

Exploring models of information behaviour: the “Uncertainty” Project

Tom Wilson

Department of Information Studies, University of Sheffield, UK
t.d.wilson@shef.ac.uk

INTRODUCTION

My original intention in this Keynote Paper was to talk about models of information behaviour, and I shall do that to some extent. However, both Carol Kuhlthau and Amanda Spink address this general conceptual level of research into information-seeking behaviour and I thought it would more appropriate to present my current research.

MODELS OF INFORMATION BEHAVIOUR

Existing research in the field of information behaviour may be perceived as based upon a set of “nested” models bound together by a dependency upon one another and by an increasing concern, as we move to deeper levels, with finer and finer details of human information seeking and searching behaviour. This over-arching model is represented in Figure 1:

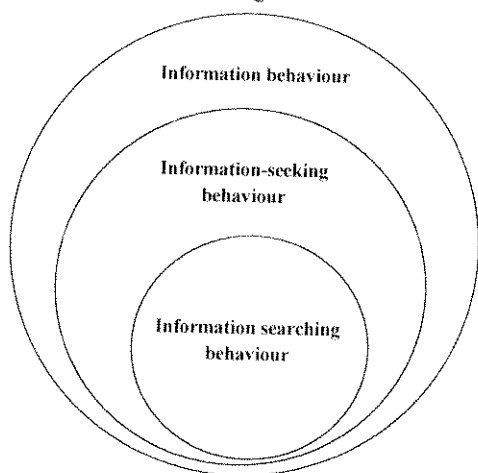


Figure 1: A nested model of conceptual areas

I can find few models of information behaviour in general - in fact only my own general model of 1981 (Wilson, 1981) - whereas there are a number that relate to information *seeking* behaviour: Wilson's (Wilson, 1981); Dervin's (Dervin, 1983) sense-making theory; Ellis's (Ellis, 1989; Ellis, Cox, & Hall, 1993) behavioural model of information search strategies; Kuhlthau's (Kuhlthau, 1991) model of the stages of information-seeking behaviour; and Wilson's (Wilson, 1997) model, which expands his 1981 model through an analysis of the literature in fields other than information science. In a forthcoming paper (Wilson, in review) I explore these and other models in an attempt to integrate them into the general framework set out above.

THE PROBLEM-SOLVING MODEL OF SUCCESSIVE SEARCHES

Most of these models, however, model a single process of searching - or, as with Ellis (Ellis, 1989; Ellis et al., 1993), attempt to show the general features of search behaviour, and it is now well-established that people engage in successive searches for information on the same problem (Spink, 1996). Within the overall model of Figure 1, therefore, something is needed that expresses the structure and processes involved in successive searching.

I propose that the basis of such a model will be a problem and that a problem situation is defined as a state of uncertainty. "Problem" is generally understood in a commonsense kind of way, but may be defined in phenomenological terms as something in the individual's life-world, which has led, in Schutz & Luckmann's terms (Schutz & Luckmann, 1974), to a discrepancy between the typifications applied to the life-world and a phenomenon that, at first sight, cannot be fitted into those typifications. Schutz's notion of typification can be explained by quotation:

"What is newly experienced is already known in the sense that it recalls similar or equal things formerly perceived. But what has been grasped once in its typicality carries with it... a series of typical characteristics still not actually experienced but expected to be potentially experienced." (Schutz, 1967)

Thus, once we have experienced any phenomenon we have certain expectations of things we experience as similar - we typify them as belonging to particular categories of our experience of the world. Once I experience a tree, I have certain expectations of anything that occurs in my life-world as being tree-like: it will be rooted in one place, rather than moving, a tree-like object will be expected to have leaves, and so on. Similarly, we identify all kinds of events in our life-worlds as being similar to previously experienced events. Schutz makes the connection between relevance and typification, in that those facts or experiences that enable us to identify phenomena as members of a particular object group or sub-set of such a group may be viewed as relevant to the typification of those phenomena.

The solution of the problem, the resolution of the discrepancy, the advance from uncertainty to certainty (or at least some pragmatic solution of the problem) then becomes a goal of the person and we typify the resulting behaviour as *goal-seeking* behaviour. We then argue that *en route* to the goal, the individual moves from uncertainty to increasing certainty and that there are stages in the problem-resolution process that are identifiable and recognisable to the individual. These stages are: **problem identification** (where the person is asking the question, "What kind of problem do I have?"), **problem definition** ("Exactly what is the nature of my problem?"), **problem resolution** ("How do I find the answer to my problem?") and, potentially, **solution statement** ("This is the answer to the problem." or, if a pragmatic, rather than a theoretically-based resolution has been found, "This is how we are going to deal with the problem.")

