2004) description of IE suggests it is embedded within a *search* task, Jiang et al. (2015)'s model (Figure 4) suggests it can also occur during a variety of different types of information seeking tasks - when *browsing*, or when engaging with social networking or instant messaging tools to support *social interaction*.

Another of this model's key contributions is the integration of several contextual factors related to the encounterer (*user*), *information* and encountering *environment* identified earlier by Erdelez (1997). User-related factors include their curiosity levels, ability to respond to informational stimuli effectively, current emotional state, search expertise, diversity of information activities engaged with and their attitude towards information acquisition. Information-related factors include topic, relevance, quality, visibility and source. Environmental factors include perceived or actual time constraints on information acquisition and Website usability (sites with low usability discouraged exploration and therefore encountering).

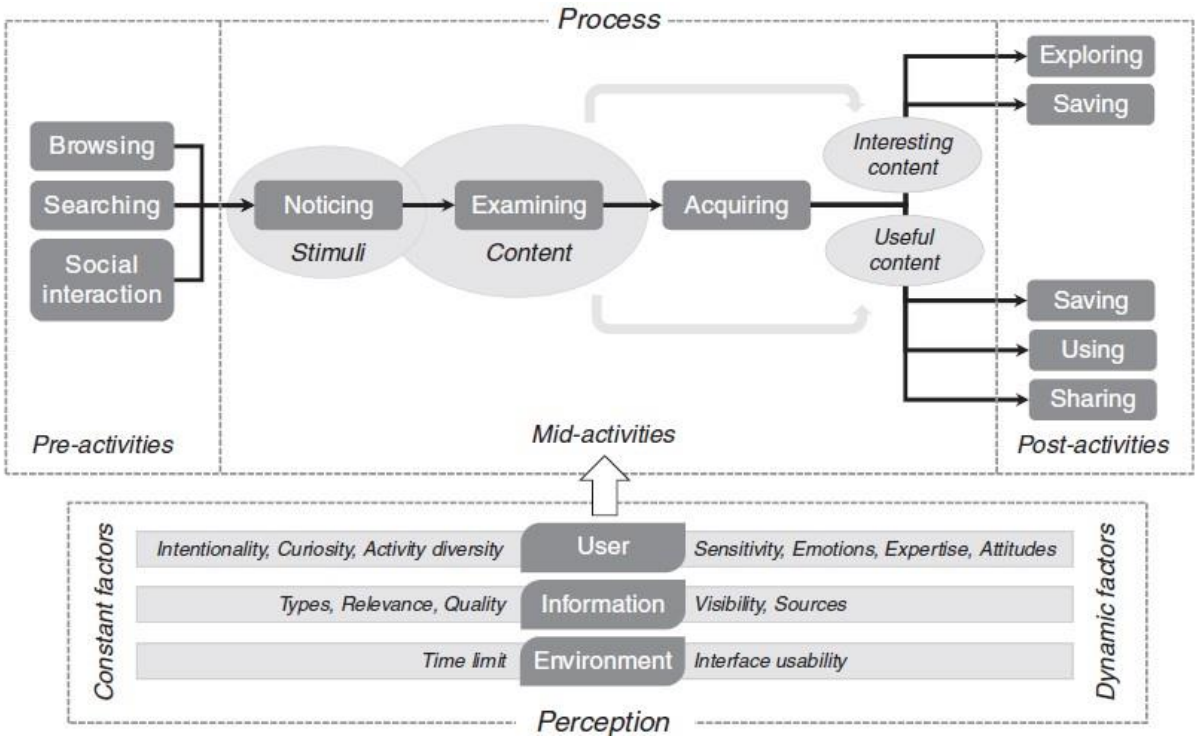

Figure 4: Reproduced with permission from Jiang, T., Liu, F., & Chi, Y. (2015). Online information encountering: Modeling the process and influencing factors. Journal of Documentation, 71(6), 1135-1157.

8.3. Jiang et al.'s refinement of the IE process based on secondary data analysis

A recent refinement to the IE process (Figure 5), based on secondary analysis of examples of IE from the literature, was made by Jiang et al. (2019) - resulting in a new, but complementary model of the IE process that integrates findings from previous empirical studies. The Jiang et al. (2015) model (Figure 4) focused primarily on breaking down the core activity of the encounter into constituent physical activities such as 'noticing,' 'examining' and 'acquiring.' The model (Figure 5) by Jiang et al. (2019) describes the process at a higher level of abstraction, focusing on pre- and post-encountering activities in as much detail as the encounter itself. These include:

- The **environment** IE occurs in; IE can occur in a variety of offline environments (e.g., physical libraries, bookshops, museums, stores) and online environments (e.g., the Web, digital libraries, social media platforms) (Björneborn, 2017; McCay-Peet and Toms, 2015).
- The **foreground activities** that can spark IE (i.e., the types of activities that IE can be an embedded part of).
- The encounterer's **emotional state** before and after encountering information. IE can be experienced as a personal triumph that can result in a sudden, unexpected spark of interest or insight, potentially turning negative emotional states (e.g., frustration or uncertainty) into positive ones (Makri & Blandford, 2012 a, b; Erdelez, 1997).

