

A Context-based Study of Serendipity in Information Research among Chinese Scholars

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Purpose: The current understanding of serendipity is based primarily on studies employing Westerners as participants, and it remains uncertain whether or not this understanding would be pervasive under different cultures, such as in China. In addition, there is not a sufficient systematic investigation of context during the occurrence of serendipity in current studies. This paper examines the above issues by conducting a follow-up empirical study with a group of Chinese scholars.

Design/methodology/approach: The social media application “Wechat” was employed as a research tool. A diary-based study was conducted and 16 participants were required to send to the researchers any cases of serendipity they encountered during a period of two weeks, and this was followed by a post-interview.

Findings: Chinese scholars experienced serendipity in line with the three main processes of: encountering unexpectedness, connection-making and recognising the value. An updated context-based serendipity model was constructed, where the role of context during each episode of experiencing serendipity was identified, including the external context (e.g. time, location and status), the social context, and the internal context (e.g. precipitating conditions, sagacity/perceptiveness and emotion).

Originality/value: The updated context model provides a further understanding of the role played by context during the different processes of serendipity. The framework for experiencing serendipity has been expanded, and this may be used to classify the categories of serendipity.

Keywords: serendipity, context, model, information encountering

Paper type: Research paper

1. Introduction

Research into serendipity has been ongoing since the term “serendipity” was first coined by Horace Walpole in 1754, in reference to the Three Princes of Serendip, who were always making discoveries by accident. Studies relating to serendipity can be found in various disciplines, including information studies (Foster and Ford, 2003),

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6 human computer interaction (Sun et al., 2011), social science (Merton, 2004), career
7 research (Bright et al., 2005), arts and humanities (Delgadillo and Lynch, 1999),
8 psychology (Heinström, 2006), organisation (Cunha et al., 2010), and medicine
9 (Allegaert, 2013).

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11 However, regardless of the increasing interest in the understanding of serendipity,
12 an interesting discovery revealed from our review of current studies is that the
13 proposed frameworks or theoretical models for serendipity were formed primarily on
14 the basis of taking Westerners as the research subjects (e.g. Makri and Blandford,
15 2012a; McCay-Peet and Toms, 2015). This led to our thinking about whether or not
16 these research findings would be pervasive under different cultures, such as in China.
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20 In addition, although a number of theoretical models for serendipity have been put
21 forward by various researchers (Erdelez, 2004; Makri and Blandford, 2012a; McCay-
22 Peet and Toms, 2015; Rubin et al., 2011), very few of these studies have examined
23 the occurrence of serendipity from a systematic perspective of context. The empirical
24 studies by Points et al. (2015) showed contextual factors such as location, activity and
25 focus can influence a user's experience of serendipity. Kefalidou and Sharples's
26 (2016) study also found that time, location, and the content of a text message can also
27 impact a user's experience of serendipity. Serendipity, as part of a wider behaviour
28 model, is considered as "the product of context" (Foster and Ellis, 2014, p.18), and the
29 role of context in fostering serendipity deserves to be understood in its own right.
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33 We previously undertook a mobile-diary study to understand serendipity among a
34 group of British researchers (Sun et al., 2011). Eleven British scholars participated in
35 that study, and we received 23 serendipity cases within one week. The outcome of the
36 study was that we identified the perception of serendipity among these British
37 researchers and made an initial probe into the role of context in serendipitous
38 experiences (See Figure 1). We identified two different levels of abstraction that can
39 lead to a positive outcome during a serendipitous experience, including level of
40 abstraction 1 "the unexpected finding of information" and level of abstraction 2
41 "making unexpected connections between pieces of information", and in some cases
42 level of abstraction 1 can lead to level of abstraction 2. Context played a role in
43 affecting the experiencing of serendipity, and it has been examined from the three
44 perspectives of: people (active or less active), temporal factors, and environment (i.e.
45 working environments, places, and changing environments). We then adopted
46 Schmidt's (2000) context model to denote the relationship between the role of the
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6 individual and their context in serendipity by considering different elements, such as
7 an individual's level of attention, pressure, and focus under the effects of the physical
8 environment, the social environment and the time. However, limited by the perception
9 of serendipity at that time, we only discussed these elements as different factors
10 having an influence on participants' readiness to experience serendipity, and thereby
11 failed to make a further examination of how these elements would act during the
12 separated processes of serendipitous encountering.
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16 Based on our previous study and the inspiring achievements made in the field of
17 serendipity study in recent years, we carried out a follow-up empirical study among a
18 group of Chinese scholars with the following research aims:
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- 20 • To identify whether the current understanding of serendipity can also be
21 adapted to Chinese scholars;
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- 23 • To further investigate the role played by context during the different
24 processes of experiencing serendipity.
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26 {Insert Figure 1 here}
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29 2. Background

30 2.1 Context in serendipity research

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32 In recent decades, a number of researchers have performed different studies with
33 respect to serendipity, although these researchers have not reached a consensus on the
34 definition of serendipity. For example, van Andel (1994) defines serendipity as “the
35 art of making an unsought finding”, while Fine and Deegan (1996) give the definition
36 of serendipity as “the unique and contingent mix of insight coupled with chance”.
37 More recently, McCay-Peet and Toms (2015) contend that serendipity is “an
38 unexpected experience prompted by an individual's valuable interaction with ideas,
39 information, objects, or phenomena”, while the term serendipity is defined in
40 Björneborn's (2017) paper as “what happens when we, in unplanned ways, encounter
41 resources (information, things, people, etc.) that we find interesting”. Rather than
42 giving a definition, Makri and Blanford (2012) identified three key elements for
43 serendipitous encountering: unexpectedness, insight and value.
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49 However, regardless of the various definitions, it is well accepted by information
50 researchers that serendipity is an integral part of information behaviour, and “context”
51 is a significant concept when studying information behaviour, as argued by Case and
52 Given (2016):
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7 The seeker—whether actively looking for information or receiving information
8 through serendipity—exists in an environment that partially determines,
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10 constrains, and supports the types of needs and inquiries that arise. The seeker
11 also has his or her own memories, predispositions, and motivations—an internal
12 environment of influence. (Chapter 3, p. 48) and Context determines much of a
13 person’s perceptions throughout the [information seeking] process, and it affects
14 one’s choice of sources and meanings. (Chapter 11, p. 351)
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19 Björneborn’s (2017), who adopted the theory of affordances from Gibson (1977),
20 also argues that serendipity can be viewed as an affordance, which should never
21 reside inside the environment alone nor inside people alone, but should be viewed as
22 the relational phenomenon between people and a given environment. In a similar vein,
23 after a review of serendipity studies in information research, Foster and Ellis (2014)
24 concluded that serendipity does not exist within a vacuum, but is “the product of
25 context” (p.18). Some empirical studies also demonstrate contextual factors affecting
26 an individual’s experiencing of serendipity. For example, through a “Wizard of Oz”
27 approach, where users received text messages/suggestions from a group of “wizards”
28 based on users’ notes in an app “SerenA”, Points et al. (2015) found that those
29 contextual factors such as location, activity and focus can influence a user’s
30 experience of serendipity. Similar findings can be found in another paper (Kefalidou
31 and Sharples, 2016), where the contextual factors such as time, location, and the
32 content of the text message can impact a user’s experience of serendipity. McCay-
33 Peet and Toms (2015) have found that those environmental factors which are trigger-
34 rich, enabling connections and leading to the unexpected can help users facilitate
35 serendipity in a digital environment. Such ongoing research findings provide
36 substantial evidence that context does play a vital role in people’s experience of
37 serendipity.
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47 *2.2 A Further Discussion of Context*

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49 From a review of the existing studies on the issues of context and serendipity, it is
50 evident that none of them have systematically discussed the term “context”, nor how
51 it may influence the different processes during a serendipitous encounter. Björneborn
52 (2017) used the term “affordance”, McCay-Peet and Toms considered “environmental
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factors”, while Kefalidou and Sharples’ (2016) description of context also refers to a user’s different activities. Foster and Ellis (2014) argued that “even context is debatable and has been the subject of exploration in its own right” (p. 18). Case and Given (2016) considered context to be “ill defined”, but also highlighted its important role when integrated in human information behaviours. Taken together, we believe there is a need to probe this special term “context”.

Based on a review by Courtright (2007), the study of “context” in information science has shifted from a “system-centred” to a “user-centred” stance. A previous “system-centred” view regards context as an “objective reality” (Talja, 1997), which has served as a backdrop for those environmental factors or variables that exist objectively around the information actor, and can therefore be enumerated by the researcher. Such a view of context is also labelled as “objectivist” (Talja et al., 1999), which presents context as a set of entities that can be conceptualised independently to influence a participant’s information practices (e.g. temporal or spatial conditions, problem situations, etc.). However, taking only those environmental variables into the consideration of context fails to shed light on the variability among actors in the same or similar settings. The information actors can carry out actions independently and differently in response to the variability of the environmental factors in their information practices. Therefore, an increasing number of researchers have now attempted to examine the role of context from the viewpoint of the information actor. This “user-centred” view emphasises the role of information actors during their information practices, and considers the information activities in relation to the contextual variables and influences. Various models have been constructed to support this kind of view, such as Wilson’s (1981) information seeking model where an individual’s physiological, affective and cognitive needs are located in the concentric layers at the root of motivation towards the information seeking behaviour. Foster’s (2004) nonlinear model for interdisciplinary information-seeking also highlights information seekers’ feelings and thoughts, coherence, knowledge and understanding as the internal context to influence information seeking behaviour. Although such a person-in-context stance is being accepted by more and more researchers, there are also critics who argue that these models do not account adequately for the mutual interactions of contextual factors, especially the social interactions. Each individual is conceptualised as a social actor (Lamb et al., 2003) and knowledge as inherently social (Talja, 1997). Therefore, information actors should construct information not

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6 only through their physiological or affective needs but also through social
7 interactions. Rather than simply observing the information actors' behaviours or
8 recording their views, the relevant discourse should also be taken into consideration
9 when trying to gain an understanding of the role of context in information research
10 (Given, 2002; Sundin, 2002; Talja et al., 2005). Taken together, Courtright (2007)
11 suggests the combination of multiple methods to paint a comprehensive portrait of
12 context, which should not only try to capture any environmental variables around the
13 information actor, but should also try to understand their mind-sets and follow the
14 links across their multiple social settings.
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19 Following the above discussion, in this paper we discuss the environmental
20 variables as the "external context", the mind-sets relating to the role played by the
21 information actor as the "internal context", and the social settings around the actor as
22 the "social context".
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26 2.3 Existing Serendipity Models

27 Although the study of serendipity is still an emerging research discipline, several
28 studies in information research have explored how serendipity happens, and
29 theoretical models have been designed by the researchers. We reviewed the six
30 existing models for serendipity, five of which are process-oriented while the sixth is
31 based on the essence of serendipity.
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36 *Process-orientated models*

37 The first model designed to help with an understanding of serendipity was
38 proposed by Erdelez (2004), who also labelled serendipity as "information
39 encountering", a specific type of opportunistic acquisition of information. The study
40 was undertaken in a controlled environment where users were asked to actively look
41 for information relating to a particular foreground problem, but where they actually
42 encountered information relating to a background problem. According to this model,
43 the information encountering process is divided into five stages: *noticing*, *stopping*,
44 *examining*, *capturing* and *returning*. A user's current searching behaviour with regard
45 to the foreground problem is interrupted when he *notices* the information related to
46 the background problem. The user then *stops* to *examine* this information, *captures*
47 any useful details and finally *returns* to the search relating to the foreground problem.
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6 This model later won support from Makri and Warwick (2010) in a study of
7 architects' web behaviour.

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9 McCay-Peet and Toms (2010) adapted Cunha's (2005) conceptual model of the
10 serendipity process in organisational management, and identified the process of
11 serendipity as follows: *while searching for a solution to task A*, with certain
12 *precipitating conditions* a person perceives a *trigger* and then sparks a *bisociation*
13 between disparate, previously unconnected pieces of information and finally this leads
14 to *an unexpected solution to task A, or even to a new task B*. The most salient point of
15 this model is the *precipitating condition* (Cunha, 2005) which shows that, to some
16 extent, serendipity can be guided with appropriate strategies. This model has been
17 updated recently by combining several other models with respect to serendipity
18 (McCay-Peet and Toms, 2015). The process of a serendipitous experience is redefined
19 as a combination of seven elements, namely, *trigger, delay, connection, follow-up,*
20 *valuable outcome, unexpected thread* and the final *perception of serendipity*. In
21 addition, they argued that, unlike other elements, the elements of *delay* and *follow up*
22 "do not have to happen for perception of serendipity to occur".