The transition from *problem identification* to *solution statement* is not without difficulty: if it was, there would be no problem, since (as Schutz & Luckmann argue) the issue would be dealt with through the individual's existing typifications of phenomena in the life-world and his/her existing stock of knowledge applicable to those typifications. We hypothesise that, (a) each stage where uncertainty fails to be resolved at any one stage, it may result in a feedback loop to the previous stage for further resolution. We may represent this as in Figure 2:

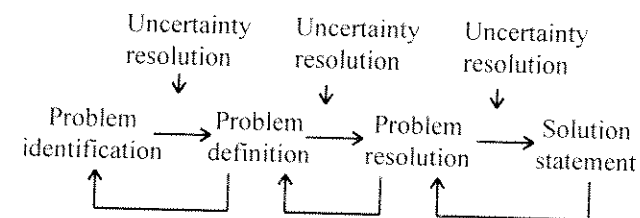


Figure 2: The problem resolution chain

THE "UNCERTAINTY" PROJECT

A project has been funded by the British Library Research and Innovation Centre, the aim of which is to explore information search behaviour within the more general framework of information behaviour based upon this model of the problem-solving process and upon the concept of uncertainty reduction.

Objectives

Within this overall model of the problem process, this project is addressing research questions relating to the following:

- evaluating models of information searching in information retrieval (IR) systems;
- testing whether the proposed model of information-searching as related to problem solving is valid for the population in question;
- establishing whether the use of Kuhlthau's model of information searching as a stage process fits the suggested model of multiple searches in a problem solving strategy;
- examining whether Ellis's behavioural model of the search process is a more appropriate model in the problem-solving context, and
- exploring whether the concept of individual differences (e.g., (Ford & Ford, 1993)) is valuable in explaining differences in problem solving and searching behaviour in searching.

Methodology

The Department of Information Studies carries on its normal teaching of on-line searching by having students respond to the information needs of researchers elsewhere in the University. This is done by announcing the availability of a search service and then attaching groups of two or three students to each accepted client. The Project has adopted the same practice of advertising the service to Departments, but with the caveat that the client must be willing to participate in the research project. The advantage of the Project from the client's point of view is that it can gain access to Dialog databases in addition to the generally available BIDS search services and the Internet.

The Project employs a combination of interviewing, data collection instruments, tape-recordings of searcher/client interactions, and logs of online searches to collect information on the original search problem, search interactions, responses to the retrieved references and, ultimately, follow-up interviews when clients have had time to obtain actual documents and evaluate their usefulness.

The interviews cover both the nature of the enquiry and its background, as well as soliciting responses to questions on the state of the client's uncertainty about the problem, the problem stage, the information searching stage, and other aspects of the research questions. The interviews may last for up to one-and-a-half hours, but most have been completed in a shorter period. Perhaps because acceptance as a search client depends upon a willingness to collaborate in the research, very little adverse reaction to the time taken by the interviews has been experienced.

The searches are carried out by the Project's Research Officer, in the presence of the client and, as noted above, are tape-recorded.

International collaboration

A key part of the Project is its involvement with Dr. Amanda Spink's National Science Foundation POWRE project, held at the University of North Texas, the purpose of which:

"...is to investigate the nature, manifestations, and behavior of successive searching by users in digital environments, and to derive criteria for use in the design of information retrieval interfaces and systems supporting successive searching behavior." (Spink, 1996)

Although the focus of Dr. Spink's project is somewhat different, the two Projects are using the same research instruments, which have been developed jointly, and will combine the two data-sets for analysis.

PRELIMINARY FINDINGS

The Pilot phase of the Sheffield was carried out from October 1997 to June 1998: twenty-two clients were accepted into the Pilot and interviews and searches were carried out with all of them. (The clients were distributed over the Faculties as follows: Architectural Studies (1); Educational Studies (2); Engineering (5); Medicine (3); Pure Science (4); and Social Sciences (7).)