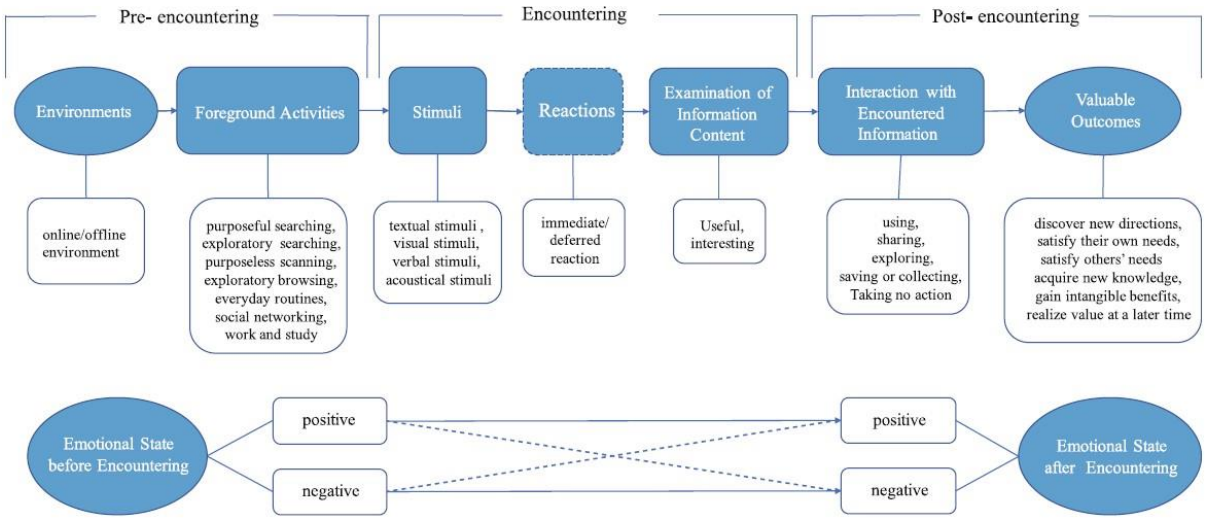

Figure 5: Reproduced with permission from Jiang, T., Fu, S., Guo, Q. & Song, E. (2019). Modelling the process of information encountering based on the analysis of secondary data. In proc. iConference, Washington D.C.

8.4. Our refinement of the IE process

Figure 6 below represents an incremental refinement of the IE process, synthesizing and building on the existing models by Erdelez (1995; 2004), Awamura (2006) and Jiang et al. (2015; 2019). The model *enhances detail* of the process by elaborating the types of task that can lead to encountering and those that can happen post-encountering, based on empirical IE research findings. It also incorporates task-related contextual factors, which have also been found to influence the encountering process. Finally, it *clarifies* the process by synthesizing the process stages from prior research into a coherent process that explains what happens during an encounter in more detail than previous models.

8.4.1. Pre-encounter

While the IE process has been previously considered as *embedded* within an active information seeking (usually search) task, the revised model considers it as a potential (positive or negative) 'detour' from an existing task that can, but does not necessarily, result in the encounterer returning to the task afterwards. The existing task can be but is not always an *active information seeking task* – it can fall within any of the four information acquisition space quadrants in Figure 1. When it is an active information seeking task, it will often be an active *search* task - as suggested by Erdelez's original model (Erdelez, 1995). However, it can also be a *browsing* task. This task can be anywhere along a spectrum of goal-directedness, from highly goal-directed, to semi-directed, to relatively non-directed. During active information seeking, IE has been found to occur both when looking for particular information and when looking for some information, but not anything in particular (Jiang et al., 2015; Makri et al., 2015).