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29 The remaining two models are more focused on the mental processes of
30 individuals who have had serendipitous experiences. Lawley and Tompkins (2008)
31 considered serendipity as "the whole shebang" with six components including the
32 *prepared mind, an unexpected event, recognised potential, seizing the moment,*
33 *amplifying the effects* and *evaluating the effects*. They argued that following the
34 removal of any of the six components and the iterative circularity from recognising
35 potential to amplify the effects, the process would no longer be regarded as
36 serendipity. Makri and Blandford (2012) developed their serendipity model based on
37 semi-structured interviews with 28 interdisciplinary researchers. Their findings
38 suggested that *unexpected circumstances* and *insight* could stimulate a person to *make*
39 *new connections* with an iterative process *by projecting the potential value of an*
40 *outcome* and further *exploring the value* to gain a *valuable, unanticipated outcome*.

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46 Apart from the five process-oriented models, there is another important model
47 which depicts the essence of serendipity. Rubin et al. (2011) employed a selective
48 blog minding method by analysing 56 blog entry accounts of chance encounters, from
49 which they identified four key facets which can be used to facilitate serendipity: *a*
50 *prepared mind* (including a prior concern and previous experience), *an act of noticing*
51 (the ability to notice the provided clue), *chance* (an accidental or unplanned encounter
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6 with the find) and *a fortuitous outcome* (unexpected benefits linked to the find). An
7 individual may conclude whether or not an event should be regarded as serendipity by
8 a reframing of these four facets.
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10 On further reflection of these models, we have found that from a “user-centred”
11 point of view, these models all partly refer to the contextual factors, especially those
12 relating to the information actor, as is listed in Table 1. Erdelez’s model requires users
13 to notice the background problem, and such an “ability to notice” can be considered
14 as part of the internal contextual factors that affect an individual’s experiencing of
15 serendipity. In addition, her model is useful for understanding part of the process post-
16 encounter, but it fails to cover what happens beforehand (e.g. whether or not external
17 factors played a role to trigger the encounter). McCay-Peet and Toms’s (2010) model
18 identified “precipitating conditions” as “active learning” (internal context) and “social
19 networks” (social context), and as a requirement for a “trigger” (e.g. text, images,
20 audio) to facilitate serendipity. However, as an early model in knowledge work, this
21 model fails to look into how the “precipitating conditions” would impact the process
22 of serendipity. In their updated model (McCay-Peet and Toms, 2015), they further
23 highlighted how the “trigger” confirms the “noticing” element of the process of
24 serendipity, and identified the three forms of triggers as “verbal” “textual” and
25 “visual”. They further proposed different external factors (trigger-richness, highlight
26 triggers, enabling connections and enabling capturing) and internal factors (openness,
27 a prepared mind, the ability to make connections) that may influence the perception of
28 serendipity, but these factors, especially the external factors, are not discussed from
29 the perspective of context. The other two mental-process models focus mainly on the
30 perceptual process required for a serendipitous episode, and also discussed some
31 contextual factors. For example, Lawley and Tompkins (2008) considered a “prepared
32 mind” (internal context) and an “unexpected event” (external context) as necessary
33 components in a serendipitous episode, while similarly, Makri and Blandford (2012a)
34 considered how “unexpected circumstances” (external context) and “insight” (internal
35 context) can lead to making new connections, and they also found that, although not
36 directly reflected in their model, their participants’ moods or feelings (internal
37 context) can impact the openness to making connections. Similarly, chance (external
38 context), a prepared mind, an act of noticing and surprise (internal context) can all be
39 considered as contextual factors that are referred in Rubin et al.’s (2011) model.
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6 However, a systematic discussion from the perspective of these contextual factors
7 cannot be drawn from these existing studies.

8 {Insert Table 1 here}

11 3. Research Method

12 We developed a mobile-diary method for our study in the UK to help participants
13 capture their serendipitous experiences in a comparatively natural setting. Satisfactory
14 feedback was received via the mobile diary application, with 23 serendipitous cases
15 reported by 11 British participants within a one-week period. One major concern
16 raised by some of the participants in that study was that they were unwilling to carry
17 around an additional mobile device, and this undoubtedly affected their serendipitous
18 experiences. To overcome this particular drawback, in this study we used the social
19 media platform “Wechat” to replace the diary application. The main reasons for
20 choosing “Wechat” were: 1) it covers similar functions to our diary application, and
21 different types of data can be recorded and transferred (i.e. text, video, audio, and
22 image); 2) participants had no concerns about portability problems, and no additional
23 package needed to be installed on participants’ own mobile phones, as they were all
24 frequent users of “Wechat”, and were quite familiar with its functions; 3) “Wechat” is
25 a social media platform, so it also has the function of allowing direct communication
26 between participants and the researchers, and if participants had any problems during
27 the experiment period, they were able to send messages to the researchers and receive
28 immediate responses; 4) it had the advantage of allowing the researchers to send a
29 “reminder” to participants each day, to help to make them aware they were in an
30 experiment situation.

31 3.1 Participants

32 16 Chinese PhD students (eight males and eight females) were recruited to take
33 part in this follow-up study, with each participant having had at least 12 months’
34 research experience. We chose PhD students mainly because: 1) following the
35 research findings of Foster and Ford (2003) which showed that serendipity is
36 experienced widely among researchers, and PhD students are a group of scholars
37 dedicated to research projects who are easy to access; 2) our previous study recruited
38 11 PhD students and received 23 serendipity cases within a week. This successful
39 experience demonstrated that it was a feasible solution to recruit PhD students with
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6 which to conduct such a diary-study. Detailed information about all participants is
7 listed in Table 2. All the participants' names reported in this study are aliases.

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12 *3.2 Procedure*

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14 1) *Pilot Study*. A pilot study was performed with two participants (one male and
15 one female) at the University of Nottingham Ningbo China for a period of four days.
16 The detailed experiment issues (e.g. time arrangement, interview preparation) were all
17 determined according to the pilot study. Four serendipitous cases were collected from
18 the pilot study.

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20 2) *Pre-interview*. Each participant was invited to a short interview (around 30
21 minutes) before the empirical study. The research purpose was introduced, and
22 participants were invited to collect any cases they considered as serendipity during a
23 period of two weeks, either on the Web or as part of their daily activities (e.g. reading,
24 research, and socialisation). In addition to introducing the research purpose to each
25 participant, we also conducted two additional operations during the pre-interview, as
26 follows:

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28 (a) Each participant's initial understandings of serendipity were collected. During
29 the interview process we found that each participant reported that this was the first
30 time s/he had heard about the concept of serendipity. To better support the study, we
31 then carefully introduced participants to this concept. First, we presented the
32 definition of serendipity from the Oxford Concise English Dictionary: "*the*
33 *occurrence and development of events by chance in a happy or beneficial way*". We
34 then provided participants with the following example from the pilot study:

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43 *I was trying hard to download a journal paper which could be very relevant to my*
44 *research. However, when I checked in our university databases, it was not available to*
45 *download and payment was required to get access to the paper. Then, one day when I*
46 *was searching for other research papers, a web link of the paper turned up on the screen.*
47 *Being curious, I clicked the link and it asked me to register in a platform called Research*
48 *Gate. I followed the registration and was then amazed to find that the author of the paper*
49 *was also a member of Research Gate, so I followed him on Research Gate and sent him a*
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6 *request for a copy of the paper, and he sent me a copy of his working paper free of charge!*
7 *It was really exciting for me to get the paper by such a chance! (Pilot study Case 4)*
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10 We took care to highlight to participants that this example was simply provided to
11 help them to understand the concept of serendipity, and by no means to restrict them
12 to a particular type, stressing that there are various examples. They were instructed
13 that if they experienced any encounters which they considered as serendipity, they
14 should send the researchers a relevant message.
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17 (b) Participants were introduced to the group created using the social media tool
18 “Wechat” and its functions. To achieve better research results, we designed a specific
19 interface and instructed our participants on how to use its functions (Figure 2). A
20 detailed description of the interface is provided in Appendix A.
21

22 {Insert Figure 2 here}

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26 3) *Two-week study.* A lesson we learnt from our previous study is the necessity to
27 extend the experimental time window to give our participants sufficient time for
28 potential encounters with serendipitous experiences (one participant failed to send us
29 any information and argued that the time available was insufficient for him to
30 encounter serendipity). Thus, we set the experiment time period at two weeks for this
31 study. Participants were required to use the tool provided to record their serendipitous
32 experiences, and return them to the researchers within two weeks. All the sent data
33 was only visible to the researchers. In addition, at approximately 10:30pm each day, a
34 reminder message was sent to each participant by the researchers to better provide
35 them with a research context (Figure 2-c). The time chosen for sending the reminder
36 was based on the pilot study and observation of the routines of most participants.
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41 4) *Post-interview.* Each participant was invited to a post-interview at the end of
42 the study. The interview was conducted within one week and lasted for approximately
43 one hour with each participant. It was semi-structured and qualitative in nature and
44 centred on participants’ recorded serendipitous encounters, as well as participants’
45 experiences of the research method.
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49 3.3 Data Collection

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51 Two types of data were collected: the recorded diary data of the participants’
52 serendipitous experiences and the post-interview data. We received a total of 62
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6 serendipitous records, each describing a case which the participant regarded as
7 serendipity. The records for each participant were printed out to help them reflect on
8 their experiences during the post-interview. All interviews were recorded and
9 transcribed by the interviewer.
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11 3.4 Data Analysis

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14 The data we collected are qualitative in nature. A Thematic Analysis (Braun and
15 Clarke, 2006) was conducted to code the interview data. We first followed a top-
16 bottom theoretical thematic analysis to investigate how the participants experienced
17 serendipity. We began this part of the coding by identifying the themes drawn from
18 our previous study, where we identified the nature of serendipity according to two
19 different levels of abstraction, and the value of serendipity. The first level identified
20 the “unexpected finding of information” by considering different combinations of
21 three components: whether the information was directly related to the activity being
22 undertaken by the individual (non-activity-based vs. activity-based); whether or not
23 the information encountered was unexpectedly valuable to the encounterers
24 (unexpectedly valuable or not); and whether the information was from an unexpected
25 or likely source. The second level identified the making of unexpected connections
26 between different pieces of information, people and ideas.
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29 We then used a bottom-top inductive thematic analysis to identify any contextual
30 factors which existed in the serendipity cases. Initially, we identified a number of
31 categories, including the time for experiencing serendipity (i.e. a.m., p.m., and across
32 time periods), the different locations in which serendipity occurred (e.g. office,
33 dormitory, classroom, , library, etc.), the different activities during which serendipity
34 was experienced (e.g. travelling, surfing the Internet, attending seminars, talking to
35 classmates, talking to friends, etc.), and a category more related to an individual’s
36 cognitive or psychological characteristics, such as memories, an amount of thinking,
37 expertise, previous needs, instantly raised needs, and emotions (see Figure 3, for
38 examples of the coding for the pilot study case). We then compared the categories and
39 grouped those categorised with overlapping meanings into possible themes. As a
40 result, we concluded this layer of analysis with the three major themes of: external
41 context (i.e. time, location, and personal status), social context (e.g. different social
42 counterparts) and internal context (i.e. precipitating conditions,
43 sagacity/perceptiveness and emotions). It should be noted that the precipitating
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6 conditions include visceral needs, conscious needs and previous
7 experience/knowledge.

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9 After we finished coding the themes of the contexts, especially the internal
10 context themes of the precipitating conditions, we carried out a full review and found
11 that our original coding of the first level “unexpected finding of information” could
12 also be considered as a process of making connections between the encountering and
13 the precipitating conditions. As a result, we re-coded this part of the framework into
14 the three different themes of unexpectedness, connection-making and value, which
15 were further expanded into the sub-themes of “unforeseen means of encountering
16 information”, “unexpected content of the encountered information” and “both”. The
17 theme of “connection-making” was further expanded into “connection-making
18 between unexpectedness and visceral needs”, “connection-making between
19 unexpectedness and conscious needs” and “connection-making between
20 unexpectedness and previous experience/knowledge”, while the theme of “value” was
21 expanded into the sub-themes of “substantial value” and “emotional value”. This will
22 be discussed in detail in the following sections.

