Serendipity and information seeking: an empirical study

Foster, Allen; Ford, Nigel

SERENDIPITY AND INFORMATION SEEKING:

AN EMPIRICAL STUDY

Allen Edward Foster

&

Nigel Ford

SERENDIPITY AND INFORMATION SEEKING:

AN EMPIRICAL STUDY

Abstract

"Serendipity" has both a classical origin in literature and a more modern manifestation where it is found in the descriptions of the problem-solving and knowledge acquisition of humanities and science scholars. Studies of information retrieval and information seeking have also discussed the utility of the notion of serendipity. Some have implied that it may be stimulated, or that certain people may "encounter" serendipitous information more than others. All to some extent accept the classical definition of serendipity as a "fortuitous" accident. The analysis presented here is part of a larger study concerning the information seeking behaviour of interdisciplinary scholars. This paper considers the nature of serendipity in information seeking contexts, and reinterprets the notion of serendipity as a phenomenon arising from both conditions and strategies – as both a purposive and a non-purposive component of information seeking and related knowledge acquisition.

Introduction

In the context of information seeking, "serendipity" is something of a paradoxical concept. Whilst being perceived as valuable, it is at the same time elusive, unpredictable and – at least at first sight – not subject to either the understanding or the resultant control that would enable it to be "used" as a conscious information seeking strategy. Possibly for this reason serendipity does not figure prominently in current models of information seeking or behaviour, for example those of Ingwersen (1996), Wilson (Wilson and Walsh, 1996; Wilson, 1997), Kuhlthau (1993), Saracevic (1996), and Spink (1997).

Serendipity is defined in the Oxford English Dictionary as: "The faculty of making happy and unexpected discoveries by accident". It was originally coined by Horace Walpole in a letter to Sir Horace Mann on 28 January 1754 (Remer, 1965: 20).

> "This discovery is almost of a kind which I call serendipity, a very expressive word….I once read a silly fairy tale called 'The three Princes of Serendip'…as their highnesses travelled, they were always making discoveries, by accidents and sagacity, of things which they were not in quest of…"

Serendipity has been considered in the literature to form an integral part of the creative process in the arts and humanities, social sciences and the sciences. In each, however, the experience of serendipity may be different. Delgadillo and Lynch (1999), for example, confirm the essential value of serendipity in the work of humanities researchers such as historians. Cobbledick (1996) considers serendipity as an important source of artistic stimulation. Sometimes serendipity is described in terms of finding similar information to that already identified, as described by Buchwald (1999: 4):

> "Serendipity appears to have its place in research….the process of serendipity should not be underestimated. One client who made an interlibrary loan request at the desk eventually revealed to me that she did not want just an article from all journals she requested, but the entire volume, because

often a journal or serial will have a theme for a particular volume, while in general, similar articles can be strung together. Access to materials is an important aspect of serendipity for the humanities scholar".

However, serendipity in the humanities may also have a role in revealing hidden connections or "hidden analogies", enabling creative connections to develop (Cory, 1999). The hidden analogies are revealed through serendipitous links between information sources.

In the social sciences, serendipity appears in a similar "connection building" role. Merton (1968) describes this process within sociological research, and Fine and Deegan (2000) in a number of cases of anthropological and sociological fieldwork. Serendipity also has a role in science research. Recent examples are cited in Thagard and Croft (2000) who include the identification of bacterial roles in peptic ulcers, discoveries in palaeontology and even the development of the basic Java programming language. This was originally created for a different purpose, and serendipity was instrumental in finding a more appropriate application as a prime Internet programming language. Further discussion of the key role of serendipity in science may be found in Myerly (1980) who describes the accidental discovery of polyethylene oxide and Senoff (1990) whose paper cites personal experience of serendipity occurring within the context of scientific method.

However, a number of writers have hinted at an element of potential control. In science, serendipity has been thought of as the product of mental preparation, of an open and questioning mind. As Rosenman (1988: 137), for example, has noted:

"By realising that discovery involves a dynamic interplay between conventional scientific methods and chance in all of its forms, and by cultivating an aptitude for serendipity, scientists can greatly enhance their investigative powers".

Rosenman points to the discovery of penicillin and the importance of the will of the questioning mind to view data from several perspectives. Roberts (1989) also points to discoveries taking place for the "prepared mind" – a theme that continues throughout the literature of science, with many examples from Pasteur to Fleming being cited. Seifert *et al.* (1994) suggest that creativity originates in a preparation of mind that allows subsequent recognition of the serendipitous when it is encountered. In science, serendipity is an essential tool to aid the process of discovery and one for which preparation is perceived as to some extent possible.

Serendipity would seem to be important across disciplinary areas for its role in connection building, discovery and creativity. The literature presents serendipity as being in some way both passive and yet capable of "efficiency", or techniques by which hidden knowledge may be retrieved. Accounts of the creative process of research do not leave serendipity as Walpole's classic "fortuitous discovery", but hint at something more active, operating at the edge of consciousness.

Serendipity and information retrieval

Retrieval systems have been at the centre of debates over the role of serendipity. Gup (1997; 1998), for example, highlights the value of serendipity but perceives it to be under threat as electronic retrieval may tend to reduce the opportunity for serendipitous information encounters.

This theme continues in Cooper and Prager's (2000) study of digital collections, which illustrates the potential for limiting the occurrence of serendipity through filters and document rankings which can excessively limit searches. Similarly, Huwe (1999: para 9)

suggests that the move to digital libraries might jeopardise serendipity by reducing the number of available paths to reach a given set of material.