It is also possible for IE to occur when *passively acquiring* rather than actively seeking information. This can be as a 'tangent to a tangent' during another encountering episode (chains of information encounters were noticed in Makri and Buckley, 2019). It can also be as a result of other forms of passive 'lean back' information acquisition (Lindley et al., 2012). Unlike when actively monitoring specific information topics or sources of interest, when maintaining awareness, the user *does not* specify what information they are interested in. Instead, they 'absorb' interesting or potentially useful information from the environment. Information can also be encountered when not looking for information at all (Makri and Blandford, 2012 a, b; Makri et al., 2015, Yadamsuren and Erdelez, 2010, 2016), when engaged in *everyday life activity*, such as watching television, shopping or simply walking down the

street. While these everyday life encounters have been referred to as "micro-serendipity "by Bogers and Björneborn (2013), they can range from being low-impact, to life-changing.

8.4.2. The Information Encounter

Regardless of whether it happens while undertaking an active seeking, passive acquisition or everyday life task, the IE process involves the following process: Firstly, it involves *noticing* a promising informational stimulus, as described at the beginning of this section. The pre-encounter task is then either permanently *stopped* or temporarily *suspended* (a clarification to the terminology used by Erdelez, 1995; 2005, where 'stopping' involves temporarily suspending an active seeking task, to return to it later). Next, the process involves *acquiring* the informational content (e.g., an interesting, useful or potentially useful article or Webpage). As in Jiang et al.'s (2015) model, the informational stimulus and content may be one and the same, or the stimulus may be an abbreviated form of the content (e.g., a title, search result snippet, summary or abstract). The process then involves *examining* the acquired content, often by reading it - sometimes thoroughly, word-for-word, other times skimming through it or reading only particular sections in detail), in order to determine its interestingness or usefulness. This serves to clarify the order in Jiang et al.'s model, as in our refined version information is acquired before it is examined, rather than the other way around.

After examining the content, the encounter may immediately consider the information interesting or useful or dismiss it as uninteresting or not useful. They might also be unsure, considering it as potentially useful. In such cases, the IE process involves *exploring* the encountered information, by conducting follow-up information seeking to determine its actual usefulness. Next, the process involves *capturing* the encountered information (using terminology proposed by Erdelez, 1995; 2005), provided it is considered interesting, useful or potentially useful, and *storing* it - e.g., by saving it, bookmarking it etc. Not all encountered information deemed interesting, useful or potentially useful is captured; sometimes encounterers will attempt to re-find it again in the future instead. The process concludes by *using* the encountered content, if it is considered useful for one's self by incorporating it into one's work, everyday life or thinking. It involves *sharing* content considered interesting or (potentially) useful for others. Using and sharing may occur immediately after the information is captured and stored, or sometime in the future.

As in Jiang et al.'s (2015) model, our refined process incorporates several contextual factors that have been found to influence information encountering as referenced earlier in the work of Erdelez. These include: *user-related factors*, such as personality, interests, attitudes and mood; *information-related factors* such as the relationship of the information encountered to past, current and future needs (as illustrated in Figure 2 above), the information design and the quality and availability of the information source; *environment-related factors* such as environment design and usability and *task-related factors*, such as the perceived urgency or importance of the pre-encounter task.

