

# Chance Encounters in the Digital Library

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**Abstract.** While many digital libraries focus on supporting defined tasks that require targeted searching, there is potential for enabling serendipitous discovery that can serve multiple purposes from aiding with the targeted search to suggesting new approaches, methods and ideas. In this research we embedded a tool in a novel interface to suggest other pages to examine in order to assess how that tool might be used while doing focused searching. While only 40% of the participants used the tool, all assessed its usefulness or perceived usefulness. Most participants used it as a source of new terms and concepts to support their current tasks; a few noted the novelty and perceived its potential value in serving as a stimulant.

**Keywords:** Digital libraries; serendipitous discovery.

## 1 Introduction

Introducing the potential for serendipitous discovery within digital libraries brings also the possibility for diverting attention away from the task, leading to unproductiveness. Like many tangible fields of endeavour, e.g., medicine, biology and engineering, “finding information without seeking it through accidental, incidental or serendipitous discoveries” [20] may lead to a fresh approach to a problem, novel information, or a fruitful departure leading to solutions to other problems. The challenge from a design perspective is in how to enable serendipity without also causing a non-productive distraction or interruption.

Serendipitous information retrieval, which also has been called *information encounters* [3], *chance encounters* [19] and *incidental information acquisition* [23] “occurs when a user acquires useful information while interacting with a node of information for which there were no explicit *a priori* intentions” [19]. In each case, the retrieval or viewing of the information object occurred when the user made an accidental and often perceptive discovery. The connection between user and object is likely influenced by the person's prior knowledge and experience within a particular problem space and by the person's recognition of the 'affordances' within that information object [19].

In this research, we introduced and tested “Suggested Pages,” a list of items that are somewhat related to the currently viewed webpage to assess how users interact

with it while in the process of doing other work. Because the Suggestions were dynamically created and based on the current page viewed, we had little control over what might actually appear. Potentially the Suggestions were directly related to the task, but given the nature of information retrieval algorithms, they might also be semantically dissimilar.

## 2 Previous Work

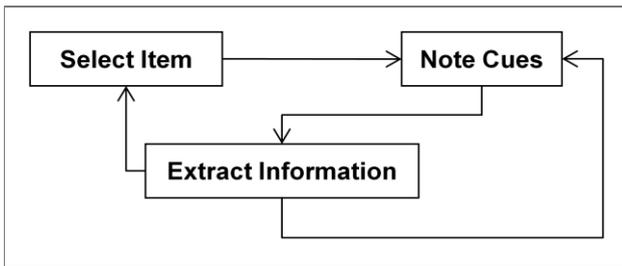
Evidence for serendipitous encounters is unmistakable in prior research in both physical and virtual information environments. Ross [15] and Williamson [23] in separate studies found incidental information, respectively, through reading and conversation pertinent to daily lives. More recently, Rimmer and colleagues [14] observed serendipitous interactions in the use of text in a library speculating on the advantage that the printed work provided.

While many acknowledge the challenge of designing a system that would enable serendipity, but not inhibit productivity [16, 22], triggering a serendipitous encounter has been proposed and tested in a number of ways. Back in 1968, Grose and Line [8] proposed that books be arbitrarily shelved to facilitate browsing. More recently, Campos and de Figueiredo [2], developed a software agent called ‘Max’ that wandered the web selecting links to follow, at times random, in order to induce serendipitous discovery. Twidale and colleagues [22] found that spurious results were perceived as serendipitous, offering potential opportunities for new directions. Erdelez [5] found in preliminary studies that it is possible to trigger information encountering episodes by embedding information known to relate to a participant’s secondary information needs in a list of search results.

In a newspaper reader, Toms [21] introduced an “Items-to-Browse” interface tool that suggested other pages to read based on the page currently being read. She noted that participants found the most interesting articles from the list of articles suggested by the system while people were reading the daily newspaper. While ordinarily following a standard menu-based system, participants used these suggestions which subsequently invoked a chance encounter that they may not otherwise have experienced had they read the newspaper according to their usual practices. Each identified the reason for selecting an article from the Items-to-Browse; their motivations varied from the esoteric and sensational, to connections with a thought or event held in memory [18].

As well, serendipitous encounters cannot solely be enabled through the design of information systems and individual differences have been found to play a role in the degree to which people make or are receptive to making a serendipitous discovery [4, 9]. While some people, for example, are not easily distracted from the information task at hand, others are very sensitive to noticing the information objects that surround them [4]. Franken [6] describes human ability to process information as limited, motivating us to be selective about the information we process and tending to process information that is consistent with information we already have. McBirnie [11] suggests information literacy education should highlight the value of serendipity in the information search so that users will be more open to chance discoveries rather than aiming solely for the controlled, efficient search.