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28 {Insert Figure 3 here}

29 30 31 32 **4. Participants’ Perceptions of Serendipity**

33 By analysing the 62 reported serendipitous cases, we found that the Chinese
34 scholars conformed to the framework of experiencing serendipity according to the
35 three main processes of: encountering unexpectedness, connection-making and finally
36 leading to a valuable outcome.
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39 40 41 *4.1 Unexpectedness*

42 Three different channels were identified from our empirical study to facilitate the
43 likelihood of encountering unexpectedness during the new study:
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45 (i) *Any unforeseen means by which a participant encounters a piece of*
46 *information.* An example, which can better explain our identification of this element,
47 is provided in the following case:
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51 *[In a training session] a student delivered a talk on fire extinguishers several*
52 *days ago, which made me recognise that I had never noticed there is a fire*
53 *extinguisher in my lab before, and I raised some concerns, such as what were*
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6 *they used for? How did they work? I had all these concerns resolved today by*
7 *accidentally attending a 'fire alarm introduction' presentation. (Case 7)*
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10 The participant (P3) reported she had learnt about the principles of fire
11 extinguishers from a talk during a training session. She then raised the need to collect
12 relevant information about fire extinguishers around her lab setting (e.g. where they
13 are located in the lab, and how to use them). However, this need was not addressed at
14 that time and the participant forgot to address the need after the talk had finished. As
15 explained by the participant during the interview, "I just thought about it in my mind
16 and didn't write it down during the talk. Actually, when the talk finished, I just forgot
17 about it". It was not until she accidentally attended a related "fire alarm introduction"
18 that she realized the need again, and found the answer to this need during the
19 presentation. We argue that the answer to the participant's need was not unexpected to
20 her, but the way that she received the answer made her feel it was "unexpected", as
21 attending such a presentation was not her original schedule, "I even didn't know about
22 such a presentation, but one of my friends just asked me to accompany her".
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29 (ii) *The content of the encountered information brings unexpectedness.* In some
30 other cases, it is the content of the information that leads to a sense of
31 unexpectedness:
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34 *My instructor from an academic training session asked his students to present*
35 *an article during the session which he had just handed out to us. The article*
36 *was about a wind-up radio which greatly aroused my interest in radio*
37 *technology. I had never thought I would learn about wind-up radios in this*
38 *training. (Case 6)*
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43 In this case, the participant was situated in a certain context (a training session),
44 and it was the sudden appearance of information (about the radio) which was
45 interesting to him and resulted in his feeling of "unexpectedness".
46

47 (iii) *Both the unforeseen means and content of the encountered information bring*
48 *a sense of unexpectedness.:*
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51 *There was a seminar, but I didn't pay attention as it seemed not so relevant to my*
52 *research. However, I was required by my supervisor to attend. It was difficult for*
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6 *me to concentrate at the beginning of that seminar. My interest was aroused when*
7 *I noticed from the PPT that the lecturer had used the same simulation software as*
8 *me and he used a graphical way to present the results in his research, which I had*
9 *never considered before. I found it was really useful! (Case 1)*
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12
13 This is an interesting case, not only because of the unexpected information gained
14 from the seminar by the participant (i.e. presenting results with graphics), but also the
15 unexpectedness of attending the seminar, as explained by the participant:
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18 *In the beginning, it was not my intention to attend the seminar as I thought it was*
19 *not so relevant to my research. I just attended by accident and it was not*
20 *something I had planned to do. Furthermore, I didn't expect there would be such*
21 *useful information which I could take away from the seminar. Therefore, I would*
22 *consider it as serendipity. (P 1)*
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27 From this response, it is evident that both the useful information she received from
28 the seminar, and the way she received the information (by attending the seminar
29 accidentally) functioned in her coming across this serendipitous experience.
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33 4.2 Connection-making

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35 We have previously found that connections can be made between different pieces
36 of information, people and ideas (Sun et al., 2011), and it is a level of abstraction that
37 can lead to a positive impact. In this paper, we have further expanded this process of
38 connection-making by identifying the different internal contextual factors of
39 precipitating conditions:
40

- 41 • Connections made between unexpectedness and visceral needs.
- 42 • Connections made between unexpectedness and conscious needs.
- 43 • Connections made between unexpectedness and previous
- 44 • Connections made between unexpectedness and previous
- 45 • Connections made between unexpectedness and previous
- 46 • experience/knowledge.

47 The term “visceral need” and “conscious need” originates from Taylor’s (2015)
48 work, which characterized four different levels of information needs during the
49 interaction between an information seeker and a librarian. An information seeker may
50 begin with an unexpressed need in mind (what Taylor calls a “visceral need”), and
51 then such a need becomes “conscious” with accumulated information (e.g. by talking
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Comment [t3]: This section is revised by referring to Taylor’s work.

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6 to the librarian), and turns to a “*formalised need*” with a qualified and rational
7 statement, which finally leads to a “*comprised need*” that can be presented to
8 information systems. Although Taylor’s framework is usually used to describe the
9 negotiation process between an information enquirer and an information specialist,
10 which is not exactly the process of encountering a serendipitous episode, we do find
11 that the characteristics of such “visceral needs” and “conscious needs” conform to the
12 situations reflected in the participants of our empirical study. For example, Taylor
13 argues that a “visceral need [not] existing in the remembered experience of the
14 enquirer, [probably] is inexpressible in linguistic terms, [and can] change in form,
15 quality, concreteness, and criteria as information is added.” In our study, we also
16 found some participants did not raise a need, which was not previously in their
17 memory or experience, until they encountered unexpected information. While a
18 “conscious need”, as described by Taylor, is a “within-brain description”, it is quite
19 similar to a previously unaddressed concern/question by a participant. This part will
20 be discussed further in Section 5.3.1.
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29 4.3 Value

30 Our participants pointed out that they would only consider any unexpected
31 experiences as serendipity if they offered them some form of benefit. Two types of
32 value arose from our study: *substantial value* and *emotional value*. *Substantial value*
33 refers to a value that brings beneficial results or outcomes to the participant (e.g.
34 finding the answer to a previous concern), while *emotional value* refers to a value
35 caused by an emotion which is aroused when a participant encounters unexpected
36 information (e.g. the emotional satisfaction of recalling previous memories). This part
37 will be discussed further in Section 5.3.3.
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43 5 The Role of Context

44 Context plays a significant role in nurturing serendipitous experiences, although it
45 has often been neglected in previous studies. As a complement to our previous work
46 (Sun et al., 2011), in this paper we have identified the conception of context more
47 comprehensively, based on the discussion in the background section, including
48 external context, social context and internal context, and different contextual factors
49 were identified from the empirical study.
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5.1 External context

“External context” refers to the ambient conditions surrounding the participant, and the three different external contextual factors which have been identified from our empirical study are time, location and personal status (Table 3).

{Insert Table 3 here}

(1) *Time*. There were seven out of 62 collected cases for which our participants were unable to recall the time of the encounter. Among the remaining 55 available cases, only eight happened before noon (a.m.), while the remaining 47 cases happened after noon (p.m.). It is evident that different time periods during the day contributed distinctly to the development of serendipitous experiences. The final eight cases were reported across different time periods, where the participant was engaging with an ongoing activity until s/he recognised the occurrence of serendipity after some time. Existing research has demonstrated that different times of day can impact human performance (Fröberg, 1977), and even the cognitive and evaluative efficiency of individuals (Natale et al., 2003). Our participants also reported that they were more engaged in different activities in the afternoon, as a result of which it was also more likely that they would encounter serendipity, as explained by one of the participants:

Personally speaking, I find myself more conscious about the concept of serendipity in the afternoon or evening than in the morning, and normally I'm more engaged in the afternoon. So I think that's the reason why I always send you messages in the afternoon. (P 4)

(2) *Location*. Some locations (e.g. libraries) are richer in resources (e.g. books) than other locations (e.g. canteens). Therefore, it is intuitively sound to assume that locations may influence the occurrence of serendipity. 58 of the cases reported by our participants indicated where their serendipitous experiences had taken place (the location of the remaining four cases could not be recalled). Our data showed that 29 cases happened in an office environment, followed by 11 cases in a seminar room, six cases in a dormitory and other random places (laboratory, café, library, etc.). Following a further look into the office environment, which produced most serendipity cases during our study, we found that there were three possible reasons that contributed to the encounter of serendipity:

- The office environment is resource-rich, including posters, notifications, different online libraries, etc. Where more information is presented to a participant, s/he will have an increased possibility of experiencing serendipity;
- It provides an interdisciplinary social setting. The work settings for the participants was interdisciplinary, so a participant from mechanical engineering would be sitting in the same office as colleagues from other backgrounds, such as chemical engineering, architecture, or computer science, etc. Foster and Ford (2003) provided several examples of experiencing serendipity among interdisciplinary researchers, and similar cases were also collected in our study. For example, one participant (P 2) from mechanical engineering accidentally learnt about a new image-searching engine “TinEye” during a break, when talking with a colleague from computer science, which helped him locate the resource literature for an image he had used in his writing. Another participant (P 6, design background) also encountered useful information about using Nvivo to help his data analysis, of which he was not previously aware, from a casual conversation with a colleague with an HCI background;
- It makes it easy to get access to different resources. Consider the following example. One participant (P 7) sent us a case in which he happened to encounter a method of “histogram equalization” from a blog when he was browsing the Internet in the office. He then conducted a further search into this method (by referring to Wikipedia and other relevant literature), which enabled him to understand this method and recognise its value (i.e. it could be used in his own research). Compared to other environments, such as a laboratory or a café, it is obvious that the accessibility of resources (e.g. licenses to libraries) impact a participant’s judgement of the value of the encountered information.

(3) *Status*. Status here refers primarily to a participant’s commitment to certain ongoing activities. We have identified three different types of personal status, as follows:

- *Leisure*: the participant was in a relatively relaxed and open state, such as travelling, playing games, flicking through interesting books or browsing online information, etc. This was a state in which the participant was in his/her own private time fulfilling his/her own interests.

- Seminar: the participant was attending a seminar, a lecture or a presentation where the participant was a student or a listener.
- Working/Studying: the participant was in an intense and focused state carrying out research-related tasks.

According to Table 3, among the three different types of personal status, participants tended to experience serendipity more often during their “leisure” time. Studies show that openness and a relaxed setting can facilitate encountering serendipity (McCay-Peet and Toms, 2015; Sun, et al., 2011). Compared to the status of attending a seminar or working/studying, we consider that the participants in the leisure status were more open and relaxed.

5.2 Social context

Socialisation has always been considered as a significant factor when it comes to discussions on the role of context (Foster, 2004). In our collected cases, aside from the 37 of 62 cases where the participants had a different personal status, the remaining 25 all took place when they were socialising with others (see Table 4).

{Insert Table 4 here}

Table 4 illustrates that participants experienced serendipity frequently when they were socialising with different people, ranging from the familiar (e.g. classmates, colleagues) to the unfamiliar. However, an obvious trend which can be identified from the table is that our participants tended to experience serendipity more often during periods of socialisation with their peers (classmates, colleagues and friends), while only one case occurred during contact with a superior. This differs from our previous study in the UK, where four of the collected serendipity cases under a social context came from communicating with superiors. A possible reason for such a phenomenon is “power-distance”, which is a widely-understood cultural difference between the West and the East (Hofstede, 1980), while China has been confirmed as one country with a high power-distance, where students are known to keep a larger interaction distance from their professors (Richardson and Smith, 2007). Therefore, compared to communicating with their superiors, the Chinese participants were more likely to communicate with their peers, leading to more serendipitous encounters.

5.3 Internal context

Based on our collected data, we have divided the internal contexts into the following three aspects: precipitating conditions, sagacity/perceptiveness and emotions.

5.3.1 Precipitating conditions

Precipitating conditions refers to the prior conditions for experiencing serendipity. We have defined such precipitating conditions from a more subjective perspective, which is in relation to an individual's mind-set, covering *visceral needs, conscious needs and previous experience/ knowledge*.

- *Visceral needs*. As explained in Section 4.2, a visceral need refers to a need that does not exist in a participant's remembered experience, and it is not raised until the moment the unexpected information is encountered, as illustrated in the following example:

During a casual conversation with a friend of mine, I was really surprised to know that she was in collaboration with one of my classmates in graduate school whom I had not contacted since our graduation. It was an unexpected piece of information to me and I think there would be a high possibility that I could collaborate with him in the future. (Case 44)

In this case, the participant was initially unconscious of her need to contact an old classmate. It was not until encountering the unexpected information (i.e. her friend was working with him) that she became aware of such a need (to make contact and perhaps collaborate in the future).