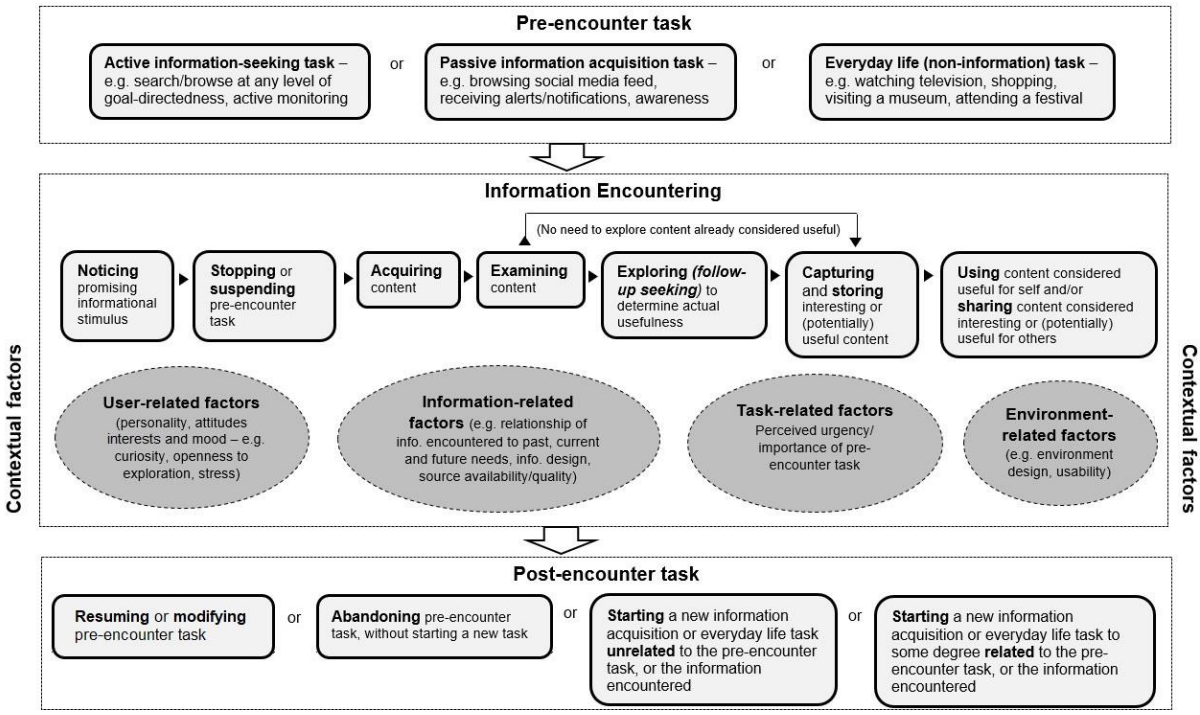

Figure 6: The refined information encountering process

8.4.3. Post-encounter

The above IE process is an idealized one; it can be disrupted at any point if the encounterer does not consider the encountered information interesting, useful or potentially useful enough to drive the process forwards, or if they consider it a more useful investment of their time to perform an alternative information or everyday life task. Waugh et al. (2017) noted a 'seeking-encountering tension' which, on one hand enticed encounterers to explore and examine in detail content they unexpectedly found and, on the other, pulled them back towards the relative safety of the active, goal-directed information seeking task they suspended. At any time, the encounterer may decide to **resume** or **modify** their pre-encounter activity (regardless of whether it was an active seeking, passive acquisition or everyday life activity). But, as noted by Awamura (2006), they may decide to **abandon** the pre-encounter task, without starting a new task or to start a new task (as noted by Makri and Warwick, 2010).

9. Theoretical contributions

In this section, we discuss the importance of the theoretical contributions of this work to the sub-field of Human Information Behavior and to the field of Library and Information Science more broadly.

The key theoretical contributions of this work are: 1) a re-conceptualization of the definition and scope of information encountering, 2) a conceptual model of information acquisition, which situates information encountering within a broad 'information acquisition space', 3) a conceptual model of how information acquisition occurs over time from an information encountering perspective and 4) a refined process model of information encountering, synthesizing and building on existing models. All these contributions seek to clarify the concept of information encountering by explaining it in more detail than before, and by explaining it more holistically (in relation to information acquisition more broadly and how it can unfold over time).

A broader re-conceptualization of the definition and scope of IE allows for the term 'information encountering' to be used to explain and describe all possible types of serendipitous information acquisition – not just those that occur during an active search for other information. Information

encountering can occur across the information acquisition space; when *actively* searching, browsing or monitoring or when *passively* monitoring or maintaining awareness of a topic or person, event etc., when information acquisition is highly *goal-directed* (such as when searching for a specific journal article) or more *undirected* (such as when browsing all articles in a particular issue of a journal). This work has also situated information encountering within a broad 'information acquisition space' – a conceptual space spanning the dimensions of user initiative (from active to passive) and user goal-directedness (from highly goal-directed to undirected). We hope this will encourage future research on types of passive information acquisition that do *not* occur during active seeking (e.g., maintaining passive awareness). While passive information acquisition is an important means of finding information, acquisition beyond active seeking is little understood. The information acquisition space can be leveraged by LIS researchers to consider what different types of information acquisition may be important to study in their specific research area of interest and by designers of digital information environments to consider what different types of information acquisition to support and how best to support them.

We think 'information encountering' is a particularly appropriate term for serendipity in the context of information acquisition, as it allows the broader concept of 'information acquisition' to be broken down into active *information seeking* and passive *information encountering*. This is a simple, yet powerful way of distinguishing between active and passive information acquisition and may also serve to unify terminology if adopted by the research community as a preferred term for serendipity in the context of information acquisition. We also think IE is a particularly appropriate term as it was one of the first serendipity-related terms to be created in the field of HIB (Erdelez, 1995) and is still used to frame and motivate current studies of passive information acquisition (e.g., Jiang et al., 2019; Makri and Buckley, 2019).