> "Researchers crave flexibility, multiple pathways, and circuitous journeys. The image of the academic specialist, searching the shelves for a serendipitous connection, may seem quaint, but it remains powerful. The challenge for the digital library is to preserve this opportunity in cyberspace"

The literature of information retrieval and information seeking has also provided some support for the view of serendipity as a purposive or active phenomenon. Within this literature, serendipity has been seen to be of some importance, often considered as a by-product of browsing. Thirty years ago Morse (1971) noted that "browsing may be defined as a search, hopefully serendipitous" and considered ways to increase the efficiency of browsing. Rice (1988) described serendipity from a library perspective as

> "…sometimes totally fortuitous but it is also, perhaps even more often, actually systematic in a convoluted way that is almost impossible to explain. But reference librarians know that what comes under the rubric of serendipity is often an actual, possibly subliminal, search strategy. Stated very generally, the potential for serendipity should be directly related to the number of different access points or potential ways of retrieving from a given system". (1988: 139)

Much later Callery (1996: para 2), writing about the Yahoo Search engine's tree-based classification system, noted the benefit of serendipitous findings from within the same classification branches:

> "Another benefit of browsing is the serendipitous discovery of related items. In cases in which the user may be looking for a specific site and doesn't see it in its subject area, chances are that other sites grouped in the same area may have something useful"

The link with activity is continued in the work of Bawden and Rice and McCreadie (2001). Bawden's (1986) definition of Browsing appears most cogent in connection with the findings of the present study. Bawden put forward

"At least three kinds of browsing have been recognized: 'purposive' browsing, the deliberate seeking for new information in a defined (albeit broad) subject area; 'capricious' browsing, random examination of material without a definite goal; and 'exploratory' or 'semi-purposive' browsing, in search, quite literally of inspiration." (Bawden, 1986: 211).

In a similar approach Rice and McCreadie (2001) make much of the connection between browsing and serendipitous retrieval, indicating that "Serendipitous findings are one of the consequences of browsing in the library and through journals is finding something of interest or some things that are not originally sought" (Rice, 2001:182). Browsing was associated in Rice and McCreadie with the most pervasive information searching activity and said to exist in three forms, Search Browsing, General Browsing and Serendipity Browsing (2001: 179). More significantly Rice and McCreadie linked serendipity and browsing with four dimensions that further confirm the presented later in this paper. Within this Rice identified four dimensions to the process, the act of scanning, the presence or absence of purpose, the specificity of search outcomes or goals, knowledge about the resource and object sought.

In these cases, something more than mere chance is implied, as with Toms (1998), who talks of "serendipity-focused" research, and Roberts who discusses "pseudo-serendipity", in which serendipity arises not from random accidents but from circumstances brought about by unconscious motives which lead ultimately to the serendipitous event.

These authors link serendipity to action and to important aspects of the retrieval process. Others, for example Hill et al (1997), consider ways to exploit serendipity amongst users of hypertext navigation systems. Jones and Rosenfeld (1992) suggest serendipity as an information retrieval strategy and moot it as an appropriate *tool* whereby information retrieval systems can retrieve inaccessible "invisible material". Similarly, Batley (1988) describes an experimental retrieval system that offers serendipitous browsing as an active search option. In a similar vein Koch (2001) argued that some things should be left to chance to broaden the serendipitous results generated by information systems.

The connection between browsing, serendipity and access is also of relevance from the perspective of dependence upon access to resources. As Line (1992; 1996) points out that issues of ownership and technology may adversely affect the physical access to resources that benefit serendipitous retrieval. Further work indicates the experimentation with collocation of materials to generate serendipity (Boyd, 2000).

Beyond these perspectives Erdelez describes a type of serendipity appearing in two contexts of activity: browsing and environmental scanning (Erdelez, 1996a; 1996b, 1999). Erdelez draws together a number of papers, suggesting that the concept of information encountering has long been identified, if not investigated. She reviews work on browsing and environmental scanning and labels several descriptions of browsing proposed by various authors as: directed (Herner, 1970), systematic (Beheshti, 1992), semi-deterministic (Levine, 1969), discriminating (Vickery, 1960) and specific (Apted, 1971). Erdelez's own research (1996: 418) found that "information encountering" was an integral element of information seeking activities and that information seekers could be classed as (a) super-encounterers, (b) encounterers, (c) occasional encounterers and (d) non-encounterers:

> "The presence of the super-encounterers was an especially interesting finding in this study. These respondents appeared to share a common excitement for information encountering. They believed in creating situations conducive to information encountering and in that way finding useful and important information"

Observations of information encountering and the resultant papers by Erdelez appear to accept a degree of passivity, but also allow the notion of serendipity occurring more often in the case of the "super encounterers". Erdelez is amongst authors who identify the importance of the role of personal characteristics in Serendipity. The literature relating to individual differences, cognitive styles and personality would provide a further dimension for further

reading. The emphasis in this paper is however upon the behaviour and skills involved in the phenomenon of serendipity.

Thus the literature of information retrieval presents an underlying principle, complementing that found in the literature of other sciences, that it is not only the prepared mind, but also the prepared retrieval system and appropriately developed information seeking skills that may have a role in engendering serendipitous information encounters. Such questions about the nature and controllability of serendipitous information encounters are taken up in the section *Research questions* below.

Theoretical framework and research questions

Although there is an increasing number of models of information seeking behaviour – for example those of Ingwersen (1996), Wilson (Wilson and Walsh, 1996; Wilson, 1997), Kuhlthau (1993), Saracevic (1996), and Spink (1997), our understanding of this behaviour is still developing. The use of methodological approaches aimed at discovering "sensitising" concepts is arguably justified in this context.

"Sensitising" concepts, according to Olaisen (1991: 254) are tentative and speculative concepts that:

> *".. offer a general sense of what is relevant and will allow us to approach flexibility in*
> *a shifting, empirical world to 'feel out' and 'pick one's way in an unknown terrain ….*
> *In sum, the on-going refinement, formulation, and communication of sensitizing*
> *concepts must inevitably be the building block of our exploratory theory."*

The search for such concepts is particularly appropriate in the case of investigating what Olaisen refers to as "what we don't know that we don't know" as opposed to "what we

know that we don't know" types of questions. Such an approach is arguably appropriate in the investigation of information seeking behaviour.