- *Conscious needs*. This indicates that a participant had encountered a need/concern at a previous time (e.g. the need to download a useful paper), but for some reason the need/concern failed to be addressed immediately (e.g. unable to access the data resource). Such a need/concern was resolved when the participant encountered the information unexpectedly, as in the following example:

I was doing my own experiments recently and gathered loads of experimental data. However, I was not clear how to deal with the errors of the experimental

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6 *data. During a fluid lab session, I was demonstrating the experiment procedures*
7 *to the UG (undergraduate) students when I accidentally found a handbook near the*
8 *lab facilities which explains how to read data and deal with errors. I just felt like I*
9 *had found a big treasure. I started reading immediately; it is easy to understand*
10 *and is really helpful. (Case 16)*
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14 Clearly, the participant was conscious of his needs/concerns related to dealing
15 with the errors in his experimental data, to keep his research moving forward.
16 However, unexpectedly, this need/concern was addressed as a result of serendipity.
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20 - *Previous experience/knowledge.* Several participants also reported that
21 serendipitous experiences were triggered by their previous experience or knowledge:
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24 *Today I was cleaning up my summer clothes. Then suddenly I found my old*
25 *computer which I hadn't used for a long time. When I turned it on, I saw a picture*
26 *folder which contained all the pictures I took during my UG and this file was the*
27 *only copy I had! They were really precious memories to me and I had never*
28 *thought they would come to me in such an unexpected way! (Case 20)*
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33 *I taught my students an old Chinese poem yesterday in my class. And today I just*
34 *saw the same poem on one of my friends' Wechat shared pages. What a surprise!*
35 *Even though we were far away from each other, we still shared the same feelings*
36 *from the old poem! (Case 60)*
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40 In Case 20, the accidental discovery of the old pictures helped the participant to
41 recall precious memories of her university life, so the sense of serendipity felt by the
42 participant was mainly based on her previous experience. The situation is similar to
43 the information encountered coincidentally (i.e. recalling the same poem) in Case 60.
44 These cases demonstrate that the prior knowledge, interests and personal experiences
45 can be recalled in unexpected ways, thereby contributing to serendipitous experiences.
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50 51 5.3.2 Sagacity/Perceptiveness

52 Unexpectedness and precipitating conditions are two necessary components for
53 making connections. However, sagacity or perceptiveness is also required when
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6 making such connections. Heinström (2006) and Rubin et al. (2011) have both
7 considered the act of noticing as an ability to “shift the attention from a primary
8 activity to a clue in the environment”, and it is “one of the central elements in
9 incidental information acquisition”. Sagacity/perceptiveness is also reflected in our
10 study, as in the following example:
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14 *It was annoying to search for academic articles in China. I used Go-Agent before, but it*
15 *no longer works in China. Later on, I encountered serendipity on three different*
16 *occasions and finally selected the best option for searching academic articles: the first*
17 *was through the Wechat chatting group, where many members in the group proposed*
18 *different solutions; the second searching method I learnt was in the laundry room where I*
19 *met a post graduate student and he talked about some software which he told me that*
20 *even foreign students use to search for academic articles; and the third method was*
21 *learnt in the canteen where I met my senior and discussed the issue with him and he*
22 *proposed a solution to me. (Case 30)*
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28 The participant experienced different information on three different occasions, and
29 during the interview he emphasised how it was the concatenation of the three
30 experiences that made him consider the whole matter as one piece of serendipity. The
31 sagacity/perceptiveness in this case helped the participant to make connections
32 between a conscious need (strategies to search for academic papers) and the
33 unexpected encountering of information on three different occasions. Apart from this
34 example, during the two-week study, the number of serendipitous cases we collected
35 from each participant ranged from one to thirteen. Such differences in
36 sagacity/perceptiveness are consistent with the discovery by Erdelez (1997) that
37 serendipitous encounterers can range from super-encounterers to occasional
38 encounterers.
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45 5.3.3 Emotions

46 When a connection is made between unexpectedness and the precipitating
47 conditions, participants switched their attention from the current task to an evaluation
48 of the serendipity they had encountered. Once the value of an encountered experience
49 is acknowledged, serendipity occurs. The term “valuable outcome”, which has been
50 highlighted in previous studies (Makri and Blandford, 2012; McCay-Peet and Toms,
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2015; Rubin et al., 2011), is also manifested in our study as follows:

(1) Finding answers to a prior problem or concern. This is most relevant to those serendipities with conscious needs, where the participants are aware of their needs but the answers to prior problems were obtained in an unexpected way.

(2) Providing a potential solution to a need or simply discovering other needs. This is most relevant to visceral needs, as in the example reported in Case 44, where the unexpected information from the participant's classmate may be useful in the future, but whether or not a desirable outcome can be reached in the future is still unknown.

We identified such a value as "substantial value", as it is most relevant to those need-oriented serendipity cases (either for conscious needs or visceral needs), and it is of substantial benefit for helping participants to address their needs or concerns.

However, apart from "substantial value", we also identified from the study "emotional value" – which highlights the role of emotion–, especially in those cases categorised as previous experience/knowledge-oriented. In both Case 20 and Case 60, the unexpected information triggered a huge emotional response from our participants, and it was because such "emotional value" was so compelling that they came to conclude that the encountered experience was an episode of serendipity.

It should be noted that "emotional value" usually accompanies "substantial value" in need-oriented serendipity cases, such that finding solutions to previous conscious needs, or finding potential benefit from visceral needs often accompanies a positive emotion. However, "emotional value" also functions independently in the experience of serendipity, such as in the previous experience/knowledge-oriented cases (e.g. Case 20 and Case 60) in our collected data. Previous studies have pointed out that positive emotions can result from serendipity (McCay-Peet and Toms, 2015; Sun et al., 2011). Nevertheless, few studies have investigated how the role of emotional value is embedded in the process of encountering and perceiving something as serendipity.

6. Discussion

6.1 A Context-based Model of Serendipity

Comment [t4]: The whole discussion part is rewritten and complemented. We have removed the culture part throughout the paper, and focused on the finding of context.

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6 Based on this empirical study and our previous study, we have identified
7 contextual factors during the processes of serendipity, and further developed a
8 context-based model, as illustrated in Figure 4. This model consists of two parts: 1) In
9 the centre of the model are the three main processes in experiencing serendipity,
10 including encountering unexpectedness, connection-making and value; 2) the impact
11 of external context, social context and internal context on each process during a
12 serendipitous encounter.
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16 The participants' experiencing of serendipity began with encountering
17 unexpectedness, either in an unforeseen way and/or in the unexpected content of the
18 encountered information. Connections are then made between the encountered
19 information and the precipitating conditions (i.e. visceral needs, conscious needs or
20 previous experience/knowledge) of the participant. Once the value of the encountered
21 information (i.e. substantial value and/or emotional value) is recognised by the
22 participants, serendipity occurs.
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26 Each process for encountering serendipity is impacted by context. The main
27 impact of external context and social context is that they are the stimuli for
28 encountering unexpectedness. Such unexpectedness would then lead to connection-
29 making by combing the precipitating conditions, including visceral needs, conscious
30 needs or previous experience/knowledge, which are the internal contextual factors of
31 an individual.
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35 The connection-making process depends mainly on the information encounterer's
36 sagacity/perceptiveness. However, there is also the situation in which connections are
37 provided by external variables, such as from an interaction partner during a period of
38 social contact. One of the participants (P 14) sent us a case concerned with "how to
39 prevent falling asleep while driving" when she was discussing something with her
40 friend, when she unexpectedly received information from her friend that passengers
41 may read books aloud during the journey, which may interest the driver and prevent
42 boredom. The participant considered the received information to be serendipitous
43 because it was both an unexpected idea and she also applied the idea to her own
44 driving, which turned out to be quite useful. In this case, the participant's process of
45 making connections was simplified thanks to her friend's suggestion. Thus, we argue
46 that the external or social context can sometimes facilitate the process of making
47 connections. Furthermore, the interaction time and activity may also prohibit making
48 connections or evaluating the encountered value. One participant (P 6) reported that
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6 he had unexpectedly encountered some information relating to his own research while
7 teaching undergraduates in the laboratory. However, he was too busy answering the
8 problems from the students to think further about the encountered information. It was
9 not until he received the daily reminder that he was able to recall the encountered
10 information from earlier in the day, at which point he became aware of the value of
11 the same. In this case, we argue that the participant's status of being busy (e.g.
12 answering questions from students) may have prohibited his immediate recognition
13 of, or attention to, serendipity at the time at which it occurred.
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17 Emotion played an important role in recognising the value of any encounters.
18 Makri and Blandford's (2012a) study found that a good mood may help participants to
19 exploit the value of an encounter, while a bad mood may impede such exploitation (p.
20 694, case UD1 and AD4). In our study, we have identified the value of an encounter
21 as a substantial value and an emotional value, and particularly in any previous
22 experience/knowledge-oriented cases (e.g. recalling good memories, as in Case 20),
23 the emotional value would directly lead participants to consider the encounter as an
24 episode of serendipity. Another point which should be noted is the relationship
25 between emotions and sagacity/perceptiveness (the broken arrow line in Figure 4).
26 Research from the fields of psychology and neuro-science has revealed that emotions
27 can also impact an individual's cognitive processes, such as their memory, decision-
28 making, attention or learning (Schupp et al., 2006; Lerner et al., 2015), which may
29 thus further influence how connections are made between any unexpected information
30 and the precipitating conditions.
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37 {Insert Figure 4 here}

38 39 40 *6.2 A comparison with our previous model*

41 There are two main differences between this updated model and our previous
42 model. The first is that we have found that the process of connection-making is
43 actually pervasive in all cases of serendipity. In our previous model, we identified two
44 different levels of abstraction that can lead to serendipity, and connection-making is
45 the second level of abstraction that can sometimes result from the first level, although
46 we also identified some cases of serendipity which directly resulted from the first
47 level of abstraction. However, by identifying the internal context of the precipitating
48 conditions in this new empirical study, we have found that the original first level of
49 abstraction also involves a connection-making process. For example, we previously
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6 identified a case as the first level of abstraction where the participant accidentally
7 noticed some interesting module codes when he was looking at the whiteboard during
8 a workshop. The participant was looking for module information from different
9 sources (leaflets, the Internet) at that time, and this new module turned out to be
10 useful. We previously considered there to be no connection-making during this case
11 and we identified it as non-activity-based, unexpectedly valuable information from
12 unexpected sources (a category of the first level of abstraction). However, according
13 to our new identification of internal context, this participant had a conscious need in
14 mind (always looking for interesting module information), and the unforeseen means
15 by which he obtained the new module source from the whiteboard during the
16 workshop (unexpectedness) led to a connection between this unexpectedness and the
17 conscious need, and when he finally recognised the value of the encounter (a useful
18 module), serendipity occurred. We believe this new identification of internal context
19 helps us to better understand the connection-making process during serendipity.
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26 The second difference between this updated model and the previous model is that
27 it demonstrates the impact of different contexts during each process of serendipity.
28 Our previous model mainly discussed the role of context in encountering serendipity
29 from three aspects: the role of people (active or less active), the role of temporal
30 factors, and the role of the environment (i.e. the working environment, places, and the
31 changing environment). We directly adopted Schmidt's context model (2000) to
32 denote the relationship between the role of the individual and their context in
33 serendipity, but failed to explain how these contextual factors affected the different
34 processes of a serendipitous episode. This element is complemented in this empirical
35 study through a new identification of contextual factors:
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42 1) The role of people was further identified by explaining the internal context of
43 the precipitating conditions (i.e. visceral needs, conscious needs and previous
44 experience/knowledge), sagacity/perceptiveness, and emotions. The precipitating
45 conditions form a premise for each individual to make connections when
46 unexpected encountering happens, sagacity/perceptiveness impacts mainly on the
47 process of making connections, while emotion can affect a participant's
48 recognition of the encountered value, and may also impact an individual's
49 sagacity/perceptiveness when it comes to making connections.
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6 2) The role of temporal factors and the role of the environment were further
7 identified by defining the external context (i.e. time, location, personal status) and
8 social context. The external context and social context are the stimuli for
9 unexpected encountering, and they also affect a participant's connection-making
10 (e.g. facilitation) and recognition of the encountered value (e.g. being busy).
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14 The proposed new context model verified serendipity as "the product of context"
15 (Foster, 2014, p. 18), and these external, social and internal contexts play different
16 roles and are interwoven throughout the encountering process of serendipity.
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19 20 *6.3 Implications of the updated model*

21 *6.3.1 An extension of the existing framework*

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23 We identified three processes for experiencing serendipity: "unexpectedness",
24 "connection-making" and "value". This identification is similar to the framework
25 proposed by Makri and Blandford (2012b), in which they considered
26 "unexpectedness", "insight" and "value" as the three key elements with which to
27 evaluate serendipity, and where the "making of the connection itself involves an
28 amount of insight" (p. 714). Our new contribution to this framework is that, based on
29 our empirical study, we have further expanded the three processes. We have identified
30 three different channels that lead to "unexpectedness", the different situations of
31 connection-making between the encountered unexpectedness and the precipitating
32 conditions of visceral needs, conscious needs and previous knowledge/experience,
33 and we have also identified value as substantial value and emotional value.
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39 The identification of "unexpectedness" in our work is similar to the work by
40 Foster and Ford (2003), in which they classified four different categories of
41 serendipity. Our identification of "unforeseen means of encountering information" is
42 similar to Foster and Ford's third category, "the unexpected finding of information the
43 *existence* and and/or *location* of which was unexpected, rather than the value" (p.332),
44 and the identification of the "unexpected content of the encountered information" is
45 similar to Foster and Ford's fourth category, "the unexpected finding of information
46 that also proved to be of unexpected value: (a) by looking in "likely" sources"; (b) by
47 chance" (p.332). However, our work also goes beyond their framework by identifying
48 the processes of "connection-making" and "value", which is not discussed in their
49 paper. By expanding the different processes of serendipity, we have found it is
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possible to give a new classification of the different categories of serendipity. Table 5 categorises the cases listed in the previous sections of this paper, and we argue:

- For a conscious need/concern, it is more the unforeseen means of encountering the information that results in the participants' sense of unexpectedness, and brings both substantial value (e.g. an answer to the concern) and emotional value (the positive emotion when the need is addressed), as identified in Case 7, Case 44 and Case 30.
- For a visceral need/concern, it is usually the unexpected content of the encountered information that leads to participants' feelings of unexpectedness, while it also brings both substantial value (e.g. finding a possible solution for a visceral need) and emotional value (a positive emotion), as identified in Case 6 and Case 44. However, sometimes the unforeseen means of encountering information may also play a role in leading to unexpectedness, as identified in Case 1.
- For previous experience/knowledge, it often results in emotional value, and both the unforeseen means of encountering the information and the unexpected content of the encountered information have the potential to bring a feeling of unexpectedness to participants, as identified in Case 20 and Case 60.