Follow-up interviews have not yet been carried out. The first phase of the main study has now been launched and 38 clients have been accepted: interviews have been carried out with most of these and searches are now in progress. As a result of the Pilot study and in order to satisfy the Project's original objectives, some amendments have been made to the interview schedule and the research instruments and scale items have been created in attempt to operationalise for quantitative use the concepts employed by Kuhlthau and by Ellis in their qualitative studies.

The data relating to the searches carried out for the twenty-two clients were analysed using SPSS for Windows (release 6.0) and the initial (and very preliminary) results are discussed here under three headings: problem stage, uncertainty and cognitive style.

Problem stage.

A key element in the Project's research plan is the idea that information users will be able to perceive themselves as dealing with a problem and will be able to categorise their position in the problem-solving process according to some predefined categories. We have found this, generally, to be the case. One or two clients (in social science disciplines) raised an objection to having their enquiry described as a 'problem' but were, nevertheless, able to categorise the stage of the enquiry in problem-solving terms.

It was anticipated that some clients would be likely to perceive their present position in the problem-solving process as falling between one stage and

another. This proved to be the case and, in recording the stage position, the intermediate positions were identified. The distribution over the stages is shown in Table 1, below:

Problem Phase	No. of respondents	Percentage
1 - Identification	1	4.2
2 - Definition	8	33.3
2.5 - Intermediate	1	4.2
3 - Resolution	11	45.8
3.5 - Intermediate	1	4.2
4 - Soln. statement	0	0.0
Total	22	100.0

Table 1: Problem phase of respondents

As may be expected, the two most common phases were Problem Definition and Problem Resolution: these are the points at which we might expect assisted systematic searching to take place, whereas Problem Identification, for example, the person is likely to browse or systematically review known and readily available sources, and at the Solution Statement phase, is more likely to be checking references and confirming points from documents already to hand.

Cognitive styles

Cognitive styles are tendencies displayed by individuals consistently to adopt a particular type of information processing strategy (Brumby, 1982; Ford, 1995; Miller, 1987; Riding & Cheema, 1991). Researchers have categorised styles in a number of ways, usually resulting in a binary classification: thus, we have *holist/serialist*, *field-independence/field dependence*, and *verbaliser/imager*. All of these are being explored in this Project, using Ford's 'Study process questionnaire' (Ford, 1985) and Riding's 'Cognitive styles analysis - CSA'.

'Holists' tend to adopt a *global* approach to information processing: they concentrate first on building a conceptual overview into which detail can be fitted. They typically address several aspects of a learning task at the same time, relating them using complex links, and making extensive use of enrichment material such as analogies, illustration and anecdote. 'Serialists', on the other hand, concentrate on one thing at a time and build up their understanding on a

relatively narrow base, mastering one aspect before moving on to another (Pask, 1988).

'Field independence/dependence' relates to the extent to which an individual will engage in analysis and conceptual structuring of a field. The 'field independent' is highly analytic and uses an internal frame of reference to structure problems and organise information; the 'field dependent' relies more on external frames of reference and operates best where structures and analysis are already provided (Witkin, Moore, Goodenough, & Coc, 1977).

'Verbaliser/imager' relates, as the terms suggest, to the individual's propensity to represent his or her thoughts in words or in images (Riding & Cheema, 1991). The idea has received less research than the other concept but has been included in the Project's framework because of Ford and Miller's (Ford & Miller, 1996) findings of links between it and information seeking on the Internet.

Pearson correlations were run on the data, and those found to be significant (at the 0.05 level) in relation to cognitive style are shown in Table 2, which reveals a significant link between gender and cognitive style. Males are imagers, make high use of holist approaches to learning and were also associated with requiring a more complex search, as judged by the (male) searcher. Females tended to be verbalisers, to utilise serialist approaches to learning, and to be associated with less complex searches.

As noted above, holists were less certain than serialists of their problem definition both before and after the search, and they also displayed greater change in their relevance criteria. They also reported their problem to be at an earlier stage of solution than their serialist counterparts. Field-independents tended to consider non-verbal aspects of the communication between themselves and the intermediary as less important than did more field-dependent individuals. Field-independence was also linked with high holist (but not low serialist) scores.

Further analysis of the role of cognitive style is presented in a forthcoming paper from the research team (Ford, *et al.*, in progress).

Uncertainty.

"Uncertainty" was measured by asking the respondents the following questions:

"How certain are you:

that you have recognized a real problem to investigate?

that you have defined the problem appropriately?

that the problem can be resolved?

that an effective way of presenting the results can be found?

that relevant information is available and can be found?"