By presenting conceptual models of the information acquisition space and of how information acquisition can occur over time from an information encountering perspective, we provide a richer theoretical description of the nature of IE. The temporal model allows LIS researchers to reason about the role time plays in IE – emphasizing that information encounters can relate not only to current information needs but also to past or future needs. This has implications for the personal information management of information previously encountered (in case this information might be useful to address an as-yet unrecognized need) and of information encountered in the present (in case this information might be useful to address a past, but still active, need). The model can be used flexibly to illustrate various examples of IE from across the information acquisition space (e.g., information encountered through a notification or alert related to a present, past or potential future information need).

Our refinement of the IE process model incorporates and builds on existing models, clarifying the IE process by synthesizing the process stages from prior research into a coherent process that explains what happens during an encounter in more detail than previous models. It enhances the detail of the process by elaborating the types of task that can lead to encountering (active seeking, passive acquisition and non-informational) and those that can happen post-encountering (resuming or abandoning the pre-encounter task, starting a new task), based on empirical IE research findings. It also incorporates task-related contextual factors (such as the perceived urgency or importance of the pre-encounter task), which have also been found to influence the encountering process. This incremental refinement to the IE process adds clarity and detail to the process and provides a more holistic view of the process, by situating the information encounter itself within the context of the pre- and post-encounter tasks that trigger and follow-on from it. The model illustrates the 'conceptual landscape' of IE, supporting future researchers in identifying aspects to understand in more detail. These include particular types of pre-encounter tasks (e.g., IE through receiving notifications or alerts), particular types of contextual factors (e.g., the influence of digital environment design), or particular types of post-encounter tasks (e.g., starting a task related to the encountered information). The model also allows designers of ~~digital~~ physical and digital information environments to reason about which types of pre- and post-encounter tasks as well as which parts of the IE process specifically to support and how best to do so.

Cumulatively, these theoretical contributions enhance the concept of IE by providing greater clarity and detail. We hope that providing a more precise definition, clearer scope and richer theoretical description of the nature of IE will make the concept more accessible – not only to researchers in HIB, but also to LIS researchers more broadly. In turn, we hope this will encourage future terminological uniformity and therefore research consistency - thereby promoting deeper, more unified theoretical development and accelerating the theoretical growth of research into passive forms of information acquisition.

10. Conclusion

In the field of information behavior, process-based models have been created and subsequently revised to better reflect reality (i.e., what people actually do to look for information). In this field, models have often been extended or enhanced to incorporate a broader or deeper range of activities, or to model more complex aspects, such as contextual factors that can influence seeking. We envisage a similar trajectory for models of IE, where conceptual and empirical research will drive enhancement - 'stabilizing' once the concept is sufficiently clear and detailed to accurately reflect reality, but not necessarily remaining static.

In this article we first elaborated on definitional aspects of information encountering, the term we propose as the preferred, unifying term for experiences of serendipity in the context of information acquisition. Second, we provided a re-conceptualized definition of IE emphasizing that it appears within a multi-dimensional information acquisition space that ranges from passive and undirected to active and directed information acquisition. We offered some additional interpretations of how the proposed definition of IE may contribute to a temporal understanding of information acquisition and Human Information Behavior. Third, we proposed a refined model of the IE process. At a micro level, this model terminologically identifies presence of additional, alternative steps in the IE process. At a macro level, building upon the existing literature, the model positions IE within contextual factors related to user, information, task and environment-related characteristics. The model also integrates the IE process with pre-encountering and post-encountering activities.

Finally, we return to the opening thoughts on serendipity as an intriguing and challenging topic of study. From the perspective of LIS, it is important to understand it both at a broad level, as a fundamental aspect of the human experience, and also as applied specifically to information acquisition. The mechanisms of serendipity at the broad level help contextualize the information acquisition aspects that have long been neglected in LIS research.

Information encountering as a type of information acquisition is a way of finding information with seemingly little or no effort. It is a welcome and delightful experience – a 'stitch in time' that can stimulate augment new insight. Therefore, it is important to design physical and digital information environments to support information encountering, whether explicitly or implicitly. It is also important to design information environments where facilitating information encountering is considered important to support both active and passive information acquisition. This will provide flexibility in how information encounters can occur (e.g. through passive modes of information acquisition such as awareness as well as active modes, such as search).

This work contributes to the delineation of concepts and conceptual model-building, aiming to support the theoretical growth of research into information encountering and serendipity more broadly. Such growth has the potential not only to help us better understand this important (but relative to information-seeking under-researched) area, but also to better reason about how we can design information environments that support users in having stimulating and productive information encounters.

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