# Reasons for the use and non-use of electronic journals and databases

## A domain analytic study in four scholarly disciplines

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Received 27 June 2003
Revised 8 August 2003
Accepted 11 August 2003

***Keywords*** *Information retrieval, Research, Electronic journals, Searching*

***Abstract*** *Previous research has shown that there are major differences in the search methods used in different disciplines, and that the use of electronic journals and databases likewise varies according to domain. Previous studies have not, however, explored whether, or how, this variation is possibly related to factors such as domain size, the degree of scatter in a domain or domain-specific relevance criteria. The aim of this paper is to contribute to the development of a domain analytic approach for explaining the use and non-use of e-journals and databases. We identify and define factors to account for disciplinary differences in e-journal use, outline hypotheses to be tested more rigorously in future research, and test them initially on a limited data set. The empirical data was gathered as a part of a wider qualitative study exploring scholars' use of networked resources in four different disciplines: nursing science, literature/cultural studies, history and ecological environmental science. The findings suggest that e-journals and databases are likely to be used most heavily in fields in which directed searching is the dominant search method and topical relevance the primary relevance type, and less in fields in which browsing and chaining are the dominant search methods and paradigmatic relevance the primary relevance type. The findings also support the Bates hypothesis that domain size has an important impact on the search methods used.*

## Introduction

The increasing use of the electronic information-seeking environment has produced changes in the practice of science. Much significant research has been conducted on the impact of new information and communication technologies on scholarly work. The first surveys on scholars' Internet use set out to discover the basics: types of applications used, extent and frequency of use, purposes of use, skills in use, access to, and perceived utility of networked information (Adams and Bonk, 1995; Bane and Milheim, 1995; Curtis *et al.*, 1997; Lazinger *et al.*, 1997; Liebscher *et al.*, 1997). Surveys showed that in the

This work has been funded by the Academy of Finland as part of the Research Program of Media Culture (2000-2002). The authors thank the scholars who participated in the study. The authors are grateful to Birger Hjørland, Reijo Savolainen, Pertti Vakkari and the anonymous referees for valuable comments.

Journal of Documentation
Vol. 59 No. 6, 2003
pp. 673-691

0022-0418
DOI 10.1108/00220410310506312

early phases, lack of access, lack of knowledge of what is available, conservative attitudes and lack of computer skills, were often significant obstacles to use (Adams and Bonk, 1995; Budd and Connaway, 1997; Kaminer, 1997; Zhang, 2001). Subsequent studies that focused explicitly on the scholarly use of electronic journal services yielded detailed information about the influence of contents (coverage and relevance) and technical aspects on use (Pullinger, 1999; Eason *et al.*, 2000).

Savolainen (1998) notes in his review of Internet use studies, however, that quantitative surveys can capture the viewpoint of users and conxtualise networked information use in the document work and communication patterns of scholarly communities and disciplines only to a limited extent. In the early phases, studies on scholars' use of networked information had only a weak or non-existent connection to the fifty-year old tradition of research on scholars' information practices, which nevertheless provides a cumulated knowledge base for understanding and explaining e-journal[1] use. In the beginning, the assumption was often that, given scholars' satisfaction (Bruce, 1998) with the ease, speed and seamless experience provided by access to full-text e-journals from the scholars' own terminal, all fields would come in a homogeneous manner to rely on e-journals (Kling and McKim, 2000). Hence, surveys gathered information about use, acceptance, attitudes and computer and Internet use skills, in order to discover ways in which scholars' awareness and use could be enhanced. The more user-oriented studies (cf Barry, 1995) also often viewed individual differences, especially individuals' attitudes and feelings (e.g. reluctance to learn), as the determinants of the take-up of electronic systems.

Studies undertaken from social informatics (SI) and work practice oriented viewpoints (Kling and Covi, 1997; Covi, 1999) developed a perspective for studying the use of networked information by grounding it in discipline-specific work and communication practices. These studies established that important field differences will persist in the extent to which scholars use e-journals (Covi, 2000; Kling and McKim, 2000). Different disciplines embrace e-journals at different rates, and rely on different types of networked information (Mahé *et al.*, 2000; Talja and Maula, 2002; Tenopir *et al.*, 2003).

