Psychological Processes in the Use of Electronic Journals

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Evidence of user behaviour with electronic journals from the SuperJournal project is reviewed to identify the psychological processes being employed. The article reviews patterns of use, the dominance of browsing as the means of seeking information, the depth, breadth and range of use and the tendency to print. The article concludes that the dominant user approach is a coping strategy that maximises success for minimum psychological effort.

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1. The promise and the problem

Scholars, researchers and students are on the brink of acquiring a great treasure. The delivery of full text electronic journals to their PCs means that they might have instant access to up-to-date information across all the subjects of interest to them. There are many problems to overcome to achieve this objective, but, if it were achieved, what would it mean for the user? They would have the world of knowledge at their fingertips, and therein lies the problem. If everything is possible, how does the user find what is relevant, track what is going on, use study time effectively, etc?

We have now had a considerable period when substantial electronic journal services have been delivered to users and, in many cases, their reactions to these services have been well documented. The purpose of this paper is to review the evidence regarding user behaviour with these services as a pointer to the development of progressively better and more 'user-centred' services. Rather than treat each item of evidence separately, an attempt is made here to identify the underlying psychological processes by which users are processing information. If we understand these processes, it may be possible to predict how users will respond to different kinds of services.

During 1996–1999, we were responsible for the user evaluation studies in the eLib SuperJournal project: the data from this project will be the main source of evidence to be reported. However, to establish the generalisability of the findings, we will also introduce the conclusions of other studies where relevant.

The SuperJournal Project provided full text electronic versions of 49 established journals from 19 publishers. The journals were grouped into science 'clusters' – Molecular Genetics and Proteins and Materials Chemistry – and social science 'clusters' – Communication and Cultural Studies and Political Science. The service was offered for a 22-month period to users at 13 university sites. Between February 1997 and November 1998, there were

2,712 registered users, who engaged in 8,968 sessions of use. Detailed logs were kept of each session of use, and approximately 10% of the users were asked about their use of the service through interviews, questionnaires and focus groups. The project produced rich evidence of user behaviour, which can be used to explore the psychological processes underpinning usage. Fuller accounts of the results of the project are to be found in Eason, Yu and Harker (2000) and Eason, Pomfrett and Yu (2000) and at the website http://www.superjournal.ac.uk/sj/

The presentation and discussion below focuses upon three key questions

- What were the patterns of use?
- How do users locate relevant information?
- How do they study articles that they locate?

2. Patterns of use

Table 1 lists some of the major findings about the usage patterns of the users of SuperJournal.

The first point to make is that, although many users start, not all become active regular users, availing themselves of the breadth of material or the many functions in the service. It takes a very little barrier or disappointment to stop users or restrict their usage. Of the 2,712 users who registered for the service only 34% came back to it in one or more subsequent months. Those who returned did so relatively infrequently and viewed only a few journals. There were noticeably different patterns of use amongst repeat users. There was a small group of enthusiastic users who accessed a great many journals. A larger group made regular access to a limited set of journals (the focused regular users). An even bigger group (the specialised occasional users) made infrequent use of a broader range of journals. However, the biggest group (157) were restricted users, who accessed a small number of journals on average every other month.

Table 1: Usage of Electronic Journals

Repeat usage	**Registered users**	**Repeat users n**	**%**
	2,712	922	34
Frequency of use	**Users**	**Mean sessions per month**	
	2,378	0.37	
Breadth of use	**Users**	**Mean journals used**	
	1,963	3.01	
Patterns of use	**n**	**Mean no of journals**	**Mean sessions per month**
Enthusiastic users	16	18.44	1.64
Focussed regular users	92	4.54	2.52
Specialised occasional users	218	6.65	0.71
Restricted users	434	2.24	0.50

NB Repeat users – those who returned after first month
Sample size varies depending on type of analysis

Table 2: Required Properties of an Electronic Journal Service (Questionnaire responses from 107 repeat users)

Feature	**% Rating Very Important**
1. Range of relevant journals covered	80.4
2. Up-to-date	78.5
3. Fast access	58.9
4. Easy to use	52.3
5. Ability to search titles/abstracts	47.7
6. Good back file	45.8

We can explore the reasons for this range of behaviour by looking at the properties the users identified as important in an electronic journal service (listed in Table 2).

Two factors dominate this list. First, what is available in the collection as represented by the range of journals, how up-to-date they are and the extent of the back file. There was great diversity in the specific subject interests of SuperJournal users and, whilst the 'enthusiastic' and 'specialist occasional users' found a good match with the journals held, others located only a few journals of interest. The second component is the operation of the service as indicated by the need for fast access, ease of use and ease of searching. The 'restricted user' group, in particular, reported giving up or restricting their usage because of slow access, software barriers etc., often because of local provisions.

3. Locating relevant information

The issue of ease of use can be further explored through the features of the service that were used to locate articles (Table 3).

SuperJournal offered users a browse facility which replicated library and journal conventions, i.e. cluster-journal-issue-table of contents-abstract-article. It included three different search engines. It also had other facilities we have called 'exploratory browse', for example, accessing from reading lists, references, citations etc.