The analysis reported here forms part of a larger doctoral study, aimed at developing a model of the information seeking behaviour of inter-disciplinary academic researchers.

The study adopted an inductive analysis of qualitative interview data (described in detail below). Early in this analysis the notion of "serendipity" was identified as a coding category that was appropriate to accommodate many interview comments relating to accidental and fortuitous encounters with information. These differed from those coded using other categories such as "browsing" in that they all entailed an element of surprise, accident or fortuitous discovery.

The aim of the part of the research concerned with serendipity was to build as rich as possible a picture of the concept – along with other emergent concepts that related directly to it – in terms of its nature and attributes as perceived by the interviewees. The research questions of this part of the investigation were:

1. To what extent do inter-disciplinary academic researchers experience serendipity in their information seeking?

2. Are there different levels and types of "serendipity"?

3. To what extent is it perceived as a phenomenon that can in any way be consciously influenced or controlled?

4. If so, then using what type of strategy can we exercise such control?

Methodology and methods

The study was based on Naturalistic Inquiry as described by Lincoln and Guba (1985). This entails an inductive data-exploratory, as opposed to a deductive hypothesis-testing approach. In this way, the intention was to explore information seeking in a way that allowed relatively unanticipated aspects and links to emerge.

Population

The population from which the sample was drawn consisted of all academic and postgraduate researchers from some 100 research groups and departments listed as belonging to the faculties of arts and humanities, social science, engineering, and medicine.

Sampling

A combined sampling method was adopted, taking account of both population and methodological context. The first stage of sampling applied was purposive. Lincoln and Guba (1985: 40) particularly suggest that the naturalistic research:

> *"… is likely the eschew random or representative sampling in favour of purposive or theoretical sampling because he or she thereby increases the scope or range of data exposed…"*

Purposive sampling is the selection of a sample on the basis of its contribution of information rich cases for in-depth study (Patton, 1990). In this study criteria were specified to guide the growth of the sample within the population forming the sampling frame. The criteria were developed to allow a sample (a) comprising interdisciplinary researchers and (b) ensuring rich data from a wide ranging sample drawn from the different University faculties. Purposive sampling was thus selected in order to maximise the potential contribution of a rich and diverse population of interdisciplinary researchers. Following Patton (1990) who

described combinations of sampling methods to achieve a desired shape and size, the study combined purposive sampling with the "snowball" technique. This technique entails using the knowledge and contacts of existing interviewees to suggest other potentially information-rich cases. As noted above, purposive sampling entailed the setting of criteria for evaluating the suitability of cases for inclusion in the sample. The snowball technique enabled the generation of candidates for such evaluation.

Interdisciplinarity was defined for the purpose of this study in terms of research topics in which there was a primary knowledge domain, but where this domain was related to one or more other knowledge domains – or topics that had no single domain focus, and appeared as a composition or hybrid subject, reliant to varying degrees on several sub-disciplines or partial elements of disciplines. This definition was reinforced by the classification of potential participants based on 3 additional factors:

(a)   The interviewees' own description of their topics as interdisciplinary, given in the initial meeting with the researcher.

(b)   Following the work of Saracevic and Kzinto (1988), research topics were also classified using the information domains listed in the DIALOG databases catalogue 'Onesearch' categories.

(c)   One last check, based on the researcher's interview notes, prevented the acceptance of merely ill-defined topics or topics that were merely sub-fields of a larger discipline.

Once identified potential participants were contacted by letter and subsequently by a brief meeting to ensure that all participants did indeed meet the criteria. A pilot study confirmed that the sampling methods functioned appropriately.

Data Collection

Open ended interviews were employed in the study. Such interviews offered a way to explore beyond established theoretical frameworks and to minimise preconceptions when investigating information seeking behaviour.

Interviews took place at the workplace or office of interviewees. Interviews were between forty five minutes and two hours in duration. Interviews were taped and transcribed in full. The interviews were supplemented by notes made by the interviewer. It was felt that the tape-recording of interviews permitted nuances in interviewees' responses to be considered in more depth, and avoided distractions to both interviewer and interviewee that may have resulted from constant note-taking.

Data Analysis

Data analysis was guided and informed by the systematic approach recommended by Glaser and Strauss (1967) and Lincoln and Guba (1985), entailing inductive coding and the constant comparison method. As a Naturalistic Inquiry the aim was to generate rich qualitative data, frequency of occurrence was deemed a distraction from the Naturalistic process of exploration.

Interviews were transcribed and coded immediately following interviews and coded inductively. In the terms of Strauss and Corbin (1990: 23), codes were

> "...inductively derived from the study of the phenomenon…. That is, discovered, developed, and provisionally verified through systematic data collection and analysis of data pertaining to that phenomenon…". (Strauss and Corbin, 1990:23).

The qualitative data analysis software, Atlas-Ti (Muhr, 1998) was used to both manage the process of coding and linking concepts and to enable effective searching and retrieval of

quotations. Originally designed for grounded theorists Atlas-Ti proved transparent enough to allow a combination of analysis methods to coexist.

The study adopted the methods put forward by Lincoln and Guba (1985), Merriam, (1998), and Kuzel and Like (1991) for increasing trustworthiness, credibility and accountability. Lincoln and Guba (1985) suggested prolonged engagement, persistent observation and triangulation methods. These methods were applied to the research in that (a) the interviewer was familiar, in the sense of professional experience of online searching and collaboration, with the academic disciplines involved; (b) in-depth interviews were used; and (c) a larger number of participants were interviewed than might strictly be considered necessary for a naturalistic inquiry.

An element of triangulation as described by Patton (1990), Lincoln and Guba (1985) and Denzin (1970) was built in to the study via the comparison of diverse participant groups in terms of academic status, research topics and faculties. Member checking is a particularly important method of increasing the credibility of qualitative research (Erlandson et al, 1993; Lincoln and Guba, 1985). The present study utilised member checking in three ways:

Firstly, member checking at the pilot stage contributed the thoughts and opinions of a sample of five interdisciplinary researchers with whom interviews were conducted and questions candidly discussed following each interview.