Studies on scholars' use of networked information have moved towards domain-analytic approaches (cf Brown, 1999), and are being increasingly integrated with the tradition of information seeking research that strives at forming holistic understandings of scholars' work and communication practices (cf Brockman *et al.*, 2001). However, as noted by Palmer (1999), Bates (2002), and Hjørland (2002a), the development of a domain analytic approach for explaining information practices in still in its infancy. Thus, although it is well established that the use of e-journals varies according to domain, the effects of factors such as domain size (Bates, 2002), degree of scatter in a domain (Mote, 1962; Packer and Soergel, 1979), or domain-specific relevance criteria (Hjørland, 2002b) on e-journal use have not been addressed or

probed in a detailed manner in earlier research. This is not surprising given the lack of research directly addressing the questions of what "topics" or "domains" are, how they should be defined and treated as research units, and how they differ from disciplines, specialities, research areas, or discourse communities (Palmer, 1999)[2].

The present study compares patterns of e-journal use in four different fields with the aim of contributing to the development of a domain analytic model for explaining e-journal use. Given the lack of clear definitions of domains and topics, the study is necessarily exploratory in nature. We identify and define factors for explaining field differences in e-journal use. Second, we outline hypotheses to be tested more rigorously in future research and test them initially on a limited data set.

## Towards a domain analytic model for explaining the use of e-journals and databases

Earlier research on scholars' information seeking patterns has shown that there are major differences in the kinds of search strategies used in different fields (Bates, 1998). Building on these findings, Bates (1996, 2002) has argued that domain size (the amount of topically relevant materials available relative to all materials in the area) and the degree of scatter in a domain are likely to influence search strategies in systematic ways. According to the Bates (2002, p. 148) hypothesis that will be used as a point of comparison in the analysis of the findings:

- research areas with high numbers of topically relevant materials are best searched by browsing;
- areas with middling numbers of topically relevant materials are best searched by directed subject searches[3]; and
- areas with very sparse ("needle in a haystack") numbers of relevant items are best searched by linking (chaining from seed documents)[4].

The distinction between low scatter domains and high scatter domains was originally made by Mote (1962). According to Mote (1962), low scatter domains are those in which the underlying principles are well-developed, the literature is well organised and the width of the subject area is relatively limited and clearly defined. For instance, searches in organic chemistry are typically limited to organic chemistry and do not extend to other subject areas in addition (Mote, 1962, p. 170). In high scatter domains, the subject area is wider (the number of different research topics is greater) and the literature is less clearly organised or unhelpfully organised in the light of scholars' research interests and problems. Interdisciplinary fields are typically high scatter disciplines in the sense that the researcher must typically cross several disciplines to locate all relevant materials (Bates, 1996, pp. 156-7). Scholars in low scatter fields are served by a small number of highly specialised journals (Packer and Soergel, 1979). In high

scatter fields, relevant articles are published in a large number of different journals (that may be scattered across different fields) (Packer and Soergel, 1979). We will also look at the potential effects of scatter on e-journal use. The (a posteriori) hypothesis is that:

*H1.* In high scatter domains, access to e-journal services and databases covering several domains helps in counteracting scatter.

Hjørland (2002a) argues that mainstream information studies have largely "ignored the way different domains may put different demands on systems for organising and retrieving documents". He stresses that domains differ in their theoretical views, paradigms and epistemological assumptions and thus also in their general relevance criteria (Hjørland, 2002b). Differences in relevance criteria are also likely to influence information search strategies and e-journal use patterns. However, relevance criteria may also vary within domains, because domains may host divergent approaches and schools of thought (Tuominen *et al.*, 2003).

One example of this are the different approaches to relevance in information science. In information retrieval research, topical relevance is always assumed to be the primary relevance type (this assumption is necessary in the evaluation of the performance of information retrieval systems, cf Kekäläinen and Järvelin, 2002). Hjørland and Sejer Christensen (2002), in turn, argue that epistemological and paradigmatic relevance precedes topical relevance. Domains and scholars implicitly or explicitly choose positions on fundamental questions about the nature of science, knowledge and human beings, and this choice limits the range of documents viewed as relevant. In the light of current constructionist views of science (Knorr-Cetina, 1981; Latour and Woolgar, 1986), this also applies to the natural sciences. Vakkari (2000) similarly identifies theoretical and methodological relevance as independent dimensions of relevance.