As Table 3 indicates, the preferred mode of usage, by a huge margin, was the basic browse facility with vertical chaining (e.g. moving from journal and issue to specific article) the dominant form. The search engines were valued, but not heavily used. The other facilities were rarely used. The finding that 'browse' is the preferred mode of use is a replication of the Elvyn conclusion (Meadows and Rowland 1995). Questioned about the preference for browse, many users pointed to the two most favoured features of SuperJournal – the clusters of journals in a similar discipline from a number of publishers and the opportunity to browse them in a familiar way. The users reported that it was like having a 'virtual library shelf' where you could explore a number of journals in a similar subject area using the familiar structure of issues, tables of content, etc. If you were lucky enough to find on the 'virtual shelf' a lot of the journals of interest to you, it was a powerful and easy way of finding articles. The users who found a good match with their interests reported that the ease of browsing led them to explore unfamiliar journals and find articles of interest in unsuspected places. The ease of use encouraged them to explore beyond their intentions.

Table 3: Features used to Locate Articles

	No. of Sessions	%
Basic browse	8,944	99.1
Vertical chaining	7,495	83.8
Vertical leaping	3,750	41.9
Horizontal chaining	3,949	44.1
Search	1,082	12.0
Exploratory browse	61	0.7
From reading list, references, citations etc.		
Total	**8,968**	

These findings allow us to piece together a user's most favoured mode of operation and to look at what happens if this is not possible. Ideally, the user wishes to deal with the complex world of electronic information by locating a small part, a 'virtual library shelf', which contains a limited set of relevant journals that can be explored by the well-known conventions of journal construction. If only a few of the relevant journals are in one place, it may be necessary to find other shelves. If the electronic world creates problems of access, e.g. many passwords, downloading delays, etc., the user may give up, or seek another way of finding information. Just occasionally, it may be appropriate to use a search engine to make a more comprehensive exploration of the available material.

This description of user behaviour has many echoes of human behaviour in other information processing domains: seeking information in non-electronic services; decision making, and problem solving, etc. The psychological processes involved come under the general heading of 'economy of psychological effort' theories. They start from the premise that human beings are relatively slow and limited information processors and, especially under time pressure, need to use their limited cognitive resources sparingly. This has several effects:

- Users display 'satisficing behaviour'. Simon (1972) developed this term from studies of decision making and problem solving. Simon describes the entire area where a problem solution might be found as the 'problem space' and any optimising strategy would need to search the whole space. However, the human response is to select a likely solution area and make an intensive search in that spot. If that locates a satisfactory answer, it is selected, although there may be better answers elsewhere. If it fails, the search area may have to be widened. Simon also calls this 'bounded rationality': bounding the problem and being rational within these limits. It can be a very effective strategy for making good use of limited resources, if you know a good place to start. Looking on a 'virtual library shelf', rather than making a comprehensive search, is an example of this kind of behaviour.
- Users follow the Principle of Least Effort (Zipf, 1965). Studies of information seeking behaviour before the advent of the electronic

journal have repeatedly shown that people follow a path which has two properties: (a) a high probability of a useful outcome, and (b) minimum psychological effort, i.e. dealing with the familiar, rather than the unfamiliar. In general, human beings are creatures who start with what they know how to do and venture into the unknown only when they have to. Faced with a barrier, they are just as likely to look for an alternative 'least effort' path, as to expend the psychological effort required to overcome the barrier. Thus the 'restricted users' reported finding other ways of seeking information when there were barriers to using SuperJournal.

- Ease of use means that current 'mental models' work. What makes a task easy is when the user's current understanding or representation of the world provides guidance and clues which lead to intended results. The current 'mental model' proves to be valid, and there is no need to expend psychological energy creating and validating new models. In the case of SuperJournal, the clusters of journals and the basic browsing facilities meant that the familiar conventions of the library shelf and the structure of journals were available in the virtual world, and made exploration very familiar.

The principles underpinning these theories of economy of effort apply in many areas of human information processing behaviour and, because they are based upon the character and limitations of the human cognitive capacities, provide evidence of immutable forms of behaviour. They are principles that designers of electronic services will need to work within, if they are to encourage users to make full use of the facilities provided. One approach, for example, might be the construction of a customised 'virtual library shelf' for each user. A number of studies, e.g. Stenstrom and McBridge (1979), Jenkins (1997), have suggested that users regularly use up to 20 journals. A valuable 'shelf' could be constructed with this number of journals which could be 'browsed' effectively and efficiently.

4. Studying electronic articles

Following initial exploration of the information service, we might expect that users would wish to select specific full text articles for detailed study. Table 4 reports two sets of data that show user behaviour as they attempt this stage of information processing.

The SuperJournal log shows the depth each user achieved in each session of use. It is striking that in 48% of sessions the users did not get below the table of contents level. We might presume that such sessions were a disappointment to users; nothing of interest was found. This was the case in many sessions, but the questionnaires and interviews showed that many users were content with this outcome. In a busy, high stress world, a user who is trying to keep abreast of current developments can be quite pleased when a search of recent issues of journals shows there is nothing new that has to be studied. It is noticeable that very few sessions stopped at the abstract level (although abstracts were widely read): in 47% of sessions, users went on to download full text articles.