Secondly, a form of member checking was adopted at the time of the interviews themselves. All respondents were given the opportunity to discuss findings in an informal post-interview session. These sessions allowed themes and the emerging analysis to be discussed.

A third member check involved gathering a sub-sample of interviewees throughout data collection who would be willing to contribute to a further session. This sub-sample was subsequently asked for feedback on the transcripts of their own interviews, and to consider the analysis and resulting model as a valid report of their experience.

In line with the naturalistic approach the study aims, through rich description and reporting of the research process, to achieve transferability as opposed to generalisability (Lincoln and Guba, 1985; Patton, 1990; Sanjek, 1990).

Results

The sample

The sample is detailed in Table I. It consisted of 45 researchers from a range of academic backgrounds, all of whom were working on interdisciplinary research topics at the time of interview.

Take in Table I here

The role of serendipitous information encounters in research

As data analysis proceeded, a number of quotations included terms which all indicated a level of "unplanned surprise" on the part of the interdisciplinary researchers when encountering information relevant to their research. Interviewees talked, for example,

of "randomness", "chance", "accident", or that they "just happened to" do something that sparked off the acquisition of unanticipated information.

Categories for "browsing", "networking" and "eclecticism" had already been established as codes in the broader study of which the present analysis forms a part. However, these quotations did not easily fit into any of the other codes already established, which essentially did not reflect the essential "unexpectedness" inherent in the quotations – for example:

> "…when I was doing my thesis, it happened all the time, I would just pick a book up off the shelf and find something which was either directly relevant or related. I don't do it as much as I used to, but I am uncomfortable because I don't. So yes, I would say there has been a big part of serendipity. I think a lot of what I read is partly dictated by deciduous heaping up, not by an empirical approach, but certainly chance plays a big part and it is important to me at least that it does". *Interviewee 35.*

> "Well, the awful thing with quirky is that you tend to come across them by chance almost, a few I found like radio debates where there is a half hour slot on a radio show where readers give reviews of new books but that was only by chance that I found that because I was looking for reading groups". *Interviewee 1.*

A new category "serendipity" was therefore established. Further analysis of this category revealed a number of facets relating to the concept. These facets entailed both the *impact* of serendipitously discovered information and the *nature of the discovery process*. In terms of impact, serendipity in information encountering could have the effect of:

1. Reinforcing or strengthening the researcher's *existing* problem conception or solution; or

2. Taking the researcher in a *new direction*, in which the problem conception or solution is re-configured in some way.

The following three quotations illustrate the first of these categories – i.e. the reinforcing of existing models or directions:

"… coming across by chance, rather than by tracking down … I think in a way that that is the way I get material, though I'd like to be more methodical, something coming from out of the blue kind of fuels me rather than knocks me in a new direction, for example on the kidult fiction my paper took the form of a reading of six essays which had nothing to do with kidult but hit me broadside that these two things were the same. Other things like that might just be in a bookshop and I'll spot something that doesn't appear to be relevant but is tangential to what I am interested in and I'll bring that in too". *Interviewee 37.*

"...because I myself have 30 years of conceptual history, in several disciplines, but particularly of course sociology, then something like that will make a resonance and hit something and then I will think "ooh my goodness" I had a very interesting example of this the other day when I was watching a programme on archaeology … on Vikings and Iceland and why a particular settlement went asunder at a particular time and they had pieced together an entirely sociological explanation coming from these archaeologists and it resonated with a huge amount of literature that I had ploughed through 25 years ago when I was talking about the sociology of developing societies". *Interviewee* 2.

"… there are times when by chance you just come across something. That is part of the diminishing returns that towards the end of a project that you might by chance come across something that is just perfect or opens your eyes up to a whole new set of views, but most of the time you just don't it is more often a reiteration of something you have seen before. But particularly at that point serendipity plays a huge role in finding those obscure things, most of which are going to be awful and not worth pursuing but occasionally they are really worthwhile". *Interviewee 34.*

By contrast, chance encounters may also lead to new, unanticipated outcomes – angles previously not thought of (category 2 above). The last interviewee quoted above – although stressing the less innovative aspects of serendipitous information encounters – also noted that serendipity sometimes "opens your eyes up to a whole new set of views". The following quotations describe the same phenomenon.

"Just recently for example I tuned into radio 4, a researcher came on and was talking about brain lateralisation, it is highly unlikely that I would have come across this by searching, probably not by browsing the journals, within a couple of minutes I logged on to the web and found some new academic work on this new aspect of the research. I am always amazed at the role of this serendipitous approach, you know you are listening to something, you are talking to somebody, you are looking at a journal out of boredom, and you are looking at a journal in another section of the library and you turn up something that can later turn out to be quite key and give you quite a new direction". *Interviewee 9.*

"… one would go through quite a number of channels that one would expect researchers to go through, but I also find that it is the chance factors that are interesting, you hear something on the wireless, and you hear someone say something and it is something that you haven't come across and you recognise it as important, and so you have got another avenue to pursue … so there are very important chance factors that I find in my life now increasingly that become quite significant". *Interviewee 19.*

"But I would say the approach that I would take would be fairly systematic and literature searching to start with, through all the resources that I was aware of, and then I would think often it becomes a bit more serendipitous after that, where, perhaps I find one paper or source and that leads onto another one, and just by chance takes me into a whole literature that I wasn't aware of and that hasn't arisen through systematic searching, because I wouldn't have known the language. So for instance I was recently doing some work on digital libraries, I started searching in the digital libraries literature and I came across a whole area of user centred design that I hadn't been aware of before and that was just by chance that one little reference in a paper lead me on". *Interviewee 28.*

The nature of serendipitous information encounters

As well as detailing the *impact* on their research of serendipitous information encounters, interviewees also described the *nature* of these encounters. A number of different types of

such encounter were identified. These were classified as follows. The numbers used in the classification continue the sequence used for *impact* above.