In the present study, we understand topical relevance and paradigmatic relevance as two different relevance types[5]. Theoretical and methodological relevance are subsets of paradigmatic relevance (Talja and Maula, 2002). As Talja (2002) points out, humanities scholars typically use old or established theories to make sense of new topics. The most relevant texts are not necessarily about the subject or topic the scholar is doing research on, but offer a way of thinking about and approaching the subject (Talja, 2002). In multiparadigmatic fields, paradigmatic relevance may thus preceed topicality and limit or widen the range of relevant materials independently of the subject of research (topic), but this is not likely in the natural sciences, in which topical relevance is, in practice, usually the primary relevance criterion[6]. Our hypothesis is that:

*H2.* E-journals and databases are likely to be used more heavily in fields in which topical relevance is the primary relevance criterion and less in fields in which paradigmatic relevance is the primary relevance criterion.

Finally, the professional orientations of scholars vary even within domains (Mote, 1962). For instance, teaching versus research orientation, local versus international research orientation and basic research versus applied or action research orientation are factors that are likely to influence information seeking strategies and e-journal use.

## Methodology

### *Sample*

The data for the study was gathered as part of a wider project, academic IT cultures, exploring the use of networked resources in four disciplines: nursing science, literature and cultural studies, history and ecological environmental science. The reason for the choice was to enable comparisons between fields with different communication practices, between humanities and sciences, and between low scatter and high scatter fields. Two humanistic fields were chosen because among humanists it was easiest to find both non-users of electronic networks and heavy users, researchers involved in Web publishing projects.

Informants were chosen from each field on the basis of the information given in departmental and individual researchers' homepages to represent disparate research orientations and levels of research experience. Ten informants (three professors, three assistant professors or lecturers and three doctoral students or project researchers) from each department were initially interviewed. Later, we found it necessary to recruit more informants from the professorial postdoctoral category, because of their longer experience in the practices of their fields (see Table I). The sample contains 12 nursing scientists, 11 historians, 11 literature/cultural studies scholars and ten environmental biologists from two Finnish universities. Of the 44 interviewees, 22 were male and 22 female.

Nursing science is an interdisciplinary field hosting diverse research orientations: applied research (e.g. tests of treatment methods), action research (e.g. health education programmes), medical-clinical research as well as theoretical, sociological, socio-psychological, humanist and discourse analytic research. Scholars in this field frequently explore literatures as diverse as medicine, education and social psychology. Literature and cultural studies is a field that contains both research on theories of literature, literary works and

| Discipline | Junior researchers (predoctoral) | Senior researchers (postdoctoral) | Totals |
|---|---|---|---|
| Literature/cultural studies | 4 | 7 | 11 |
| History | 3 | 8 | 11 |
| Ecol.env.sci. | 3 | 7 | 10 |
| Nursing science | 9 | 3 | 12 |
| Totals | 19 | 25 | 44 |

**Table I.** Profile of study informants

authors, as well as interdisciplinary research on audiovisual culture and new media. In addition to theories and literature published in their own field, literature and cultural studies scholars frequently use social scientific, historical and philosophical literature. Historians similarly divide into "traditional" historians (studying specific periods, regions, or milieus of life) and more social scientifically oriented historians. Methods used range from traditional "storytelling" methods to statistics and discourse analysis. Ecological environmental science is a laboratory science that is based on controlled fieldwork experiments analysed by statistical methods. The main research area in this field is the responses of plants and ecosystems to the anthropogenic changes of the atmospheric environment. This field provides basic knowledge about the working of the ecosystem, on plant biology, plant pathology and plant/microbe interactions, necessary for defining the nature and scope of environmental problems such as air pollution.

*Data collection and analysis*

The data were gathered by informal semi-structured interviews. Soveral-Dias *et al.* (1994) found in their study that for mapping the use of networked resources, questionnaires are less reliable than often generally because of the unsettled and evolving nature of both networked information and the language and terminology for discussing it. The viewpoint from which we conducted the research interviews (see the Appendix) and analysed them corresponds to that outlined by Paisley (1968). He argued that we cannot adequately understand or interpret scholars' information behaviour ("catch a glimpse of a real scientist at work") without looking at the full array of sources and search methods that are available and used. Paisley (1968) also argued against interpreting data on the use of computer-based systems without recognising that scholars stand at the centre of many systems and reference groups – their work teams, research projects, professional specialities, scientific cultures and invisible colleges – that touch every aspect of their work. He stressed that "computer-based systems that are not integrated into these systems will be expensive, unused novelties" (Paisley, 1968, p. 4).

Thus, we chose a qualitative research approach because we wanted to contextualise networked information use in the information practices of the fields selected, and judged informal interviews conducted in the informants' workplaces to be the best method for gaining a holistic understanding of scholars' work practices. The interviews lasted on average about one-and-a-half hours. They were conducted by one or the other of the authors, tape-recorded and transcribed in full for analysis. The data were not coded into predefined analytic categories according to a preselected theoretical framework to produce factual or verified information of a calculable status. Such an approach can be used to test an existing theory, whereas the aim of

small-scale qualitative studies such as that reported here is to develop models, concepts and hypotheses to be tested and enriched in subsequent studies.