	Field-dependent/independent	Verbaliser/imager	Gender	Holist	Serialist	Holist/serialist bias
Problem complexity		r = .5034 N = 18 p = .033	r = .5621 N = 22 p = .006	r = .5634 N = 18 p = .015		r = .6426 N = 17 p = .005
Problem solving stage	r = -.5812 N = 18 p = .011					
Importance of non-verbal communication	r = .4931 N = 18 p = .038					
Gender		r = .6320 N = 18 p = .005			r = -.5142 N = 17 p = .035	r = .4967 N = 17 p = .043
Change in relevance criteria			r = .4763 N = 18 p = .046		r = -.5606 N = 17 p = .019	
Holist/serialist balance			r = .4967 N = 17 p = .043	r = .7804 N = 17 p = .000	r = -.5934 N = 17 p = .012	
Field-dependent/independent cognitive style				r = .5419 N = 18 p = .020		
Certainty of problem definition (pre-search)				r = -.6435 N = 18 p = .004		
Certainty of problem definition (post-search)				r = -.5009 N = 18 p = .034		r = -.5902 N = 17 p = .013

Table 2. Pearson correlations (Source: Ford, *et al.* in progress.)

and requiring them to mark a cross on an eight-centimetre line. The position of the cross was subsequently measured and the value (0 = very uncertain; 8 = very certain) recorded as the response. This method allows very fine discrimination among respondents, compared with the use of four or five categories and, judging from the ability of respondents to locate themselves on the scales, is

intuitively understandable. Table 2 groups the responses into three categories: 0.0-2.9 low certainty; 3.0-5.9 moderate certainty; and 6.0 - 8.0 high certainty.

Table 2 shows that the highest degree of uncertainty was experienced in relation to whether or not the "problem" could be resolved and whether or not information was likely to be available. Not surprisingly, there was a high correlation between these two variables - 0.66, which was significant at the 0.001 level.

Score	Identification	Definition	Resolution	Presentation	Information
0.0 - 2.9	3	2	6	4	3
3.0 - 5.9	0	5	3	2	9
6.0 - 8.0	19	15	13	16	10
Totals	22	22	22	22	22

Table 3: Uncertainty measures

A "global uncertainty" measure was also calculated based on the mean sum of scores and built into an exploratory factor analysis. This revealed the four factors shown in Table 4 below.

	Factor 1	Factor 2	Factor 3	Factor 4
Uncertainty	-.42158	-.03622	.67283	.36342
Holist	.76104	.28791	-.10406	.36891
Serialist	-.06384	.86185	-.14623	.00235
Versatile	.64327	.68445	-.15764	.21151
Clarity	-.32673	.25451	.64013	.14442
Specificity	.18427	-.27092	.74496	-.43075
Complexity	.80166	-.27923	.19261	.06184
Global/Analytic	.66762	.44439	.30543	.14710
Verbaliser/imager	.60342	-.43563	-.01092	-.43004
Gender	.66037	-.58834	.26488	-.05106
Age	.01257	-.62571	.01175	.67985

Table 4: Factor analysis of data

Factor 1 identifies those who have a *low certainty score*, are likely to be "versatile" (i.e., using both holist and serialist approaches, but with a bias towards holism), and are likely to be judged by the searcher as having relatively

unclear and complex questions. They are also more likely to be male and to be analytic imagers.

Factor 2 individuals are also versatile, but have a preference for serialist approaches, the searcher perceived their questions to be simple, specific and clearly expressed and to be female (younger than the males) and also analytic verbalisers.

Factor 3 persons have a *high certainty score*, to have a very specific, clearly expressed and relatively simple problem. They are analytic, and, marginally, verbalisers, but, apart from that, mixed in their cognitive style.

Factor 4 included older females with *high certainty scores*, reasonably versatile, but with a bias towards holistic approaches towards less specific problems.

Of course, it must be remembered that we are using a relatively small amount of data and this level of analysis should be regarded as entirely exploratory and, perhaps, as a guide to looking for evidence in the qualitative data to support the analysis. When we have, say, 150 clients in our pool, it will be interesting to see whether or not the relationships persist, or whether new relationships emerge as stronger.