{Insert Table 5 here}

6.3.2. *Design strategies based on the identified contextual factors*

Björneborn (2017) argues that:

We cannot design environments always leading to serendipity – as serendipity is a highly subjective and situational phenomenon. But affordances for serendipity can be engineered.....Serendipity may thus be intended by designers, but must always be unplanned by users (p. 1068).

From this empirical study, the identified contextual factors of external context, social context and internal context helped us to look into the role played by context during the different processes of serendipity, and thus provide possible implications

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6 for designers to design affordances that can “engineer serendipity”. These include: (1)
7 consider participants’ status. Our participants tended to experience serendipity more
8 often in the afternoon than in the morning, especially when they are in their leisure
9 time. When organising activities that aim to facilitate serendipity (e.g. free discussion
10 seminars, using information systems to make recommendations), it is better to take
11 participants’ status into consideration and arrange such activities during their leisure
12 time; (2) consider locations. Our study has found that places with rich resources, such
13 as a physical resource (e.g. licensed online libraries) or a socialisation resource (e.g.
14 interdisciplinary offices), and with easy accessibility provide greater potential for
15 participants to encounter serendipity; (3) try to create social networks. Social context
16 is a significant stimulus, where participants can encounter unexpectedness which may
17 result in serendipity, so attention should be given to such context to help to “engineer
18 serendipity”; (4) design environments that are both diverse and conspicuous.
19 Motivated by an understanding of the internal context of pre-conditions and
20 sagacity/noticeability, we also suggest the design of more diverse and noticeable
21 environments to encourage the occurrence of serendipity. Current information
22 technologies, such as recommendations, personalisation and visualisation may
23 consider this aspect to facilitate the occurrence of serendipity; (5) combine emotional
24 design. As identified in the study, emotion plays an important role during the process
25 of encountering serendipity, so an element of curious and/or interesting information
26 may help to encourage the occurrence of serendipity. We consider that designs for joy,
27 surprise and/or other emotional design strategies can also be applied to serendipitous
28 design strategies.

39 40 41 *6.5 Two limitations of the research method*

42 There are two methodology-based issues raised from the empirical study that we
43 think are worthy of further discussion. The first issue concerns the participants’ initial
44 understanding of serendipity. According to our empirical studies, we have found there
45 are disparities in the basic understanding of the term “serendipity” between the
46 Chinese participants and the previous participants in the UK. People from non-
47 English speaking countries, such as China, may lack an initial understanding of the
48 concept of serendipity because the concept originated in the West. Even the Chinese
49 translation of the term was seen as exotic by the Chinese participants. Hence, at the
50 very beginning of the study, when we introduced the research purpose to our
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6 participants, in addition to giving the Oxford Concise English Dictionary definition of
7 serendipity, we also used an example from the pilot study to help with their
8 understanding of this subjective term. This undoubtedly raised the concern that
9 participants may have restricted the types of examples they identified for experiencing
10 serendipity during the following study. Although we repeatedly highlighted the fact
11 that this was only one example of a personal case for encountering serendipity, and
12 that they could send us details of any encounter during the following two weeks that
13 conformed to the dictionary definition of serendipity, we are not fully confident that
14 every participant was not restricted by the given example. Indeed, two participants
15 only sent us one case during the whole study. Nevertheless, we are confident that the
16 majority of the participants in this study were not restricted by the example, as evident
17 in the different categories of serendipity identified from the study. We hope this
18 concern will provide guidance to future researchers when conducting similar studies,
19 especially in the case of cross-cultural groups lacking an initial understanding of
20 serendipity.
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27 The second concern relates to the use of the daily reminder during the study,
28 which may have pressurised the participants into responding. Each reminder was sent
29 at approximately 10:30pm, based on feedback from the pilot study and observation of
30 most participants' routines, as this was the time when they had finished their daily
31 work or study and were in a relatively leisurely state, and when serendipity is more
32 likely to occur (Sun et al., 2011). During the post-interview, a few participants
33 reported that they felt pressurised into responding on receipt of the reminder in the
34 first two days of the study. This was mainly because it was the first time they had
35 heard the word "serendipity", and they were not sure whether they would be able to
36 recall any serendipitous moments in their daily activities. However, as the diary
37 studies continued, any pressure caused by the reminder became much less obvious
38 because they found serendipity was not such a cryptic phenomenon. They tended to
39 understand from the reminders that there were other participants who had already
40 experienced serendipity. This, in turn, gave them the confidence and assurance to
41 reflect on their encounters during the day. By way of comparison, there were four
42 participants who explained that they were particularly in favour of the reminder, and
43 they even argued that it would have been better to send reminders twice a day (in the
44 morning and the evening) to better remind them they were in a study situation. We
45 hope future studies will pay special attention to this concern if employing similar
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6 research methods. Perhaps a prior investigation of participants' acceptance of such
7 reminders would help researchers to arrange bespoke strategies for different
8 participants and thus achieve better research data.
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10 11 **6. Conclusion**

12 This paper presents a follow-up to an empirical study which was conducted in the
13 UK in 2011. We employed the social media platform "Wechat" as a research tool to
14 investigate the phenomenon and occurrence of serendipity in the context of
15 information research among a group of Chinese scholars.
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18 Based on the collected data, we have found that current understandings of
19 serendipity, which have been constructed mainly on the basis of Westerners, also
20 applied to our Chinese participants. They also experienced serendipity according to
21 the three main processes of encountering unexpectedness, connection-making and
22 recognising the value. In addition, we further expanded the definition of the three
23 processes. Unexpectedness is encountered by any unforeseen means and/or the
24 unexpected content of information encountering, where connections are made
25 between the unexpectedness and the precipitating conditions of visceral needs,
26 conscious needs, or previous experience/knowledge. Ultimately, either a substantial
27 value or an emotional value prompts the individuals' recognition of serendipity. This
28 expanded framework also helped us to classify the categories of serendipity.
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34 The role of context in experiencing serendipity has been further investigated.
35 Compared to the model present in our previous study, the updated context-based
36 serendipity model better demonstrates the different interactions and influences of the
37 external context, social context and internal context during the different processes of
38 serendipity. In particular, our study found that the role of emotions should not be
39 considered only as an outcome of serendipity, but it should also be embedded in the
40 process of encountering serendipity, which is an issue that has been largely neglected
41 in existing studies.
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45 Future research should pay particular attention to the methodological issues when
46 conducting serendipity studies cross-culturally, especially within participant groups
47 who lack an initial understanding of serendipity. Deliberate consideration of how to
48 introduce the term "serendipity" to participants should be undertaken before any
49 study. In addition, the research findings relating to the differences between the UK
50 scholars and Chinese scholars in terms of "power-distance", which exists in the social
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context, imply that culture may play a role in the experiencing of serendipity, so our future work will further investigate this phenomenon.

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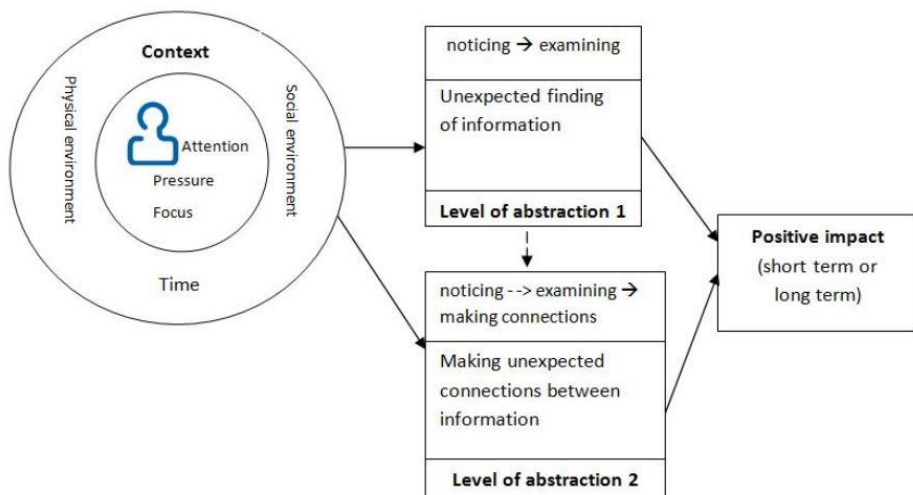


Fig. 1 Our previous context model for experiencing serendipity

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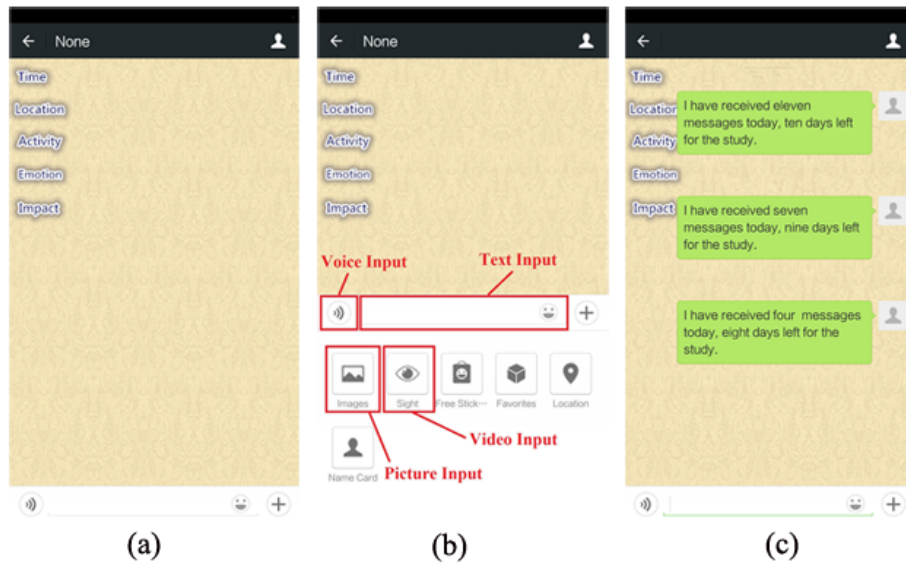


Figure 2. Wechat as our research platform: (a) designed interface; (b) different input sections; (c) daily reminder sent to participants.