## Disciplinary and intradisciplinary differences in the use of e-journals and databases

### *Literature and cultural studies*

At the time of the study in spring 2000, humanities scholars could be classified as low level users of e-journals and databases, while nursing scientists and ecological environmental scientists were already high level users (see Table II).

As Tenopir *et al.* (2003) note, both the availability of full-text e-journals and the way work is conducted in a specific scientific field affect e-journal use. At the time of the study, electronic journal services for humanities researchers were available only for short trial periods.

The EbscoHost Academic Search Elite was used by one literature scholar who also conducted searches in secondary databases such as the MLA International Bibliography, Sociological Abstracts, Humanities Index and Sophia CD-ROM. This scholar differed in her professional orientation and information search strategies from the other literature and cultural studies scholars. She also had a degree in information studies and therefore was interested in testing how much relevant material she could find in these databases for her research. She mentioned having discussed and introduced these resources and other new options (like using agents and alert services) with many of her colleagues. Literature scholars' awareness of these resources and possibilities did not lead to their regular use, however, because literature scholars mainly used other search strategies that they felt better satisfied their information needs. Although the literature and cultural studies scholars we interviewed were low users of electronic journal services and databases, many of them were heavy and habitual users of other types of networked information. Scholars readily adopt new technologies if they fit into or enhance established patterns of research (Palmer and Neumann, 2002; Talja and Maula, 2002; Agre, 2003).

Literature and cultural studies scholars' patterns of e-journal use concur with previous findings (reviewed in Stone, 1982; Watson-Boone, 1994) according to which humanities scholars rarely conduct directed subject searches (search periodical index databases) (see also Bates *et al.*, 1995).

| Discipline | Users | Non-users | Totals |
|---|---|---|---|
| Literature/cultural studies | 1 | 10 | 11 |
| History | 2 | 9 | 11 |
| Ecol.env.sci. | 9 | 1 | 10 |
| Nursing science | 11 | 1 | 12 |
| Totals | 23 | 21 | 44 |

**Table II.** Disciplinary differences in the use of e-journals and databases

Literature and cultural studies scholars instead rely on browsing (Internet homepages and subject directories, books, print journals, publishers' and library catalogues) and chaining (following bibliographic references from documents already known to them or to their colleagues). Literature scholars use older literature as much as current literature and the sources most important for their research are usually books. In line with this, the literature scholars interviewed used other types of networked resources, e.g. national and international electronic library catalogues and Internet bookstores like the Amazon.com considerably more than electronic databases and periodicals. Literature scholars typically search library catalogs and the Web for known items (authors and works). One literature scholar commented that:

> Certainly it would be great if it were possible to find documents in a reliable manner by searching databases with keywords, index terms, or subject headings, but no. It is not possible, because those who attach index terms to documents cannot possibly be in possession of the most current understandings of our field. Of course, keywords come from the authors, but still, this field is continuously evolving, and the new thing that I do is that I try to match my own thoughts with general ways of talking. It is vital that I find such concepts and theoretical frames that enable me to express myself and make my thoughts understandable (Junior researcher, literature and cultural studies, Lit 11).

Literature and cultural studies scholars innovate by developing new terms, definitions and ways of thinking and talking about their topics on the basis of previous theoretical literature. They seek to connect older existing literature to a new or emerging keyword rather than to connect new literature to an older existing keyword (Talja, 2002, p. 154). Neither free-text searching or using an established thesaurus or a well-defined vocabulary of index terms will help in identifying fruitful theoretical concepts and theoretical frames. Pao and Worthen (1989) and Green (2000) note that it is likely that different types of relevance are at work in citation searching (chaining from seed documents) and descriptor-based searching. A senior literature scholar also underlined that the nature of his field is such that "it is not based on technical searching". He characterised his information seeking as literature oriented as opposed to the result oriented information seeking necessary for scientists:

> My studies are not such that I would need to gather everything that has been published on the subject. I do try to follow what is being published, but it is by no means an extensive operation. It means staying in touch with current conversations. This field is not based on technical searching. It is not the nature of this field that you have to read each source that has been written on your topic. After all, canonic texts have a central position in research. This is different from, for instance, medicine, in which you have to be aware of and build on earlier results. In our field, it is easy to find relevant literature by technical means, but you cannot spend your whole life on trying to read it, you have to make strict decisions to read only what you need and will use. I read new publications to maintain an awareness of what people are talking about. This is by no means a uniform field, but contains really diverse theoretical and methodological starting points that you need to be aware of (Senior researcher, literature and cultural studies, Lit 3).