Conceptually, each incident of serendipitous encounter is embedded in a primary information seeking and retrieval episode. One generally does not seek serendipity; it occurs usually in the process of some other activity. Erdelez [5] proposed that a typical information encountering (IE) episode consists of some or all of the following elements: Noticing, Stopping, Examining, Capturing, and Returning. While some information seekers may simply perceive (Notice) encountered information, perception may develop into an interruption of the original information seeking task (Stopping), followed by evaluation (Examining) and mining (Capturing) of the encountered information, and finally Returning to the original task. These elements are similar to the stages of the interruption management stage model [10, 12]: interruption, detection, interpretation, integration, and resumption. Latorella [10] goes further by mapping out the behaviours associated with these stages: oblivious dismissal, unintentional dismissal, intentional dismissal, pre-emptive integration, and intentional integration.



**Fig. 1.** A Digital Browsing Instant

In her study of browsing, Toms [17] referred to these episodes as “Digital Browsing Instants” as illustrated in Figure 1. A person may select an item to support a primary task, and in the context of examining that item may notice cues, e.g., word, phrase or concept, that acts “as a stimulus influencing the user’s focus” [17]. When information is extracted, a serendipitous acquisition of information – a chance encounter – occurs. Not all cues result in serendipity; serendipity only occurs when a connection is made. “The serendipitous discovery is not a matter of blind luck, rather it is the recognition of a valuable document attribute/connection discovered by means outside established access system rules and relying on a user’s self knowledge” [13].

This research follows from Toms’ [17, 18, 21] initial study which pre-dates the Web and was used in the context of everyday use – news reading. In the work reported here, a list of suggested webpages was embedded within each page display and modified with each page viewed. This concept was deployed in a novel interface (see <http://www.interactiveIR.org/public>) used to access a version of the Wikipedia. The objective of our research was to assess how such a tool is used in the context of a work task operationalized as a set of pre-defined tasks. While news-reading is a browsing process, one with few pre-ordained notions, the task here had defined objectives, and we examine how users would use such a tool in this context.

### 3 Methods

This research is part of a larger study that is looking at the role of task in search as well as the interface elements to be introduced to search interfaces. In the research reported here, we have focused specifically on how the tool meant to induce serendipity, Suggested Pages, was used. Part of the challenge of studying serendipity is how to artificially induce it. In this case, by imposing a device in the context of a second study we were able to observe, but not control the action. Until the data was collected we had no idea of whether in fact the tool was used at all. Post session questions enabled us to ask about use without interfering with the conduct of the larger study. The methods describe how the data was collected, but we have provided only the results specifically related to this feature.

#### 3.1 System – WikiSearch

The system used was an experimental system that enabled searching the contents of the Wikipedia. Each page selected from a search results list for viewing contained ordinary hypertext links as well as links to search within the wiki. As illustrated in Figure 2, each page also displayed a box of *Suggested Pages* in the upper right corner. This set of page links was created by entering the first paragraph of the currently displayed page as a search string. The top five results not including the current page were displayed. Not unlike the Suggestions described earlier, this list had the potential to provide more specific pages about the topic, or be distracting. wikiSearch runs on Lucene 2.2, an open source search engine using the vector space model. The Wikipedia XML documents are indexed using the Lucene standard analyzer and its default stemming and stop word filtering.