Interview Data Extract: Pilot study P1	Code For
<p>I was trying hard to download a journal paper which could be very relevant to my research^a. However, when I checked in our university databases, it was not available to download and payment was required to get access to the paper. Then, one day when I was searching for other research papers^b, a web link of the paper^b turned up on the screen¹. Being curious^c, I clicked the link and it asked me to register in a platform called Research Gate. I followed the registration and was then amazed to find^d that the author of the paper was also a member of Research Gate², so I followed him on Research Gate and sent him a request for a copy of the paper, and he sent me a copy of his working paper free of charge! It was really exciting for me to get the paper^e by such a chance³!</p> <p>Q: When did you receive the paper from the author?</p> <p>A: The next afternoon^f when I was working in my office^g.</p>	<p>Framework of serendipity:</p> <ol style="list-style-type: none"> 1. Unexpected encountering 2. Connection-making 3. Value of the encounter <p>Contextual factors:</p> <ol style="list-style-type: none"> a. Existing need b. Searching online c, d & e. Emotions related f. Across time period g. In the office

Figure 3. Example of the analytical rationale used for the data analysis

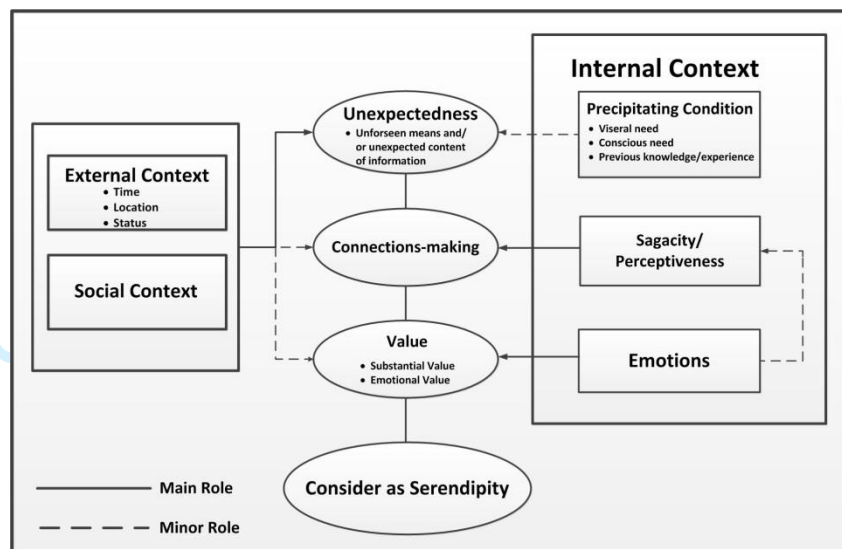


Figure 4. A context-based model of serendipity

Table 1 *Contextual related factors in existing serendipity models*

	External Context	Internal Context	Social Context
Erdelez (2004)		Notice	
McCay-Peet and Toms (2010)	Trigger	Precipitate condition	Precipitate condition
McCay-Peet and Toms (2015)	Trigger	Openness Prepared mind Ability to make connections	
Lawley and Tompkins (2008)	Unexpected event	Prepared mind	
Makri and Blandford (2012)	Unexpected circumstances	Insight	
Rubin et al. (2011)	chance	Prepared mind, act of noticing surprise	

Table 2 *Participant Information*

No.	Research Interests	Gender	Research Time (Months)
1	History	Male	36
2	Mechanical Engineering	Male	12
3	Computer Science	Male	24
4	Civil Engineering	Male	24
5	Environment and Energy	Male	18
6	Exhibition Design	Male	72
7	Computer Science	Male	13
8	Fluid Mechanics	Male	36
9	Operation Management	Female	20
10	Chemical Engineering	Female	13
11	Consumer Behaviour	Female	16
12	Pedagogy	Female	12
13	International Economics	Female	38
14	Pedagogy	Female	28
15	Environment and Energy	Female	36
16	Chemical Engineering	Female	18

Table 3 *External Context Factors*

External Context Factors	Elements	Numbers of Serendipitous Cases
Time (55 available cases)	A.M.	8
	P.M.	39
	Across different time periods	8
Location (58 available cases)	Office	29
	Seminar room	11
	Dormitory	6
	Other random places	12
Personal Status (34 cases)	Leisure	19
	Seminar	9
	Working/studying	9

Table 4 *Different Socialisation Partners*

Socialisation Partners	Number of Serendipitous Cases
Classmate	13
Colleague	3
Friend	3
Unfamiliar	3
Superior	1
Any student	1
Group meeting	1

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Table 5 Classification of serendipity cases based on the framework

<i>Serendipity</i>	<i>Connection Making</i>				<i>Value</i>	
	<i>Unexpectedness</i>		<i>Precipitation Conditions</i>		<i>Emotional</i>	<i>Substantial</i>
<i>Cases</i>	<i>Unforeseen Means of encountering Information</i>	<i>Unexpected content of encountered information</i>	<i>Visceral need</i>	<i>Conscious need</i>	<i>Previous Experience/Knowledge</i>	<i>Value</i>
<i>Case 7</i>	✓			✓		✓
<i>Case 6</i>		✓	✓			✓
<i>Case 1</i>	✓	✓	✓			✓
<i>Case 16</i>	✓			✓		✓
<i>Case 44</i>		✓	✓			✓
<i>Case 20</i>	✓				✓	✓
<i>Case 60</i>		✓			✓	✓
<i>Case 30</i>	✓	✓		✓		✓

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Journal of Documentation

Appendix A

A Description for the Content of Figure 2

Figure 2-a: a description of the five notes on the left hand side of the picture:

- a) *Time*: represents the time when the participant comes across serendipity;
- b) *Location*: represents the location where the participant comes across serendipity (e.g. in the classroom, in the dormitory, on the street, in the library, etc.);
- c) *Activity*: represents the behaviour when serendipity happens (e.g. searching the Internet, chatting with others, reading a book/literature, listening to music, watching an educational TV programme, etc.);
- d) *Emotion*: represents the emotion experienced when serendipity happens (e.g. happiness, surprise, interest, sadness, stress, etc.);
- e) *Impact*: represents the influence and follow-up behaviour when serendipity happens (e.g. store the information, use it immediately, ignore it and do nothing, etc.)

Figure 2-b: illustrations of the user input sections:

As can be seen from the image, there are different input sections for the participant to record and send the encountered serendipity throughout the study, including voice, text, picture and video.

Figure 2-c: The meaning of the sent messages (daily reminder), taking the first message as an example:

“I have received eleven messages today, ten days left for the study” indicates that the researchers have successfully received eleven serendipity messages from all the participants on that day, and there are ten days left before the study finishes.

Appendix B

Main Questions during the Post-interview

Part 1: Understanding of Serendipity

- (1) What is your understanding of serendipity now that the study has concluded?
- (2) When comparing your current understanding of serendipity to your understanding before the study, do you think are there any differences? If yes, why?

Part 2: For a Detailed Serendipity Case

- (1) When did the case happen?
- (2) Where did the serendipity happen?
- (3) Could you describe the case in more detail?
- (4) Why would you consider it as serendipity?
- (5) What was your socialisation context in this case?
- (6) How did you deal with the serendipitous information? What did you do when you encountered the serendipity?
- (7) What was your emotion after you encountered the serendipity?

Part 3: Questions about the Research Method Employed

- (1) What do you think about the reminder information that I sent to you every day?
- (2) Do you have any suggestions or opinions on such reminders?
- (3) Why did you send your case in text (or picture)?
- (4) What do you think about the designed interface of the application?
- (5) What was your experience of the study? Do you have any suggestions or opinions about the study or the research method?

*Note: The language used across the study was Chinese, including all the contents presented in the appendices. We have translated everything into English for this paper.

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3 Dear Editor and reviewers:
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6 Thank you for your thoughts and efforts devoted to our paper. Your comments have
7 helped us to substantially improve the quality of our paper. We have made significant
8 changes to our manuscript based on your comments. Changes have been made in the
9 updated manuscript and they are briefly described in the following (for those quoted
10 references, please refer to the manuscript):
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20 Reviewers Comments to Author:
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23 This is interesting work, but not yet ready for publication.
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27 Introduction
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29 **1. The research aims should be more clearly articulated. Which current**
30 **framework of serendipity? Why that particular framework and not our**
31 **understanding of serendipity in general? What are the particular 'specifically**
32 **defined contexts' you are interested in?**
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36 The research aims have now been revised to: 1) identify whether current
37 understandings of serendipity can also be adapted to Chinese scholars; 2) further
38 investigate the role context plays during the different processes of experiencing
39 serendipity. Two main changes have been made in this revised version, compared to
40 the original.
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45 First, the original research aim of “investigating culture differences” has been
46 removed. After deliberation of the reviewer’s suggestion (see the 20th review
47 comments), we agree that it is appropriate to remove from this paper the discussions
48 about culture, and to be more focused on the issues relating to context.
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53 The second change is that throughout the paper we are no longer using the term
54 “employing Makri and Blandford’s framework”. This is because we began our coding
55 of the collected data based on our original defined themes of understanding
56 serendipity from our previous study, and when we identified internal contextual
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3 factors from this empirical study, we further determined the themes to evaluate
4 participants' experiencing of serendipity as "unexpectedness" "connection-making"
5 and "value". This framework is consistent with Makri and Blandford's framework
6 (2012b) of evaluating serendipity with the three elements of "unexpectedness"
7 "insight" and "value", and they argued that "making of the connection itself involves
8 an amount of insight" (p. 714). In our original version, due to the limitation on the
9 length of the paper (as we needed to discuss both culture and context), we didn't
10 extend the description of our coding work, and just considered that it conformed to
11 the existing Makri and Blandford framework. Now that we have removed the culture
12 part, and have fully focused on the context throughout the paper, we have introduced
13 our coding process in detail in Section 3.4 "Data analysis". We also had a discussion
14 about both our framework and Makri and Blandford's framework in Section 6.3.1,
15 where we formed the opinion that our contribution lies in a further extension of this
16 framework into detailed sub-themes, namely: three different channels that lead to
17 "unexpectedness", the different situations of connection-making between the
18 encountered unexpectedness and the precipitating conditions of visceral need,
19 conscious need and previous knowledge/experience, and we also identified the values
20 as substantial value and emotional value. The expanded sub-themes make it possible
21 to classify the categories of serendipity. (Please refer to Section 6.3.1 for further
22 details)

23
24 The term "specifically defined context" has been removed, and our aim is to
25 investigate the role of context during each process of serendipitous encountering,
26 based on our own contextual factors identified from the empirical study.
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29 30 **2. More details on the previous UK diary study are needed in order to** 31 **understand how your Chinese findings compare to it.**

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33 This part has been revised from two perspectives. First, during the "introduction", we
34 have demonstrated the model from a previous UK diary study, and also explained our
35 previous research findings. The second perspective is that we have added Section 6.2
36 in the discussion of the revised paper, which provides a detailed comparison between
37 the proposed new model and previous model.
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40 41 **3. It would be useful to unpack 'context' to explain the factors that may influence**

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3 **serendipity among Chinese scholars. While your motivation on p.3. for**
4 **understanding context is useful, you don't fully explain what context means.**
5 **'Understanding the user's objective' is actually an important goal in Information**
6 **Science; see chapters on 'information needs' in Given & O'Case (2016) Looking**
7 **for Information, Belkin's seminal ASK paper and other work in that tradition**
8 **that have tried to understand and categorise what information users are looking**
9 **for. I'd suggest discussing this body of work in detail, making the link to**
10 **serendipitous information acquisition (e.g. that it is possible to understand the**
11 **degree of relatedness of encountered information to what is being sought). This**
12 **may have a bearing on how 'unexpected' or 'valuable' the information is**
13 **considered by the user. Arguably, the more detailed an understanding we have**
14 **of what users were trying to achieve at the time, their background knowledge,**
15 **their general interests and expertise, the better we can understand their**
16 **experiences of serendipity.**

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28 We have examined Belkin's ASK theory and the related chapter in the book by Case
29 and Given, and compared to Belkin's ASK theory, we are more motivated in Taylor's
30 work on information needs, and have added this part to Section 4.2. We found this
31 work provides greater benefits for our identification of the precipitating conditions of
32 internal contexts. In particular, we have found that Taylor's description of "visceral
33 need" is more appropriate to the identified situation of our participants, and we have
34 changed the original description of "unconscious need" into "visceral need".
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42 **4. To better articulate the originality/value of the paper, explain how your**
43 **context model 'provides a further understanding of the role of context...' How**
44 **exactly does it enrich our current understanding of serendipity?**
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48 In the Introduction, we have now explained that, limited by the perception of
49 serendipity at that time, our previous study only discussed these elements as different
50 factors having an influence on participants' readiness to experience serendipity, but
51 failed to have a further examination of how these elements would act during the
52 separated processes of serendipitous encountering, and this is now considered as a
53 research objective.
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3 In terms of the originality/value of the paper, we have explained this in detail in the
4 revised “discussion” section. Section 6.2 presents the difference between the proposed
5 updated model in this paper and the previous model. Section 6.3 demonstrates two
6 implications of the updated model. Section 6.3.1 presents an extension to the existing
7 framework of serendipity, which can be used to classify different categories of
8 serendipity cases, and Section 6.3.2 proposes different design strategies based on the
9 new contextual factors identified from this empirical study.
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18 **5. What cultural factors have an effect on serendipity and why? What are the**
19 **implications of this? While it may be the case that "no related studies on**
20 **serendipity have reported from the perspective of culture" (p.3), it would be**
21 **useful to form an argument around why examining culture may be potentially**
22 **useful; might it demonstrate the generalisability of serendipity (or lack of) across**
23 **cultures? Might any differences suggest the need for new forms of support? etc.**
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29 After deliberation of the reviewer’s suggestion (see the 20th review comments), we
30 agree that it is appropriate to remove the discussions of culture from this paper, and to
31 focus more on the issues of context. Due to the limited number of participants, it is no
32 possible for us to make strong comparisons between the scholars in the UK and China.
33 However, we do think that this is still missing from current serendipity studies. Yeh’s
34 (2007) research found culture can impact individual’s information behaviours, and
35 current research on Culture Neuroscience also provides evidence that individuals with
36 different cultural backgrounds can perform differently in the psychological processes.
37 Our empirical studies also found that the role of social context can be impacted by
38 power-distance, a widely recognised cultural factor in respect of differences between
39 UK and Chinese scholars. While serendipity is a cryptic phenomenon which is
40 actually highly related to an individual’s psychological processes (e.g. emotion,
41 attention, memory), we believe that it is worth investigating further from a cultural
42 perspective. Our future research will design more strict comparative studies and will
43 examine whether culture plays a role in serendipitous encounters.
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57 **6. On p.4. consider framing the argument as you having gained an initial**
58 **understanding of context, but that your 2011 study highlighted interesting**
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3 **findings that you explore in greater detail here (as well as examining potential**
4 **cultural differences).**
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6 This part is now revised in the “Introduction” section. We have presented our
7 previous context model of serendipity, and have also introduced the research findings
8 from the previous study, which only discussed context as a factor to influence
9 participants’ readiness to experience serendipity, and failed to make a further
10 examination of how these elements would act during the separated processes of
11 serendipitous encountering. This is now considered as a research objective and will be
12 further investigated in this paper.
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21 Background