Literature and cultural studies scholars often follow a limited amount of print journals or listservs to keep up to date with the discussions going on in their fields. These scholars tended to emphasise the importance of continued availability of print journals. Literature and cultural studies scholars' typical search strategy is "berrypicking" (Bates, 1989). They often have wide interest ranges, and sometimes expressed an aversion to "doing systematic searches" that in their view required too narrow and limited a focus:

> I can imagine that a molecular biologist can narrow down his searches more easily to only his own topic, but I am a broadly oriented adventurer in the field of media culture (Junior researcher, literature and cultural studies, Lit 10).

Some literature and cultural studies scholars had conducted systematic literature searches at the beginning of their projects. This had been more to get a grasp of the size and shape of the existing literature on the topic, however, than to identify relevant documents for research. Deep reading of "fine books and authors" chosen on theoretical grounds was highly valued. Literature and cultural studies scholars often stated that given the existence of large amounts of topically relevant literature on their subjects, an efficient information practice requires that one simply disregards the existence of the majority of topically relevant literature (see also Wilson, 1995).

*History*

Internationally oriented historians and literature scholars especially used the Internet heavily for finding primary sources: for locating, browsing, or downloading archive materials (e.g. newspapers) and historical texts. Two of the historians interviewed had conducted directed subject searches to identify research literature (secondary sources) from bibliographic databases (Historical Abstracts) and electronic journal services. Historians' non-use of e-journals and databases was in part due to the lack of sufficiently retrospective materials, in part due to difficulties in obtaining the relevant items identified in searches. Books are usually more important for historians than articles, and in Internet bookstores, relevant items could be identified and purchased in a single session. Many (10/22) humanities scholars commented that they had discovered Amazon.com "to be nearly complete in its coverage" of books relevant to their research and easy to use for identifying new literature and seed documents. One historian explained historians' typical search strategy, chaining from seed documents, in the following manner:

> When I start (a new project), I try to find as new and thick a book as possible on the subject, a book that contains a somewhat established interpretation of the subject, but is a recent publication. I read the book and a couple of others related to it, so that I get to the roots of the literature. Then start collecting those sources and initially analysing them. In collecting the literature, I use electronic library catalogues (Junior researcher, history, Hist 9).

Green's (2000) study confirmed that chaining not only helps in identifying relevant literature not covered by standard bibliographic tools but also

provides a more appropriate level of analytical access than the formal bibliographic apparatus. In identifying seed documents, humanities scholars rely first and foremost on their own or their colleagues' accumulated knowledge and expertise. One senior historian explained that "subject searches are for students or politicians who do not know anything about their subjects" (Hist1). He made a difference between complementary searching typical for senior scholars, and comprehensive searching (Kling and Covi, 1997) typical for students. He stressed that comprehensive searching is needed only when entering an entirely new subspeciality. Humanist scholars' research projects typically evolve from previous projects (see also Palmer and Neumann, 2002). They usually have a great deal of background knowledge of both the literature and the scholars in their field:

> The most important factor in finding relevant literature is general wisdom, having knowledge of the field. If you have been a researcher longer, you know what literature exists on your area and where something new is likely to appear. Students conduct subject and keyword searches – whereas I know the researcher who has published something on the topic and simply search by that person's name. It is complementary searching rather than conducting new searches. We have certain places and journals we are accustomed to following. For us, the Internet has not revolutionised our practices, but forms a continuum of an existing practice – before, you went to the library to read journals, now you can check their tables of contents through the Web (Senior researcher, history, Hist 1).

For historians, topical relevance is usually the primary relevance type (for some, methodological relevance is of equal importance), and history is a low scatter field with middling numbers of relevant materials. Yet, all the historians interviewed (11) used browsing and chaining as their primary search strategies, contrary to our hypothesis that topical searchers in low scatter fields would use directed subject searches and electronic journal services more than theory-oriented (paradigmatic) searchers. Book versus article orientation seems to be a stronger predictor of e-journal and database use than primary relevance criteria, and for historians backward chaining (Ellis, 1989) is the optimal subject search strategy (see also Tibbo, 1994). One historian commented that:

> ... the existing research literature in Finnish history is controllable, at least for the time being, without IT-assisted systems. I know just by following the field what has been published on political history in different universities (Senior researcher, Hist 4).