3. The unexpected finding of information the *existence* and/or *location* of which was unexpected, rather than the value:

4. The unexpected finding of information that also proved to be of *unexpected value*:

    a) by looking in "likely" sources

    b) by chance.

    The quotations below illustrate these types of information encountering.

Researchers may have a good idea of the sort of information that would be useful, but be uncertain as to whether or not such information exists and/or where it may be found (category 3). Examples of coming across such information unexpectedly in this way include the following:

> "…and one of the things that I was interested in was had anybody else done it, so then I started doing a broad search, and starting off with just 'interpreter' and 'sign language' keywords and I was coming up with virtually nothing….Then one day I was just sort of sitting in a waiting room - waiting for a colleague and I just happened to pick up a fairly old nursing journal and flipped open a page and right there In front of me was a person doing the same job in Scotland that we were planning for Sheffield". *Interviewee* 6.

> "When I was doing my thesis, it happened all the time, I would just pick a book up off the shelf and find something which was either directly relevant or related. I don't do it as much as I used to, but I am uncomfortable because I don't. So yes, I would say there has been a big part of serendipity. I think a lot of what I read is partly dictated by deciduous heaping up, not by an empirical approach, but certainly chance plays a big part and it is important to me at least that it does". *Interviewee 35.*

"I was reading the TLS online, and there was a review of a book by an anthropologist which had very parallel conceptual problems to the ones that I am facing. I was only looking at the TLS because there was a review of a book of mine coming out So, yes that is one example, but it is precisely crystallised an issue for me. Another one was I went to see a Robert Mitcham film called "Night of the Hunter" and it starts with a quotation and I suddenly realised a whole series of writing from the 1640s was relevant". *Interviewee 36.*

Paradoxically, researchers may have an idea about where potentially useful material may be found – but be unsure about the exact nature of the content that may be expected (category 4a):

"But it was a way of actually coming at my subject from around a corner because you could search what was essentially a music database to, in a way, to provide information of a cross disciplinary nature". *Interviewee 5*

"Well, I think, I am always on the look out for new avenues, and I think that has always been the way that I work, I don't expect to find things, I am always looking for new viewpoints anyway so I might actually search within an area. For instance I don't normally search the sociology literature, but I might get a sense that I should just have a look in that literature and see what it brings up. I don't know that I consciously do anything to stimulate it, but I do seize opportunities that arise in mention of something, a reference in a newsgroup, or mention of some author or personal communications, but I don't know that I do anything to stimulate that condition". *Interviewee 28*

Conversely, researchers could also experience the chance finding of information the value of which was unanticipated (category 4b):

"I would say that the work that I am doing is a lot more random now really, someone I am speaking to might suggest a book, I'll read that and that will spark off a whole new area of interest, that will tie in to what I was doing, but I could have almost got to the end of my research without knowing it was there, or finish without even studying that area necessarily. So I would say that there is a lot more chance in it". *Interviewee 7.*

"…one would go through quite a number of channels that one would expect researchers to go through, but I also find that it is the chance factors that are interesting, you hear something on the wireless, and you hear someone say something and it is something that you haven't come across and you recognise it as important, and so you have got another avenue to pursue…. so there are very important chance factors that I find in my life now increasingly that become quite significant".

Interviewee 19

Figure 1 summarises in diagrammatic form the classification developed from the interview analysis.

Take in Figure 1 here

There would appear to be a logical link between process and outcome (impact) in that in cases where the nature of potentially valuable information is anticipated (boxes 1a and 1b in figure 1) the impact of the information (box 3) is likely to be within the interdisciplinary researcher's existing conceptual framework – which, after all, generated the anticipation. However, in cases where the value of information encountered is unexpected (boxes 2a and 2b), impact is likely to entail an element of reconfiguration and moving outside the researcher's existing conceptual framework (box 4). Even though outcome may in this way be anticipated from process, it was nevertheless considered useful to separate them since they are conceptually distinct.

Serendipity and control

Perceptions of the extent to which serendipity could be influenced – encouraged or nurtured – differed. At one end of a "control" dimension, the last-quoted researcher, whilst

reporting "getting a sense" of where to look to come across unexpected information, stopped short of attributing any element of control, preferring to affirm uncertainty as to whether the process was or was not affected by anything he consciously did:

The following quotation emanates from a researcher who spoke of "almost deliberate" randomness, going on to express an element of influence in terms of the way in which information was searched for:

"I tend to go in with very simple questions to begin with and then from those questions I will start refining until I get to the pieces of information that I want. I actually even do that when I know immediately that I couldn't find it. It is almost a deliberate process because sometimes the randomness can throw up angles that you haven't thought about … Yes, serendipity I think. … deliberate randomness, we are into the field of chaos now. Yes, you have to define it – you wouldn't go in and search for pigs when you wanted cows, but you may say bovine instead of cow". *Interviewee 14.*

Another researcher spoke of researchers "making their own luck" via hard work and persistence.