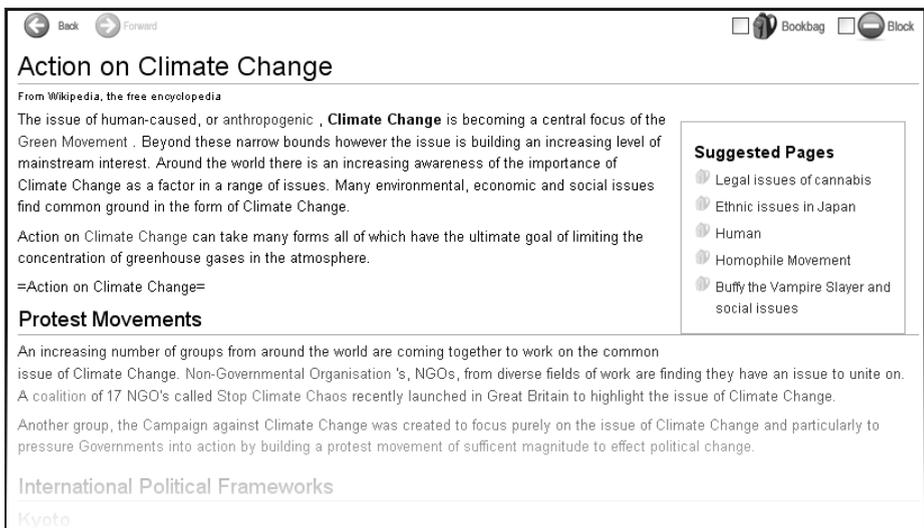


Fig. 2. WikiSearch Page view

### 3.2 Tasks

Over the course of the study, participants completed three tasks from a set of 12 tasks developed for INEX 2006. The tasks were intended to represent work tasks and varied significantly according to topic. Topics varied from recommending certain types of bridge structure to choosing between venues on a trip to Paris, and sorting out the difference between fortresses and castles. One example of the 12 tasks is:

As a member of a local environmental group who is starting a campaign to save a large local nature reserve, you want to find some information about the impact of removing the trees (logging) for the local pulp and paper industry and mining the coal that lies beneath it. Your group has had a major discussion about whether logging or mining is more ecologically devastating. To add to the debate, you do your own research to determine which side you will support.

To respond to each task, participants were required to add wikipages to a Bookbag, a tool at the interface used to collect relevant documents, and to rate the relevance of each page. Over the course of responding to these tasks, participants were exposed to the Suggested Pages.

### 3.3 Metrics

To assess the Suggested Pages, we examined each use to qualitatively identify how selected suggested pages related to the original task, and using a series of closed and open-ended questions that asked participants to assess the tool.

### 3.4 Participants

The 96 participants (M=49, F=47) were primarily (90%) students from the university community, and from mixed disciplines. 25% held undergraduate degrees and 12% graduate or other degrees. 84.4% were under 27. They were an experienced search group with 86.5% searching for something one or more times a day, and also relatively frequent users of the Wikipedia (54% use it at least weekly).

### 3.5 Procedure

Data collection took place in a laboratory setting, a seminar room where 5 to 7 people were processed simultaneously using laptops with wired network connections scattered around the room. A research assistant was always present for any questions or interventions. Participants were simply told that we were assessing how people search, the intent of the larger project, but were not briefed on the precise objectives – assessing their use of Suggested Pages – of the work reported here.

Participants were presented with the following steps in a series of self-directed webpages: 1) Introduction which introduced the study, 2) Consent Form that outlined the details of participation, 3) Demographics and Use Questionnaire to identify prior knowledge and experience, 4) Tutorial and practice time using the wikiSearch system, 5) Pre-Task Questionnaire, 6) Assigned Task to be completed using wikiSearch integrated into the interface, 7) Post-Task Questionnaire, 8) Steps 5 to 7 were repeated for

the other two tasks, 9) Post-Session Questionnaires to identify user perception of aspects of the system, and 11) Thank-you for participating page.

### 3.6 Data Analysis

First, data regarding the use of the Suggested Pages was extracted from the log files which recorded the use of all interface tools provided by this system. The suggested pages viewed by any participant were then manually coded, by comparing each to the original assigned task. Second, the data from questionnaires were loaded into SPSS to calculate means and standard deviations (SD). Third, the responses to open-ended questions were loaded into Excel and manually coded for users' perception of the use and usefulness of the Suggested Pages.

## 4 Results

Three types of data used to assess the use and perception of Suggested Pages include a) how the Suggested Pages tool was used by participants, b) the participants' assessment of the tool, and c) their perceived usefulness of the tool.

### 4.1 Use of Suggestions

Thirty-eight (40%) of the 96 participants used the Suggested Pages a total of 92 times. While the Suggested Pages were used with all tasks, not all participants used the tool for each task. To assess how the tool was used we considered two aspects: a) the relationship of the Suggested Page to the task, and b) the location within the search process.

Of the 92 instances, 54 were pages directly related to responding to the task, of which all were declared relevant by the participant who assigned an average relevancy of 3.96 out of a possible 5.0. Twenty-nine pages were considered somewhat related which means that pages had aspects of the topic at a significantly broader or narrower level. Of these pages, eight were declared relevant by the participant.

The remaining nine pages bore no logical connection to the topic of the task. Of those, one was declared relevant by the participant. The topics of these pages varied considerably:

Unclean animals	Suburb
Aphid	Domestic water system
Value added	D
Works which reference MIT	.km
Tourist guy	

Some of these topics could be classified as curiosity, defined as "had no concept of what might be found; title was esoteric, eccentric or sensational" [18].