In the Bates hypothesis, areas with very sparse ("needle in a haystack") numbers of relevant items are best searched by using links (chaining from seed documents). However, in searching primary sources, and in checking for the possible existence of undiscovered research literature, scholars specialised in Finnish literature and history – areas with sparse amounts of relevant materials – used browsing as their main search strategy. They manually browsed through archives, library shelves, books and card catalogues in the hope of encountering relevant materials. As noted by Erdelez (1997), encountering is not an unsystematic search strategy; rather, it is based on

expertise and awareness concerning the likely places where relevant materials can be encountered. These scholars used all types of networked resources less than those whose topics were international and/or theoretical, because they were aware of the fact that there was nothing on the Internet directly relevant for their research (see also Sturges and Sambrook, 1999).

*Nursing science*

Nursing scientists invariably preferred electronic journal services (EbscoHost) and electronic databases (Cinahl[7], PubMed Medline, Medic, Cochrane Library, ERIC) as their primary information seeking channels. The peer-reviewed journal is the primary information source for nursing scientists. Their main search technique is directed searching, and they are very familiar with searching bibliographic databases. Many had sought training in database searching by attending courses in their library. The one non-user among the nursing scientists delegated her searches to research assistants, who did extensive subject searches for her and the whole research group from relevant databases. Thus this informant was actually also a user.

Nursing scientists conventionally did a starting search at the beginning of a new research project, and check-up searches when finalising article manuscripts. Some did check-ups at regular intervals in the relevant databases to discover whether anything new had been published on their topics:

> I search on my own computer, and usually use PubMed and Cinahl, and usually search by using subject headings. If I know that someone has published something during the last couple of months, then I use the author search to discover in which journal it has been published and where it is available. I conduct searches pretty often, at two or three months intervals I check what has been published. I have a diary where I mark down the searches (Junior researcher, nursing science, Nurs 2).

One nursing scientist observed that it is a must for a professional scholar to be aware of and have read all the research that has been published on her topic (the treatment of pain), "otherwise, it would mean that I do not know what I am talking about, and that would be extremely embarrassing". (Nurs 2) This statement refers to quite a different notion of relevance than that expressed by literature and cultural studies scholars. However, as mentioned earlier, nursing scientists' research interests range from clinical to sociopsychological. One would be expect that in a field with a variety of scientific orientations also information search strategies would vary. This was not the case, however, because nursing scientists' information practices were fairly homogeneous.

As nursing science is an interdisciplinary field, the amounts of relevant literature are usually large, and relevant articles are published in a large number of different journals scattered across different fields:

> Our research area that has to do with promoting public health, it kind of contains almost anything and the area is wide. In seeking literature, you have to take into account and fuse many traditions: the traditional medical literature, the epidemiological side, and then the preventive side, you have to look them up, and fit them together, and relevant literature can

> be found virtually anywhere. There are research articles that are based on evidence, they are relevant, but then there are lots of articles reporting experiences, that are in some aspects relevant, and in some aspects not, so that extracting data from the literature can be quite a big task (Junior researcher, nursing science, Nurs 1).

Scholars in this field nevertheless, contrary to the Bates hypothesis, used directed searching as their main search technique. In nursing science, electronic journals services help in counteracting scatter, because they enable simultaneous searching in the journals of many fields. There are also other explanations for nursing scientists' use of directed searching as their main search strategy. One is the ready availability of suitable full-text e-journal services for nursing scientists. The other is the influence of the medical tradition on nursing scientists' search strategies, as explained by one researcher:

> When we think that this field is only about 20 years old, we still have the feeling that we have to prove that we are scientifically competent. We are always being compared to medicine, where they, nevertheless, have a quite different style of writing. We have stringent demands and rules regarding the quality of literature used and literature reviews. The status of medicine is so established that in some cases its very reputation seems to allow some bending of the rigid rules (Junior researcher, nursing science, Nurs 1).

Although topical, theoretical, and methodological relevance are often of equal importance to nursing scientists, the scientific culture of nursing science is such that they place a high value on systematic review: using a rigorous non-biased methodology to collect all topically relevant (peer-reviewed) articles, extracting information from those articles and synthesising the results (Blake and Pratt, 2002). "Web use" for nursing scientists meant searches from "official bibliographic databases". Like most (42/44) scholars we interviewed, they did use the Web routinely to find travel information, material for teaching, conference information, statistical data and researchers' and research groups' homepages. They expressed doubts, however, about using information available "on the open Net" for research purposes.