"I do think that historians make their own luck and I have down work in the past where I have drawn connections that people haven't seen and weird ways of looking at a problem that haven't been recognised before and there was an element of luck in where I chose to search and there was an element of luck in where I chose to search and how I chose to explore the topics, but I did a big project and I was specifically exploring an interpretation of literature and I found a fantastic amount of information to string together that others had not and I got better at that and the early ones that I did my resources were quite small and I just got better and better and at first I just thought I was lucky and then I recognised that that was not luck, or genuine fortune. But, the historian who goes to the archive and asks to see the papers of the 5th Duke of Richmond and finds in box 27 a previously unknown letter from Gladstone that completely recognises understanding of his opinions on home rule. Now is that because he knew that just by searching through what would be an unlikely source,

is this just genuine credit for wading through loads of dusty boxes or is it serendipity?" *Interviewee 30.*

Serendipity could also be viewed as rather less mysterious – as simply the product of the subtle influence of significant others, such as librarians and the authors of classification schemes:

"For art history, in order to think about some of the images that I have had to look at, I went to periodicals, I remember this very clearly, I went to the periodicals room in the Senate House Library, which is the University of London library, because they have them laid out very nicely on slanted shelves with the covers facing out, so it is readable and user friendly and I just went into the art section and found some great journals and of course that is current issues and then I could look at back issues. But next to the art journals were the Garden History journals which I hadn't even thought of looking for, and they proved to be very valuable to me, so there is a fortuitous, luck, element, in some of the research that I have found information when I haven't actually been looking for it necessarily, though I have wanted it. …Yes, it isn't simply luck that I found garden history, because libraries are organised logically so that the garden history journals are next to the art history journals and then next to the architecture journals. So, I suppose it isn't just by chance, but that is one way in which I guess I am not narrowing what I find, but it is being narrowed for me, in that if I go to look at art journals I am very aware of what is around the edges, what is on the periphery and what is adjacent to. It is the same with books on shelves because of course using keywords and titles searches isn't actually a scientific strategy because many people have very bizarre titles for books and one way that I have found some is just that they were next to others that I was going to get". *Interviewee 31.*

Indeed, one researcher felt that serendipity could be considered as a process whereby such logical organisation provided by information gatekeepers could simply remind researchers of what they should – and possibly once did – know:

"I have been in the game for such a long time that I have forgotten a hell of a lot, discovery is remembering really isn't it, so it is probably something that I knew once and there are traces in ones

mind. Serendipity can happen if you go along a book shelf - you can find something that you ought to have known about, if books are organised thematically and that is serendipity, but it is not exactly serendipity if you are using a big reference text fairly methodically". *Interviewee 32.*

A relatively large number of interviewees did however identify certain *attitudes* that they perceived could, if not actually attract serendipity, then at least facilitate it when it occurred. One such attitude was consciously to be open and receptive to chance information encounters:

"I think (chance, serendipity) is often overlooked by researchers, we often present to students too clear and calculated rational model, that isn't to say that isn't important but one has got to be open to possibilities and ready to fix into something very quickly should it come your way". *Interviewee* 19

"for me, looking at something from a multidiscipline, it is hard to define, because this current project could you surprise you in what it did actually come under and you have to stop having a blinkered and channelled way of looking at things, you have to be really open to anything and constantly redefining what you mean I think". *Interviewee 1.*

For some researchers this openness extended to the point where the notion of "discipline" could be a hindrance to serendipity:

"I would also encourage people not to conceive of themselves as being part of a discipline because you won't get anywhere with that, you might start coming to recycling as an economist, well you can forget that for a start, you have to open to what psychologists and sociologists and civil engineers and geographers are saying – so to be open minded". *Interviewee 11.*

"I think I would have to say forget your discipline, just don't worry about your academic or your academic career, but that is part of the difficulties …don't worry about what you thought the problem was, read everything and anything and come to your structure". *Interviewee* 3.

Complementing the cultivation of an open attitude was the *conscious strategic decision* to step back and take a broader view. This could be a way to bring in serendipitous items that would be missed by narrower searching:

"A lot of times if you are very loose with your search terms in these things you can actually pull out the disciplines just by random. So rather than taking the approach that I am going to look for something extremely specific to limit my search, you can actually pull back and do something global". *Interviewee* 14.

"I tend to go in with very simple questions to begin with … I actually even do that when I know immediately that I couldn't find it… because sometimes the randomness can throw up angles that you haven't thought about…". *Interviewee* 14.

Discussion and conclusion

Existing models of information seeking behaviour generally do not include the notion of serendipity. It may to some extent be accommodated in Wilson's (Wilson and Walsh, 1996; Wilson, 1997) model in that he includes "passive attention" and "passive search" but these are not further elaborated. However, serendipity has been widely recognised in the literature – across disciplines – for its contribution to the generation of new knowledge. The notion that certain attitudes and strategic decisions may affect if not the occurrence, then at least the exploitation of serendipitous information encounters, has been acknowledged in the concept of the "the prepared mind" in the literature of science. Certain authors have noted that to some extent serendipity may go beyond the purely accidental, and can, although stopping short of being predictable or directly controllable, to some extent be actively sought.

Within the literature of information retrieval, an element of control has also been implied for example by Jones and Rosenfeld (1992) who talk of serendipity as a retrieval

strategy – although they do not further elaborate the concept. Erdelez (1999) has also noted that some people tend to encounter more information than others – which again implies some element of either conditions or control, although such notions were not followed up.

The findings of the present study indicate that, in the particular sample studied:

- Serendipity was widely experienced amongst inter-disciplinary researchers.

- Serendipity may relate to the impact of new information on the research process (whether or not the information was encountered by chance).

- Serendipity may also relate to the chance encountering of information (whether or not this information had an unexpected impact on the research).

- Certain attitudes and strategic decisions were perceived to be effective in exploiting serendipity when it occurred.

- Perceptions of the extent to which serendipity could be induced were mixed. Whilst it was felt that some element of control could be exercised to attract "chance encounters", there was a perception that such encounters may really be manifestations of the hidden, but logical, influences of information gatekeepers – inherent in, for example, library classification schemes.

Serendipity is a difficult concept to research since it is by definition not particularly susceptible to systematic control and prediction. As such, its existence, nature and attributes are suitable, particularly in the early stages of investigation, for study using qualitative methods such as those adopted in the present study.