### 4.2 User Perception of the Tool

At the end of the study, participants indicated the extent to which they agreed with a series of statements about the interface. Three of those questions related to the

Suggested Pages. The seven-point scale varied from strongly disagree to strongly agree. As indicated in Table 1, participants were ambivalent in their response. They found the Suggested Pages pertinent to their task, but also found the pages diverted them from their task. They were in agreement about the surprise element.

**Table 1.** User Perception of *Suggested Pages*

Statements	Mean	SD
I found pages listed in <i>Suggested Pages</i> that were pertinent to the task I was working on	4.19	1.50
I found unexpected pages listed in <i>Suggested Pages</i>	5.00	1.26
I found that the pages listed in <i>Suggested Pages</i> lead me away from my search task	4.40	1.48

### 4.3 Perceived Usefulness of Suggested Pages

In two open-ended questions, participants indicated when they thought they would find the Suggested Pages useful, and when they would not use them. In responding to both questions, 21 (20%) people indicated that they did not notice the feature, did not use it, and would not use it in future. Some of these responses related to visibility: “I didn’t really pay much attention to it to be honest” (P562), and because of generalized practices: “Because of the way it is placed on the outside of the screen I felt it was a distraction and I thought it was sponsored links, a bit like you have on a google page” (P582).

Although 38 people directly clicked on a page listed in Suggested Pages, others examined the list without clicking on a link and used that information subsequently in the search process. Overwhelmingly, the comments about the pertinence of Suggested Pages related to its perceived relevance to the search. The Suggested Pages were perceived to be most useful “when the suggestions were close to the topic” (P558) or “related to the page I was currently looking at” (P563), and perceived as less useful “when the suggested pages are unrelated or not specific enough to my original topic” (P553).

Participants amplified that perspective indicating when the Suggested Pages were likely to be used such as when “I didn’t find what I was looking for on the page and it had other suggested pages that were relevant” (P548), or “when the initial search didn’t provide much” (P618). Participants also found it “useful to have topics worded differently so you can see other ways of describing your search” (P580), or to assist with “finding the ‘correct’ search words to get relevant information” (P560). In addition to giving different perspectives on direction of the search, the Suggested Pages were perceived as helping when “looking for a broad sense of the topic” (P574), “to get more variance on a topic” (P575), or “when the topic I was covering had many areas of interest” (P610). But they found them useless when “the suggestions obviously had nothing to do with what I was searching for” (P609).

In addition to assisting directly with the task at hand, participants also found that the Suggested Pages gave them perspective on the topic which appeared to be of two types. On the one hand, seeing related topics helped “with your general understanding of a topic, even though it may not help you with your particular question” (P621). While on the other hand, the Suggested Pages seemed to be a low cost learning

device; they could “look at the suggested list, click on the link to check, and then decide which information was relevant that way” (P596).

The Suggested Pages served as stimulants, particularly “when the pages suggested things that I hadn't thought to search for” (P589), or “made me think of something else to search for” (P594). But not all participants saw this as value. Said one, “Obviously if the suggested page is related to my search than I would find it useful but a lot of the time the suggested pages were unrelated or did not contain any information about the specific topic I was looking for” (P564). There seemed to be a tension not only among participants but within the responses of individuals between the value of being lead astray and staying on topic. Some were concerned that “it would take me way further away from where I wanted to be” (P573).

But not everyone considered this to be negative. Some found the Suggested Pages were more useful when “something interesting popped up” (P577), or “...did not take me too far away from my research task” (P583) or “mainly useful for interest, not information” (P634). “I found it could be distracting. It tempted me to look at information that was either slightly related or totally unrelated to my original search” (P633).

Because they were in a laboratory situation, their behaviour was not always typical in how they would use the Suggested Pages: “I looked at it once and saw a suggested page that had nothing to do with my search and would have clicked on it if I was at home (P622).

In other cases, participants had a strategy for how to use the Suggested Pages. As P602 noted “When there are multiple pages to a search result and the first half of the results have nothing to do with the topic, then the suggested pages would be most useful.” However, participants would tend not to use them when “I am doing a quick search and need some quick and general information” (P700).

Participants were equally adamant about when to ignore the suggestions indicating they would ignore them “if I really wanted to stay on the topic that I searched” (P545), when “you have found all the information you are looking for” (P569), when I “have no need or interest to expand my research on a topic” (P617) or “if I already had a general understanding of the topic I was looking up” (P598).

Time was a factor in the perceived usefulness. Said one, “When I am pressed for time and cannot explore extremely tangential suggestions” (P583). On the other hand, “perhaps if I were searching a topic to find out as much as I could about it, without limits, I would use this feature more” (P629).