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23 **7.Consider beginning by defining serendipity and explaining the importance of**
24 **context in serendipitous discoveries before moving on to discuss the literature on**
25 **context in detail; at the moment it is difficult to understand the importance of**
26 **context in serendipity research and this is key to emphasising the novelty of your**
27 **work. Why is understanding contextual factors related to serendipity so**
28 **important?**
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34 We have made the appropriate revisions in Section 2.1, giving a different researcher’s
35 definition of serendipity, and the importance of context in studying serendipity has
36 been highlighted by citing Case and Given’s (2016) argument concerning the
37 significant role of context in information seeking. This is followed with evidence
38 from existing serendipity studies that demonstrates the important role of context in
39 experiencing serendipity. For example, the empirical study by Points et al. (2015)
40 found that contextual factors such as location, activity and focus can influence a
41 user’s experience of serendipity. Similar findings can be found in another paper
42 (Kefalidou and Sharples, 2016), where the contextual factors such as time, location,
43 and the content of the text message can impact a user’s experience of serendipity. In
44 addition, McCay-Peet and Toms (2015) found that those environmental factors which
45 are trigger-rich, enabling connections and leading to the unexpected, can help users to
46 facilitate serendipity in a digital environment. Continuing research findings provide
47 substantial evidence that context does play a vital role in people’s experience of
48 serendipity.
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5 **8. Erdelez's model (p.7) is less a model of serendipity and more a model of**
6 **'information encountering' (serendipity in the context of information**
7 **acquisition). I don't think she uses the term 'incidental'. More critique of each**
8 **model you discuss is possible; for example Erdelez's model is useful for**
9 **understanding part of the process post-encounter, but doesn't cover what**
10 **happens beforehand (e.g. to trigger the encounter). It would be useful to explain**
11 **what aspects of Makri & Blandford's model make it particularly suitable for**
12 **adoption in your study; it being widely adopted by members of the same large**
13 **research team is not, in my view, a convincing justification.**
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22 After a review of Erdelez's research paper, we have now changed the term "incidental
23 information encountering" to "information encountering" and "opportunistic
24 acquisition of information". A more detailed discussion relating to each module is
25 included at the end of Section 2.3, especially how contextual factors are involved in
26 these models. For example, we discussed "notice" as an internal context in Erdelez's
27 model, "trigger" as an external context, and "precipitate condition" as both internal
28 and social contexts in McCay-Peet's (2010) model. "Trigger" is discussed as an
29 external context, "openness", "prepared mind" and "ability to make connections" as
30 internal contexts in McCay-Peet's (2015) updated model, and "unexpected event" as
31 an external context, "prepared mind" as an internal context in Lawley and Tompkins'
32 (2008) model. Finally, we discussed "unexpected circumstances" as an external
33 context, "insight", "mood or feelings" as internal contexts in Makri and Blandford's
34 (2012) model, and "chance" as an external context, and "prepared mind", "act of
35 noticing" and "surprise" as internal contexts in Rubin et al.'s (2011) model. However,
36 a systematic discussion from the perspective of these contextual factors cannot be
37 drawn from these existing studies.
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51 We are also no longer using the term "employing Makri and Blandford's framework"
52 throughout the paper. As explained in the answer to the first review comments, we
53 achieved a similar framework from this new empirical study to evaluate participants'
54 experiencing of serendipity as "unexpectedness", "connection-making" and "value".
55 This framework is similar to Makri and Blandford's framework (2012b) for
56 evaluating serendipity by the three elements of "unexpectedness", "insight" and
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3 “value”, and they have argued that “making of the connection itself involves an
4 amount of insight” (p. 714). In our original version, owing to the limitation of the
5 length of the paper (as we needed to discuss both culture and context), we didn’t
6 extend the description of our coding work, and simply considered it as conforming to
7 the existing Makri and Blandford framework. Now that we have removed the element
8 of culture and have focused fully on the context throughout the paper, we have
9 introduced our coding process in detail in Section 3.4 “Data analysis”. We have also
10 included a discussion of our framework with Makri and Blandford’s framework in
11 Section 6.3.1, where we form the opinion that our contribution lies in a further
12 extension of this framework into the detailed sub-themes of: three different channels
13 that lead to “unexpectedness”, the different situations of connection-making between
14 the encountered unexpectedness and the precipitating conditions of visceral need,
15 conscious need and previous knowledge/experience, and we also identified values as
16 substantial value and emotional value. The expanded sub-themes make it possible to
17 classify the categories of serendipity. (Please refer to Section 6.3.1 for further details)
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9. It would be useful to integrate McCay-Peet's (2015) model revisions into your earlier discussion of her model.

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36 McCay-Peet’s updated model has been integrated after her early model, and a
37 discussion of the contextual factors of both models is also introduced at the end of
38 Section 2.3, where we have argued that her early model identified “precipitating
39 conditions” as “active learning” (internal context) and “social networks” (social
40 context), and the requirement for a “trigger” (e.g. text, images, audio) to facilitate
41 serendipity. In the updated model, she further proposed different external factors
42 (trigger-richness, highlighting triggers, enabling connections and enabling capturing)
43 and internal factors (openness, prepared minds, the ability to make connections) that
44 may influence the perception of serendipity, but these factors, especially the external
45 factors, are not discussed from the perspective of context.
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10. It would also be useful to discuss Foster and Ford's (2003) model - J.Doc. 59(3), 321-340 as this is one of the original models of serendipity on the Web (even if it's not process-based).

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3 After a careful review of Foster and Ford's work, we have found their research
4 findings are more of a framework for categorising serendipity, rather than a proposed
5 model to describe serendipity. In Section 6.3.1, we have pointed out that our
6 identification of "unexpectedness" is actually quite similar to Foster and Ford's third
7 and fourth categories of serendipity, while their seminal work motivated us to classify
8 the categories of serendipity based on the collected data from this new empirical study.
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16 Method

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18 **11. It is not clear why Wechat was appropriate to collect the diary data. This**
19 **needs to be explained and justified. Also, as Wechat is heavily text based, this**
20 **might have influenced your findings that Chinese scholars tend to capture**
21 **information encounters in textual form.**
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25 At the very beginning of Section 3 "Research Method", we have now explained the
26 reason for using Wechat as the platform, and we argue there are four reasons: 1) it
27 covers similar functions to our previously designed diary application in which
28 different types of data can be recorded and transferred (i.e. text, video, audio, and
29 image); 2) participants can use their own mobile phone and now have no concerns
30 about portability problems of extra devices, and no additional package needed to be
31 installed on the mobile phones, as they were all frequent users of "Wechat", and were
32 quite familiar with its functions; 3) "Wechat" is a social media platform, thus it also
33 has the function of communication between participants and researchers, so when
34 participants had any problems during the experiment period, they could send
35 messages to the researchers and receive responses instantly; 4) it also has the
36 advantage of allowing the researchers to send "reminders" to participants every day,
37 to help keep them aware that they are in an experiment situation.
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50 As the element of culture has been removed from this paper, the cultural differences
51 were not discussed on this issue.
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55 **12. Why did you restrict your study to PhD students? How can you be sure they**
56 **are representative of the broader population? Was there a special reason you**
57 **recruited them? Explain in detail.**
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3 There are two main reasons for recruiting PhD students: 1) following the research
4 findings of Foster and Ford (2003), which showed that serendipity is experienced
5 widely among researchers, we decided that PhD students were an appropriate group
6 of scholars dedicated to research projects who were easy to access; 2) our previous
7 study recruited 11 PhD students and received 23 serendipity cases within a week. This
8 successful experience demonstrated that it was a feasible solution to recruit PhD
9 students with which to conduct such a diary-study. As a result, we recruited PhD
10 students with research experience (a minimum of 12 months) to our study. We have
11 also made this revision in Section 3.1.
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21 **13. You mention that it was surprising that students did not know about**
22 **serendipity beforehand (p.10), but as you mention in your discussion, this**
23 **concept is rarely used in Chinese cultures. Therefore this may not be too**
24 **surprising.**
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26
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28 In the beginning, we felt it was surprising because we found the Chinese scholars had
29 no conception of serendipity, and most of them heard about this term for the first time.
30 This was quite different from our previous study on UK scholars, who all had some
31 understanding of the concept. We were unaware of this situation at the beginning of
32 the study. This issue led directly to a methodology based concern: how can we better
33 introduce “serendipity” to these participants? We then addressed this concern by
34 giving our participants the dictionary definition, in addition to an example from the
35 pilot study. This concern is now discussed in Section 6.4.
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43 In this revised version, as we have removed the discussions about culture, we have
44 also removed the term “to our surprise”.
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48 **14. Providing an example from your pilot can potentially help participants**
49 **understand the concept of serendipity, but might also restrict the types of**
50 **examples they provide in the diary study. Did you mitigate for this? If so, how?**
51 **Again, explaining this would be useful.**
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56 During the study, we explained to our participants that this was merely one case from
57 the particular participant. We also clarified that there are different types of serendipity,
58 and that they could send messages to us if they thought they were experiencing
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3 serendipity. We have added Section 6.4 in the discussion, which discusses the
4 limitations of the study approach. We have considered this problem as a limitation of
5 the research methodology and hope that future studies will address this concern,
6 especially when conducting cross-culture studies with groups lacking an initial
7 understanding of serendipity (similar to our Chinese participants).
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13 **15. 30 mins. seems a long time to collect understandings of serendipity and**
14 **introduce to Wechat. Did anything else happen during interviews? What**
15 **instructions were participants given of what information to capture and how?**
16 **Were they restricted to capturing only information on the mobile Web, or any**
17 **information they encountered?**
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23 We have added the following sentence in Section 3.2: “The research purpose was
24 introduced to them, and participants were invited to collect any cases they considered
25 to be serendipity in the following two weeks, either on the Web or surrounding their
26 daily activities (e.g. reading, research, and socialisation).” Based on Figure 2,
27 presented in the paper, participants were instructed to use different forms of input (e.g.
28 text, voice, video and graphs) to send messages to the researchers, with each message
29 including the following information for the experience: time, location, activity,
30 emotion and impact, which is the background interface in Figure 2. A detailed
31 instruction of this figure has been added to appendix A.
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39 **16. What exactly did you ask during the post-study interview and why? Much**
40 **more explanation and justification is needed.**
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44 We have added Appendix B detailing the post-interview questions. Generally, the
45 interview was semi-structured and covered two main areas, including participants’
46 perceptions of serendipity with questions surrounding their submitted cases, and
47 questions based on the research methodology.
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52 **17. You do not appear to have actually followed Grounded Theory methodology;**
53 **selective/integrative coding involves relating codes to a central 'core' code. I**
54 **don't think you did this. To claim you followed Grounded Theory methodology,**
55 **you also need to demonstrate an evolving theoretical sample and cyclic process of**
56 **data gathering and analysis (see Corbin & Strauss, 2016 - Basics of Qualitative**
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3 **research). Examine Braun & Clarke (2006)'s paper on Thematic Analysis and**
4 **see if you actually followed an inductive thematic analysis process.**
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8 **More data analysis detail would be useful - how exactly did you code the data?**
9 **What are examples codes you created, merged, subsumed etc.? Your method**
10 **section is lacking in specific detail.**
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14 After a careful review of our coding schemes, we consider we have employed
15 thematic analysis to deal with our coding. We first followed a top-bottom theoretical
16 thematic analysis to investigate how the Chinese participants experienced serendipity.
17 We began this part of the coding by identifying the themes drawn from our previous
18 study, where we identified the nature of serendipity with two different levels of
19 abstraction, and the value of serendipity. The first level identified the “unexpected
20 finding of information” by considering different combinations of three components:
21 whether the information is directly related to the activity being undertaken by the
22 individual (non-activity-based vs. activity-based); whether or not the information
23 encountered is unexpectedly valuable to the individuals (unexpectedly valuable or
24 not); and whether the information is from an unexpected or likely source. The second
25 level identified the making of unexpected connections between different pieces of
26 information, people and ideas.
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38 We then used a bottom-top inductive thematic analysis to identify the contextual
39 factors present in the cases of serendipity. Initially, we identified a number of
40 categories, including the time for experiencing serendipity (i.e., a.m., p.m., and across
41 time periods), different locations when serendipity occurs (e.g. office, dormitory,
42 classroom, library, etc.), different activities during which serendipity occurs (e.g.
43 travelling, surfing the Internet, attending seminars, talking to classmates, talking to
44 friends, etc.), and a category more related to an individual’s cognitive or
45 psychological characteristics, such as memories, insight, expertise, previous needs,
46 instantly raised needs, and emotions (see Table 3 for an example of the coding for the
47 pilot study case). We then compared the categories and grouped those with
48 overlapping meanings into possible themes. As a result, we ended this layer of
49 analysis with the three major themes of external context (i.e. time, location, and
50 personal status), social context (e.g. different social counterparts) and internal context
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3 (i.e. precipitating conditions, sagacity/perceptiveness and emotions). In particular, the
4 precipitating conditions include visceral needs, conscious needs and previous
5 experience/knowledge.
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10 After we finished coding the themes of contexts, especially the internal context
11 themes of the precipitating conditions, we reviewed all our coded themes and further
12 found that our original coding of the first level “unexpected finding of information”
13 can also be considered as a process of making connections between the encountering
14 and the precipitating conditions. As a result, we re-coded this part of the framework
15 into the three different themes of unexpectedness, connection-making and value, and
16 these were further expanded into sub-themes, namely: “unexpectedness” into the
17 themes of “unforeseen means of encountering information”, “unexpected content of
18 the encountered information” and “both”; “connection-making” was further expanded
19 into “connection-making between unexpectedness and visceral need”, “connection-
20 making between unexpectedness and conscious need” and “connection-making
21 between unexpectedness and previous experience/knowledge”; and “value” was
22 expanded into sub-themes of “substantial value” and “emotional value”.
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33 This is also why in our original version we applied Makri and Blandford’s framework
34 in identifying our coding, as our re-coded themes of “unexpectedness” “connection-
35 making” and “value” are quite similar to those used in their framework. However,
36 after a clear introduction of this element in the revised paper, we have no longer used
37 the term “employing Makri and Blandford’s framework”.
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42 This has been revised accordingly in Section 3.4 “Data analysis”, where we have also
43 added a new Table 3 to explain our coding scheme.
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49 Serendipity perceptions