Despite the difficulties surrounding what is still a relatively fuzzy sensitising concept, serendipity would appear to be an important component of the complex phenomenon that is information seeking. In the present study, it emerged as an important aspect of how

researchers encounter information and generate new ideas – from interviews which neither focussed on nor anticipated it. Further research is needed to clarify concepts and issues that have emerged from the present study, particularly as this may relate to individual differences which have in other aspects of information behaviour proven interesting. However, such research should benefit from triangulated approaches – whether within individual studies or across cumulating studies – in which, for example, elements of qualitatively derived models are subsequently tested using quantitative methods. Such triangulation could maximise the benefits, and minimise the limitations, of the use of qualitative and quantitative research paradigms in isolation.

References

Apted, S.M. (1971), "General purposive browsing", *Library Association Record*, Vol. 73 No. 12, pp. 228-230.

Batley, S (1988), "Visual information retrieval: browsing strategies in pictorial databases", *Online Information 88, 12th International Online Information Meeting*, Vol. 1, Learned Information, Oxford.

Bawden, D. (1986). "Information systems and the stimulation of creativity", *Journal of Information Science*, 12, 203-216.

Beheshti, J. (1992), "Browsing through public access catalogs", *Information Technology and Libraries*, Vol. 11 No. 3, pp. 407-424.

Boyd, B. (2000), "Serendipity of the new", *Journal of Rare Books Manuscripts and Cultural Heritage*, 1(1), 36-37.

Buchwald, N. (1999), *Thinking of information through the humanist's eyes,* Online document available at: http://dizzy.library.arizona.edu/users/buchwald/humanities.html. Accessed 10 June 2002.

Burrell, G. and Morgan, G. (1979), *Sociological paradigms and organisational analysis*, Heinemann, London.

Callery, A. (1996), Yahoo! Cataloguing the web, Online document available at: http://www.library.ucsb.edu/untangle/callery.html. Accessed 10 June 2002.

Cobbledick, S. (1996), "The information-seeking behavior of artists: exploratory interviews", *Library Quarterly*, Vol. 66 No. 4, pp. 343-372.

Cooper, J.W. and Prager, J.M. (2000), Anti-serendipity: finding useless documents and similar documents, *Proceedings of the 33rd Annual Hawaii International Conference on System Sciences, Maui, Hawaii, edited by R. H. Spragu. IEEE Computer Society.*

Cory, K.A. (1999), "Discovering hidden analogies in an online humanities database", *Library Trends*, Vol 48 No. 1, pp. 60-71.

Davies, R. (1989), "The creation of new knowledge by information retrieval and classification", *Journal of Documentation*, Vol. 45 No. 4, pp. 273-301.

Delgadillo, R and Lynch, B.P. (1999), "Future historians; their quest for information", *College & Research Libraries,* Vol 60, pp. 245-259.

Denzin, N.K. (1970), *The research act: a theoretical introduction to sociological methods*, Aldine, Hawthorne (NY).

Erdelez, S. (1996a), "Information encountering: a conceptual framework for accidental information discovery", In P.Vakkari, R. Savolainen and B. Dervin (Eds), *Information seeking in context: proceedings of an international conference on research in information*

needs, seeking, and use in different contexts, Tampere, Finland, Los Angeles, Taylor

Graham, pp. 412-421.

Erdelez, S. (1996b), Information encountering on the internet, In M.Williams (Ed.)

Proceedings of the 17th National Online Meeting, Information Today, Medford (NJ), pp. 101-

107.

Erdelez, S. (1999), "Information encountering: it's more than just bumping into

information", *Bulletin of the American Society for Information Science*, Vol. 25 No. 3, pp.

25-29.

Erlandson, D.A.; Harris, E.L.; Skipper, B.L. Allen, S.D. (1993), *Doing Naturalistic Inquiry*,

Newbury Park (CA), Sage.

Fine, G and Deegan, J (2000), *Three principles of serendip: insight, chance, and discovery in*

qualitative research, Online document available at:

http://www.ul.ie/~philos/vol2/deegan.html. Accessed 10 June 2002.

Ford, N. (1999), "Improving the 'darkness to light' ratio in user-related information retrieval

research", *Journal of Documentation,* Vol. 56 No. 6, pp. 624-643.

Glaser, B and Strauss, A.L. (1967), *The discovery of grounded theory: strategies for*

qualitative research, Aldine de Gruyter, New York.

Gup, T. (1997), "Technology and the end of serendipity", *The Chronicle of Higher*

Education, Vol. 44, November 21, p. A52.

Gup, T. (1998), "Technology and the end of serendipity", *The Education Digest*, Vol. 6, pp.

48-50.

Henry, G.T. (1997), Practical Sampling. In Bickman, L. and Rog, D. J. (1997), *Handbook*

of Applied Social Research Methods, Newbury Park (CA), Sage, pp. 101-126.

Herner, S. (1970), Browsing. In A. Kent and H. Lancour (Eds.), *Encyclopaedia of Library and Information Science*, Vol 3, Dekker, New York, pp. 408-415.

Hill, G.; Hutchings, G.; James, R.; Loades, S.; Hale, J. and Hatzopulous, M. (1997), Exploiting serendipity amongst users to provide support for hypertext navigation. In: Bernstein, M.; Carr, L.; Osterbye, K, (Eds), *Eighth ACM Conference on Hypertext, Hypertext '97*, ACM, New York, pp. 212-13.

Huwe, T.K. (1999), "New search tools for multidisciplinary digital libraries", Online, Vol. 23 No.2, pp.67-70, 72-4.

Ingwersen, P. (1996), "Cognitive perspectives of information retrieval interaction: elements of a cognitive IR theory", *Journal of Documentation*, Vol. 51, pp.3-50.

Jones, J.W. and Rosenfeld, L.B. (1992), "From security to serendipity, or, how we may have to learn to stop worrying and love chaos", *Proceedings of ASIS Mid Year Meeting,* pp. 75-82.

Koch, J. (2001). "Hardwiring Serendip", *College and Research Libraries News*, 62(7), 731-732.