Others had their own ideas about how to make the Suggested Pages feature more useful. Rather than providing you with “more general information about your topic and related ones, instead... [provide] more depth or information” (P621). “The selections that it offered were just not that relevant, which is important for academic searches. If you know the subject well, you don't want to be bothered - and if you don't, you don't want to be led astray. There should be some sort of obvious link between your search term and the suggested pages, if possible. Suggestion for the sake of suggestion should be minimized” (P638). For one this was very much about control: “I don't think I would ever select sites from the selected pages unless it was really really pertinent to my search. I don't think that a computer can think for you and tell you what you think you are looking for. I would rather critically assess the information I am getting and change my search accordingly” (P582).

## 5 Analysis and Discussion

In summary, 96 participants were exposed to a tool, Suggested Pages, which identified a set of possible relevant pages, some of which were very relevant and some of which were diversions as it depended on how the search algorithm processed the query which used the contents of first paragraph of the displayed page. The participants, as expected, used this tool significantly less than any other interface tool provided by this system. Some did not see it, while others avoided it, perceiving that it would lead them astray, or that the suggestions were not very useful. When used, it was mostly used to aid with the task at hand which is what would be expected given the nature of the task. Some however, viewed the tool as a potential for digression, but not always a distracting one.

When used, the Suggested Pages helped to broaden or narrow search and to generate ideas for keywords to use in further searching. But the feature was not perceived useful when participants wanted to avoid being distracted and stay on topic due to time constraints or to finish the tasks.

Some participants indicated that they did not need to use this feature because they had other strategies. In some cases the information was already found and they had no need to look further or they were confident in their knowledge of the topic at hand and/or in their personal search abilities.

Our participants expressed elements of Toms' [17] Digital Browsing Instant, Erdelez's [5] five typical information encountering elements, and McFarlane and Latorella's interruption management stage model [12]. Interestingly, while many commented on the Suggested Pages' value in providing other connections, very few used the tool for branching out into other topics which may have been due to the primary experimental scenario in which they were immersed.

This study highlights the tendency of an information seeker to focus on one problem at a time [5, 6]. Many participants appeared unwilling to give up the reins of the search, underlining McBirnie's [11] suggestion of the *paradox of control* where the potential for novel, useful information is sacrificed for the sake of the efficiency of the information search. The willingness to allow the search to take information seekers on a serendipitous rather than straight path may be another key individual difference between participants' varied uses and perceptions of the Suggested Pages. Would, for example, those more inclined to curiosity be also more inclined to follow potential serendipitous paths? More research needs to be done to gain a better understanding of the types of individual differences that lend themselves to openness to serendipitous discovery and how this can be better facilitated in information systems.

Clearly participants view the Suggested Pages as serving two purposes. Some expected it to support the task, serving a purpose much like the Google's "similar pages" and were annoyed when taken astray. But some were clearly intrigued by the suggestions. Perhaps the presentation of suggestions needs to be differentiated so that the support for the task is separated from items that are intended to lead one astray. A core challenge may be embedded in the way we work, and the need to stick to the task. Non-task related topics may indeed be disruptive. On the other hand, they may also serve to disorient in order to re-orient, as well as introduce approaches and ideas related to the topic that had not previously been considered.

At the same time, the way in which participants used the Suggested Pages may be limited by the system. We disabled the browser's bookmarking capability for example. While we added a tool for collecting useful pages related to the topic, we did not provide the capability for multiple instantiations of it so that items not related to the task, but of interest to the participant could be tracked.

Our implementation of the Suggested Pages list was a blunt force product based strictly on similarly to first paragraph of the displayed page. In the previous test [e.g., 17, 21], the list was created using a weighted Boolean model with no control for length resulting in the unlikeliest of similarities among the list in many cases. Other examples have included randomness [2, 22] or known ancillary problems of users [5], but what makes the best triggering device is an outstanding research question. Even once we know how to develop that "list," we additionally will need to examine how best to present the list, i.e., how to provide the cues. As important will be when to introduce a serendipitous device, as there is a fine-line between enabling serendipity and being distracting.

## 6 Conclusion

In this research we exposed 96 users to a serendipitous inducing tool while asking them to complete a set of goal-oriented tasks. While the tool was used by about half in highly selected ways a few elected to view items not related to their assigned task. While participants readily made the connection between suggested pages and their task, few noted the value of disconnected findings which may be more related to selected individual differences. There remains much to be done to more fully understand how to trigger an effective serendipitous encounter and this may reside in further user modeling.

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