50 **18.Makri & Blandford (2012) discuss 'exploiting' rather than 'evaluating' value**
51 **(p.13). Review this work to make sure you're representing it accurately.**
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53

54 The work of Makri and Blandford has been reviewed and evaluated. In fact, it is their
55 framework (2012b) rather than their model (2012a) which is employed in our original
56 paper. As explained in the 17th reply, we have now shown that the framework is
57 drawn from our own coding on the collected data, so we no longer use “employing
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3 their framework”.

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7 **19. Some of your evidence from your findings doesn't explicitly demonstrate**
8 **your general argument - e.g. the fire extinguisher example on p.13 does not**
9 **explain how the fire alarm introduction was an unexpected means of finding out**
10 **about fire extinguishers. Surely both topics have fire in common? Similarly,**
11 **perceiving the experience of serendipity on three occasions doesn't necessarily**
12 **mean the participant is a 'super-encounterer' - this might have been an unusual**
13 **situation for them.**

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19 We have supplemented the case of the fire extinguisher, and also go through all the
20 participants' cases used in this paper to ensure validity of our arguments. We now
21 believe every case has an instruction to its relevant discussed topics.

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In the case of the fire extinguisher, the participant reported that she had learnt about the principles of a fire extinguisher from a talk during a training session. She then raised a need to collect relevant information about fire extinguishers around her lab setting (e.g. where they are located in the lab, how to use them). However, this need was not addressed at that moment and the participant forgot to address the need when the talk was finished. It was not until she accidentally attended a related “fire alarm introduction” that she remembered the need, and found the answer to this need during the presentation. We argue that the answer to the participant's need was not unexpected to her, but the unforeseen means by which she received the answer induced feelings of “unexpectedness”, as attending such a presentation was not on her original schedule. This has been revised accordingly in Section 4.1.

With regard to the use of the term “super-encounterer”, it is not because of the participant's sagacity on the three different occasions, but from the collected serendipity cases from all participants during the two-week study. Some participants sent us 13 cases during the study, while others only sent one case. We argue that such differences reflect the differences in each participant's sagacity, and those who sent 13 cases may be considered as “super-encounterers” (Erdelez, 1997).

Cultural differences

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3 **20. Your discussion on this was limited. If your study found no significant**
4 **cultural differences (I characterise the differences in conceptions of serendipity,**
5 **reminders and use of text as fairly minor), perhaps remove this from the write-**
6 **up and consider what else makes the study novel - e.g. a deeper discussion of**
7 **various contextual factors? My personal view is your findings on context are**
8 **interesting, but do not extend far beyond existing work. You would need to**
9 **demonstrate, through discussion, how they do.**
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16 This paper has been revised significantly. The culture section of the original paper has
17 been removed, and the focus is now on the issues of context.
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21 **21. It's not clear what 'measure by which information is encountered' (p.14)**
22 **means and this makes it difficult to understand this part of your findings (and**
23 **their importance).**
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27 The original sentence has been revised to “Both the unforeseen means and content of
28 the encountered information bring a sense of unexpectedness”, to keep it in
29 accordance with the prior descriptions in Section 4.1.
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34 **22. It is worth referring to Taylor's (1964) seminal paper conscious and**
35 **unconscious needs in 4.2.**
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38 Taylor’s work has been reviewed carefully. In particular, we have found our previous
39 definition of “unconscious need” is more accurate as “visceral need”, which was
40 referred to by Taylor as “not existing in the remembered experience of the inquirer”,
41 who also argued that it probably “is inexpressible in linguistic terms”, and can
42 “change in form, quality, concreteness, and criteria as information is added”. We have
43 explained this in Section 4.2.
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50 **23. The label 'substantial' value seems inconsistent with its description (p.15).**
51 **Can't an example represent both types of value (i.e. emotional too?)**
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54 In Sections 5.3.3 and 6.3, we have now pointed out that both emotional value and
55 substantial value will exist in any “need-oriented” serendipity cases, as either finding
56 the answer to previous concerns (conscious need-oriented cases) or finding a possible
57 solution to the raised visceral need may lead to a positive emotion for the participant
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3 when the episode of serendipity occurs.
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7 **24. In 5.1 it is not clear why you focus on time, location and personal status as**
8 **important contextual factors. Were these the most important ones you found in**
9 **your data? Why focus on context at all? In what ways does it help us understand**
10 **people's experiences of serendipity? Stronger justification is needed.**
11
12

13
14 We have now explained that the contextual factors of time, location and personal
15 status are identified based on our own coding of the collect data, and Section 5 “Role
16 of Context” has been largely revised. We have now explained the reasons for these
17 contextual factors affecting how people experience serendipity, as follows:
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22 Time: Existing research has demonstrated that different times of day can impact
23 human performance (Fröberg, 1977) and even the cognitive and evaluative efficiency
24 of individuals (Natale et al., 2003). Our participants also reported that they were more
25 engaged in different activities in the afternoon, as a result of which it was also more
26 likely that they would encounter serendipity.
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31 Location: We investigated the reasons why locations such as an office environment
32 would produce the most cases of serendipity and found that: 1) these places are
33 source-rich; 2) there is an interdisciplinary social setting; and 3) participants could
34 readily gain access to these resources.
35
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39 Personal status: participants in a more open and relaxed state (e.g. during leisure time)
40 encounter serendipity more frequently when compared to other statuses, such as when
41 attending a seminar or working/studying.
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45 We also added a possible reason for social context, where participants are found to
46 experience serendipity more often when they are communicating with their peers.
47
48 When compared to our previous findings from the UK study - where four of the seven
49 social context related cases happened during participants’ communication with their
50 superiors - we think the cultural difference known as “power-distance” played a role
51 in this situation.
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58 **25. Include page numbers when quoting directly from an external source.**
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3 In the revised version, we have included page numbers when quoting directly from
4 external sources.
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9 **26. While it clear that your findings support those from several previous works,**
10 **you do not make a strong case for why your work is novel and important. This is**
11 **essential in any empirical research.**
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15 Substantial revisions have been made in the discussion section, and compared to the
16 previous model, the contribution of this new model lies in the following:
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20 1) It helps to explain the different roles of external context, social context and internal
21 context during each process of experiencing serendipity (unexpectedness, connection-
22 making and value), which provides evidence that serendipity is the “product of
23 context” (Foster and Ellis, 2014, P. 18). This is discussed in detail in Section 6.2.
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27 2) Based on the identified internal contextual factors of precipitating conditions, we
28 expand the framework of “unexpectedness”, “connection-making” and “value” by
29 further identifying the sources of unexpectedness (unforeseen method of encountering
30 information and/or the unexpected content of such information), connection-making
31 between unexpectedness and precipitating conditions (i.e. visceral needs, conscious
32 needs and previous experience/knowledge), and value (substantial value and
33 emotional value). Such expansion made it possible for us to classify the categories of
34 serendipity. See a detailed discussion of this in Section 6.3.1.
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43 3) Based on the contextual factors identified, design implications can be drawn to
44 “engineer serendipity”, such as considering participants’ status, considering locations,
45 trying to create social networks, designing environments that are diverse and
46 noticeable, and combining emotional design. See Section 6.3.2.
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53 Discussion
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55 **27. You present some thoughtful discussion. However, it would be useful to**
56 **discuss your findings in light of the existing literature - particularly on context -**
57 **more. Much of your discussion section reads like a findings section.**
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3 **If the context-based model in Fig. 2. is one of your claimed contributions of**
4 **novelty, I recommend explaining what new or enhanced perspective it provides**
5 **over existing models.**
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11 The discussion section has been largely restructured. We have now removed
12 references to culture and have focused on issues of context. Sections 6.2 and 6.3 have
13 been added to demonstrate the novelty of our research findings. After a discussion of
14 the updated model in Section 6.1, in Section 6.2, we have compared this model with
15 the previous model, and extend the current literature by unpacking how these
16 contextual factors affect the different processes of a serendipitous episode. Section
17 6.3.1 discusses the new classification of the categories of serendipity, by expanding
18 the identified framework from the empirical study, while in Section 6.3.2, following
19 Björneborn's (2017, p. 1068) argument that "We cannot design environments always
20 leading to serendipity..... but affordances for serendipity can be engineered", and
21 based on the identified external context, social context and internal context from this
22 empirical study, we propose different implications for designers to include
23 affordances that can "engineer serendipity".
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35 **28. It is not clear why the 'disparities on the basic understandings of serendipity'**
36 **(p.26) between U.K. and Chinese scholars' results in the need for different**
37 **research approaches. Perhaps clear instruction on the nature and properties of**
38 **serendipity in all cases. I'm not sure if PD necessarily accounts for the cross-**
39 **cultural differences in serendipity you identified; might the Chinese students**
40 **simply have had less interaction with their academics? I also don't see how the**
41 **interdependent/independent argument stacks up; more reliance on reminders**
42 **may also be due to other factors (e.g. a busier workload).**
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50 **You claim your culture-based findings provide a 'new solution' for studying**
51 **serendipity. It would be useful to discuss in detail what method insights they**
52 **provide.**
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56 The discussion of the differences in culture between the UK and Chinese scholars has
57 been removed from the paper, and it is now focused on issues of context. We will
58 make more strict comparisons between different cultural groups in future studies.
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5 **29. It may be helpful to the reader to discuss limitations of the study approach,**
6 **and your findings, in a specific 'limitations' section.**
7

8 We have added Section 6.4 for the discussion of the limitations of the study approach,
9 in which two concerns are discussed. The first is the participants' initial
10 understanding of serendipity. In addition to the dictionary definition, the lack of initial
11 understanding from the Chinese participants prompted us use an example from the
12 pilot study to help explain this new term. This raised the concern that participants may
13 restrict the types of examples for experiencing serendipity during the following study.
14 The second limitation is the setting of the daily reminder. A two-week study is a
15 relatively long time, and sending reminders to participants was intended to ensure
16 they remembered that they were in an experiment situation, although it may have
17 caused additional pressure to be put on participants. Thus, how to balance such
18 reminders is another concern that needs to be considered carefully in any future
19 research.
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31 **30. The article would benefit from careful proof-reading by a native English**
32 **speaker, although the readability is fairly good as it is**
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35 We have made efforts to review and improve the readability of this paper with
36 experienced academics and experts.
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