Klawiter-Pommer, J.H.T., and Hoffmann, W.D. (1976), "Survey, for performance comparison of several literature databases of the important parameters; unique relevant references, recall, precision, miss-ratio, noise-ratio, fall-out-ratio, novelty, extension-ratio, serendipity, insufficiency", *Nachrichten fur Dokumentation,* Vol 27 No. 3, pp. 103-8.

Kuhlthau, C. (1993), "A principle of uncertainty for information seeking", *Journal of Documentation*, Vol. 49 No. 4, pp. 339-355.

Kuzel, A.J., and Like, R.C. (1991), "Standards of trustworthiness for qualitative studies in primary care", In P. Norton, M.Stewart, F. Tudiver, M.Bass and E.Dunn (Eds.), *Primary*

care research: traditional and innovative approaches, Sage, Newbury Park (CA), pp.138-158.

Levine, M.M. (1969), "An essay on browsing", *RQ*, Vol. 9 No. 1, pp. 35-36.

Lincoln, Y.S. and Guba, E.G. (1985), *Naturalistic Inquiry*. Sage, Beverly Hills (CA).

Line, M.B. (1996). "Access versus ownership: how real an alternative is it?", *IFLA Journal*, 22(1): 35-41.

Merriam, S. B. (1998), *Qualitative research and case study applications in education,* Jossey-Bass, San Francisco.

Merton, R.K. (1968), *Social Theory and Social Structure*, Free Press, New York.

Miles, M.B. and Huberman, A.M. (1994), *Qualitative Data Analysis: an expanded sourcebook.* Sage, Thousand Oaks (CA).

Morse, P.M. (1971), "On browsing: the use of search theory in the search for information", *Bulletin of the Operations Research Society of America, Vol.* 19 supplement, p.1.

Muhr, T. (1998), *Atlas-Ti*, Scientific Software Development.

Myerly, Richard C.; and others. (1980), "Real world of industrial chemistry: serendipity and discovery", *Journal of Chemical Education*, Vol 57 No. 6, pp. 437-438.

Olaisen, J. (1991), "Pluralism or positivistic trivialism: important trends in contemporary philosophy of science", In: Nissen, H.R., Klein, H.K. and Hirschheim, R., eds. *Information systems research: contemporary approaches and emergent traditions,* Elsevier, Amsterdam, pp. 235-265.

Palmer, C. L. (1996), "Information work at the boundaries of science: linking library services to research practices", *Library Trends*, Vol. 44 No. 2, pp. 165-191.

Patton, M.Q. (1990), *Qualitative evaluation and research methods,* (2nd ed.), Sage, Newbury Park (CA).

Remer, T.G. (1965), *Serendipity and the three princes, from the peregrinaggio of 557*, University of Okalmahoma Press, Norman (OK).

Rice, J. (1988), "Serendipity and holism: the beauty of OPACs", *Library Journal*, Vol. 113 No. 3, pp. 38-41.

Rice, R.E., McCreadie, M.M., and Change, S.L. (2001) *Accessing and browsing information and communication.* Cambridge, MA: MIT Press.

Roberts, R.M. (1989), *Serendipity: accidental discoveries in science,* Wiley, New York.

Rosenman, M.F. (1988), "Serendipity and scientific discovery", *Journal of Creative Behaviour*, Vol. 22, pp. 132-138.

Sanjek, R (ed.) (1990), *Fieldnotes: The Making of Anthropology.* Ithaca, Cornell.

Saracevic, T. (1996), "Modelling interaction in information retrieval (IR): a review and proposal", In: Hardin, S., (Ed.) *59th Annual Meeting of the American Society for Information Science, 3-9.* American Society for Information Science, Silver Spring (MD).

Saracevic, Tefkco and Kzinto, Paul. (1988), "A study of information seeking and retrieving. II: Users, questions and effectiveness", *Journal of the American Society for Information Science,* Vol. 39 No. 3, pp. 177-196.

Seifert, C,. Meyer, D., Davidson, N., Patalano, A., and Yaniv, I. (1994), *Demystification of cognitive insight,* In R.J. Sternberh and J.E. Davidson (eds), *The nature of insight*. MIT Press, Cambridge (MA).

Senoff, C.V. (1990), "The discovery of [Ru(NH3)5N2]2+. A case of serendipity and the scientific method", *Journal of Chemical Education*, Vol. 67 No. 5, pp. 368-70.

Spink, A. (1997), "A study of interactive feedback during mediated retrieval", *Journal of the American Society for Information Science*, Vol. 48 No. 5, pp. 382-394.

Strauss, A. and Corbin, J. (1990), *Basics of qualitative research,* Sage, Newbury Park (CA).

Taylor, S.J. and Bogdan, R. (1998), *Introduction to Qualitative Research Methods: A guidebook and resource,* Wiley, New York.

Thagard, P and Croft, D. (2000), *Scientific discovery and technological innovation: ulcers, dinosaur extinction, and the programming language java,* Online document available at: http://cogsci.uwaterloo.ca/Articles/Pages/Discovery.Technology.html. Accessed 10 June 2002.

Toms, E.G. (1998), *Information exploration of the third kind: the concept of chance encounters: a position paper for the chi98 workshop on information exploration,* Online document available at: http://www.fxpal.com/CHI98IE/submissions/long/toms/index.htm. Accessed 10 June 2002.

Vickery, B.C. (1960), *Faceted classification: A guide to construction and use of special scheme*, Aslib, London.

Walker, G. (1990), "Searching the humanities: subject overlap and search vocabulary", *Database*, Vol 13 No. 5, pp. 37.

Wilson, T.D. (1997), "Information behaviour: an interdisciplinary approach", *Information Processing and Management*, Vol. 33 No. 4, pp. 551-572.

Wilson, T.D. and Walsh, C (1996), *Information Behaviour: an interdisciplinary perspective*. University of Sheffield, Department of Information Studies, Sheffield.

Wright, D.B. (1997), *Understanding Statistics: An introduction for the Social Sciences,* Sage: London.