Nursing scientists rarely visited the library to browse print journals. Some monitored the contents of core journals from journal homepages or by accessing e-journals, but following their field in general was often defined as a "mission impossible" – in principle desirable, but something for which they simply did not have time. This also suggests a difference between literature oriented and result oriented information seeking, and a difference between fields with paradigmatic versus topical relevance as the primary relevance criterion.

*Ecological environmental science*

The peer-reviewed journal is also the main communication medium in ecological environmental science. Ecological environmental science is a low scatter discipline with middling ("manageable") numbers of relevant materials. In line with the Bates hypothesis, scholars in this field used directed searching as their primary search strategy. Scholars in this field explained that all the important journals of their field are contained in the Current Contents CD-ROM (CC):

> Searching to my mind is easy, we have this Current Contents system that works really well. I do all my searches on my own computer by using search terms, but perhaps once a month I scan the contents of all the major journals. I go to the journal's homepage. Because my subspeciality is pretty wide, it is not sufficient to do directed searches. I must also scan the journals (Junior researcher, ecological environmental science, Ecol 10).

Ecological environmental scientists found most of their sources in the Currents Contents CD-ROM (CC) and full-text electronic journals. Other search strategies included chaining, sharing information about new literature in research groups, and scanning the contents of core journals to keep up to date with the progress of the field. Topical relevance was the primary relevance type for ecological environmental scientists, and they expressed high levels of satisfaction with direct access to full-text e-journals. Scholars in this field did not find the choice of search terms and keywords problematic. Most of them conducted check-up searches in the CC or e-journals at regular intervals. They rarely visited the library to browse print journals.

In this field, too, identifying and retrieving all previous and current research publications on topics studied was considered a necessity. Scholars in this field also saw some threats in the increased reliance on e-journals, because the coverage of e-journals was considered to have an effect on the age of articles read. Some considered that without retrospective electronic access to older journals, future generations of scholars might not retrieve the older literature in which research lines had originally been set, and might reinvent or reresearch things already that had already been studied.

## Discussion

Our findings support the Bates hypothesis that the oversupply of topically relevant materials makes directed searching an unnecessary or redundant search technique. Literature and cultural studies scholars typically chose some cognitive authorities (books or authors) and proceeded by linking to identify a pool of relevant authors and works by using theoretical similarity or suitability as the primary selection criterion. Their preferred information seeking strategy was thus not browsing – as assumed in the Bates hypothesis – but linking. The scarcity of relevant materials likewise made directed searching a non-productive search technique, as assumed in the Bates hypothesis. Scholars specialising in Finnish history and literature were searchers of "needles in haystacks" (Bates, 2002). Contrary to the Bates hypothesis, they used browsing, not linking, as their primary search technique.

Although most fields we studied involve a mix of different search strategies: directed searching, browsing, chaining from seed documents, and sharing literature with colleagues, there were clear differences in the relative importance of these methods across fields. Eason *et al.* (2000) found that electronic journal services were more used by those using directed search as the only or dominant method of information retrieval. Our study confirms this finding. The behaviour of searchers is intrinsically different from that of

browsers (see also Bates, 2002). Humanities scholars can discover essential theoretical ideas and connections from literatures previously alien to them, but serendipitous findings for natural scientists are of a different nature, because they rarely conduct searches outside their own specialities. Primary relevance type was thus a stronger predictor of e-journal and database use than the degree of scatter. Our findings suggest that the existence of suitable electronic journals services helps in counteracting scatter, but only in fields placing high value on systematic literature reviews.

Literature and cultural studies scholars, for whom paradigmatic relevance is the primary relevance type, often saw the search terminology available as unsuitable for their purposes. Subject heading and keyword searching are techniques more suitable for topical searches than for multiparagmatic fields and research areas in which topicality is not the primary but a secondary relevance criterion. The book versus article orientation seems, however, to be a stronger predictor of e-journal and database use than primary relevance criteria.

For humanities scholars, "topic" in many (but not all) cases seems to be an entirely different concept than it is in natural sciences, and this can be the key to explaining both differences in search strategies and the book versus article orientation[8]. For natural scientists, results consist of empirical observations (many historians also view and frame their results in this manner), best reported in figures and tables, and in article format. If "topic" is viewed as an issue that is interpreted, narrated, constructed, and debated, research results will consist of a novel interpretation or conceptual approach, carefully set up and argued, and best reported in book format.