Table 4: Studying Electronic Articles (Questionnaire study of repeat users)

Depth of Use	**Sessions**	**%**
Stop at:		
Cluster/Search/Journal level	1853	20.7
Issue level	1070	11.9
Table of contents	1309	14.6
Abstract	440	4.9
Article	4296	47.9
Total	**8968**	**100.0**
Reading and Printing	**No.**	**%**
Study on-line and print	47	46
Print to read later	44	43
Read article on-screen	12	11
Total	**103**	**100**

What users did when they got to full text articles is of considerable interest. Unfortunately, the logging process could not detect whether they printed articles. The questionnaire study of repeat users found, however, that 89% would print, rather than read the article on-screen. This result was replicated in an interview study of 52 repeat users. There was also some indirect evidence from the log file because, where they had a choice of formats in which to view articles, 70% chose PDF and 30% chose HTML. This finding confirms the results of DECOMATE (Dijkstra 1998) and Red Sage (Arnold et al 1998) who concluded that

printing was the predominant route to detailed study of an article.

It would appear, therefore, that the electronic journal revolution is largely an exercise in printed document delivery, shifting the printing from the publisher to the end user. If the users are not going to read articles on-screen, we might ask whether electronic full text is necessary. Why not stop at the abstract? The evidence, however, is quite clear. Users make use of the full electronic text, even if they then go on to print. Full text articles were downloaded in 47% of sessions and the questionnaires and interviews demonstrated that users scanned the full text articles, looked at figures and diagrams etc., on-screen in many cases, before making the decision to print.

The tendency to avoid reading text on-screen has been widely debated, e.g.Woodward et al (1997) and Stewart (1996). One common belief is that the quality of the display is inadequate and, as it improves, the need to resort to paper will disappear. A closer look at reading strategies, e.g. Dillon et al (1988), suggests, however, that there may be other reasons. Readers rarely study articles by proceeding sequentially from beginning to end. They read actively, often for specific purposes, and may move through a number of different levels of analysis, as they make judgements about relevance and interest. It appears that people can make top level analyses on-screen but when they want to move to finer grained analysis they need to work with a paper version. One requirement readers have is to switch rapidly between a specific part of the paper and a holistic view of the whole document. This is a common feature of behaviour in many settings, in driving, control room tasks etc. People often need to focus on a specific task but at the same time sustain a wider 'situational awareness' in order that the specific activity stays attuned to the broader picture. A specific illustration of this need was noted in the DeLIver project (Neumann and Gonzalez 1998). In DeLIver components of articles, e.g. figures, tables and references, were provided separately, which, in theory, would support the user tendency to select these features when scanning an article on-line. However, users found this disconcerting because they needed to be able to judge these components in the context of the full article.

Paper is a remarkable technology because it supports all of these user requirements. It is very easy to sustain a view of the entire document. It is easy to navigate the parts and focus down on specific parts and then to switch back to a holistic view. It is also easy to manipulate and annotate and it is portable so that it can truly be studied anywhere. It will take many advances in the development of electronic paper to compete with these properties and we can expect printing to be an important part of electronic journal services for the foreseeable future.

It will be noted that the above description of user behaviour focuses upon ease of use and offers another version of 'economy of psychological effort' introduced in section 3. Users have limited cognitive capacity and any joy at being able to access the entire store of knowledge in a subject area has to be tempered by the realisation that no one can study more than a small fraction in detail. Users, therefore, need a strategy that scans at different levels of detail and matches against need and relevance. It is often a relief not to find too many articles that are in the category 'must read' and there is a great necessity to find the easiest to use medium of representation of the material if it has to be studied in detail. At present that is paper.

5. Conclusions: The discerning, coping user

The model that emerges most strongly from this analysis is of coping users who are aware of the vast and complex store of knowledge that is available and recognise that they have limited cognitive capacities to keep track of it. All of the strategies, therefore, are to get maximum benefit from the limited time and effort available. In most cases this means:

- 'satisficing', looking in likely success areas rather than being comprehensive;
- using existing, familiar mental models rather than trying unknown and possibly effortful alternatives;
- stopping when there are barriers and using alternative but known routes;
- staying at the broad level as much as possible and getting into detail where there is promise;
- moving rapidly between different levels and types of analysis;
- shifting to a familiar, easy to use medium (paper) when detailed study is required.

This profile of usage is not, of course, the whole story. There may be circumstances when, for example, the user task requires the use of a search engine. However, the weight of evidence from SuperJournal and other studies is that users cope with the flood of electronic services by cutting them down to a size they can manage and they use familiar strategies to access and use the information within them. This is not a passive process. The user is discerning and active in the pursuit of the best path. One positive conclusion from SuperJournal is that when this strategy works and users get real value for their strategy, they broaden their search and explore more of the service. If the design of future services can support the user's wish to be economical in the use of psychological effort, users may be able to make wide and effective use of electronic journals.

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