## Conclusion

This paper developed a research approach that explained e-journal use patterns with book versus article orientation, domain size, degree of scatter, professional orientation, and primary relevance types. We have tentatively shown that these factors merit continued investigation as we move our research orientations from analysing characteristics of users to analysing characteristics of domains to better understand field differences in e-journal use. In contrast to, for instance, Ellis' (1989) and Ellis *et al.*'s (1993) research phases model that outlines the similarities in information seeking patterns across fields, the domain analytic approach identified significant field differences in scholars' practices and search strategies. Our findings were based on a small, theoretically chosen sample, but they provide a basis on which to conduct further research to investigate the causality and predictive power of the variables we identified and the relationships between them.

Our findings confirm Case's (1991) statement that in studies of scholars' information practices, units of analysis must be narrower than the often used "humanities research" (see also Tibbo, 1994). Case (1991) suggests that units of analysis should be even narrower than domains and specialities. For

understanding e-journal and database use patterns, however, the best option seems to be to start from the discipline level and to use a similar comparative approach, as used in this study. In future, both qualitative and quantitative methods can be fruitfully used to develop a fuller understanding of field and subspeciality variation in search strategies, and how these are related to domain size, scatter and relevance criteria.

## Notes

1. E-journal in this article refers to electronic versions of peer-reviewed print journals, not to journals published solely in electronic format. We speak of electronic databases and e-journals, because access to full-text e-journals was, at the time of the study, considerably more limited than it is now. Scholars searching reference databases like Cinahl had full-text access to those journals their library had purchased and to abstracts of other journals' articles. Today, a considerably wider range of journals is available in full-text through FinElib licenced electronic journal services (www.lib.helsinki.fi/finelib).
2. Here, we simply use the terms discipline, domain and field as synonyms. By topic we refer to a more limited and specific research theme.
3. Directed searching means doing subject searches by using databases whose materials have been indexed, catalogued and classsified, and which provide elaborate retrieval (e.g. free-text search) capabilities (Bates, 2002, p. 142). Browsing, by nature, ignores the formal organisation of information (Bates, 2002, p. 141). Browsing may be purposive and directed (scanning core journals, a journal run, Bates, 1989), semi-purposive and semi-directed (monitoring journals, scanning shelves), or undirected and random (information encountering) (Chang and Rice, 1993).
4. Here we use the term linking in a limited sense to refer only to chaining from seed documents. Following the links within and between documents on the World Wide Web – when the links are deliberate connections created by authors – is also linking (Bates, 2002). When a searcher follows links in the World Wide Web on account of their physical proximity or collocation, she engages in Web browsing (Bates, 2002, p. 142).
5. Wang and Soergel's (1998) empirical findings on document selection and use support this view. Topicality and orientation emerged in their study as the two most important selection criteria, thus, topical relevance does not always warrant a selection decision (Wang and Soergel, 1998, p. 129).
6. Selections of topically relevant materials in natural sciences will also reflect an epistemological position (Hjørland, 2003), but natural scientists in practice search for topically relevant materials, and do not view themselves as choosing between paradigms and theories in the same way as, for instance, cultural studies scholars.
7. Cinahl (Cumulative Index to Nursing and Allied Health Literature) has been integrated to Journals@Ovid Full Text, the central full-text database for nursing research.
8. Pertti Vakkari, verbal comment.

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## Appendix. Interview schedule

- Tell me a little about your present research. What kinds of projects are you working on?
- Do you work alone or in a research group? (If collaborating, how do you collaborate?)
- Can you take a manuscript you are currently working on? Tell me a little about how you found the sources you cite there.
- Which are the most essential sources in this work? What is the basis of their relevance, what type of knowledge do they contain (e.g. methodological, theoretical, empirical)?
- How did you find these sources?
- What sources are secondary or less essential in this work? What type of knowledge do they contain?
- Do you do your searches yourself or do you seek the help of library professionals?
- In what phase of your project did you seek literature?
- How do you generally conduct your searches? (Detailed discussion of searches, monitoring, browsing, encountering, sharing; and the use of libraries, electronic journals, databases, other digital resources, persons' and institutions' homepages, subject gateway libraries, search engines, mailing lists, e-mail.)
- What kind of role do your colleagues and research group play in finding sources?
- What is the role of conferences?
- Has your way of finding sources changed during the last couple of years?
- What causes you the most problems in searching and finding literature?
- What is most enjoyable in searching and finding literature?
- Do you generally discuss information seeking with your colleagues?