CONCLUSIONS

Since the INISS Project in the period 1975 to 1980 (Wilson & Streatfield, 1977; Wilson & Streatfield, 1980; Wilson, Streatfield, & Mullings, 1979) a great deal of qualitative research has been carried out in Sheffield and elsewhere into information needs and information-seeking behaviour. It should now be possible to take this qualitative research and devise research projects, at all levels, that seek empirical confirmation of qualitative insights. Our present Project, while retaining an element of qualitative investigation in the detailed pre-search and follow-up interviews, seeks to achieve this by collecting a great deal of quantitative data on various aspects of the information-seeking and information searching processes. The international collaboration with Dr. Spink at the University of North Texas may also enable us to explore such things as the impact of the ethos and work patterns of different institutions in different countries.

The modest level of analysis we have been able to carry out on the Pilot Phase data has already drawn attention to some interesting relationships, and, as the data are augmented through the follow-up process and through the recruitment of more clients, it is likely that we shall make further progress towards understanding the complex set of relationships that are set up when the information user seeks information through electronic systems.

ACKNOWLEDGEMENTS

I would like to acknowledge the contributions to this paper of my colleagues on the Project: David Ellis, Nigel Ford, Allen Foster and, in the USA, Amanda Spink. For my interpretation of their contributions, however, I remain solely responsible.

REFERENCES

- BRUMBY, M. N. (1982). Consistent differences in cognitive styles shown for qualitative biological problem-solving. *British Journal of Educational Psychology*, 52, 244-157.
- DERVIN, B. (1983). *An overview of sense-making research: concepts, methods and results to date*. Paper presented at the International Communications Association Annual Meeting, Dallas, Texas.
- ELLIS, D. (1989). A behavioural approach to information retrieval design. *Journal of Documentation*, 46, 318-338.
- ELLIS, D., COX, D., & HALL, K. (1993). A comparison of the information seeking patterns of researchers in the physical and social sciences. *Journal of Documentaiton*, 49, 356-369.
- FORD, N. (1985). Learning styles and strategies of postgraduate students. *British Journal of Educational Technology*, 16, 65-77.
- FORD, N., & FORD, R. (1993). Towards a cognitive theory of information accessing: an empirical study. *Information Processing and Management*, 29, 569-585.
- FORD, N., & MILLER, D. (1996) Gender differences in Internet perceptions and use. *Aslib Proceedings*, 48, 183-192
- FORD, N., WILSON, T. D., ELLIS, D., FOSTER, A., & SPINK, A. (in progress) Individual differences in information seeking: an empirical study.
- FORD, N. J. (1995). Levels and types of mediation in instructional systems: an individual difference approach. *International Journal of Human-Computer Studies*, 43, 241-259.
- KUHLTHAU, C.C. (1991). Inside the search process: information seeking from the user's perspective. *Journal of the American Society for Information Science*, 42, 361-371.
- MILLER, A. (1987). Cognitive styles: an integrated model. *Educational Psychology*, 7, 251-268.
- PASK, G. (1988). Learning strategies, teaching strategies, and conceptual or learning style. In: R.R. Schmeck, ed. *Learning strategies and learning styles*. New York: Plenum Press, 83-93
- RIDING, R.J., & CHEEMA, I. (1991). Cognitive styles - an overview and integration. *Educational Psychology*, 11, 193-215.

- SCHUTZ, A. (1967). *The phenomenology of the social world*. Evanston, Ill: Northwestern University Press.
- SCHUTZ, A., & LUCKMANN, T. (1974). *The structures of the life-world* (Trans by R.M. Zaner & H.T. Engelhardt, H.T.). London: Heinemann.
- SPINK, A. (1996). A multiple search session model of end-user behavior: an exploratory study. *Journal of the American Society for Information Science*, 46, 603-609.
- WILSON, T.D. (1981). On user studies and information needs. *Journal of Documentation*, 37, 3-15.
- WILSON, T.D. (1997). Information behaviour: an interdisciplinary perspective. *Information Processing and Management*, 33, 551-572.
- WILSON, T.D. (in review). Models in information behaviour research. *Journal of Documentation*.
- WILSON, T.D., & STREATFIELD, D.R. (1977). Information needs in local authority social services departments: an interim report on Project INISS. *Journal of Documentation*, 33, 277-293.
- WILSON, T.D., & STREATFIELD, D.R. (1980). *You can observe a lot...: a study of information use in local authority social services departments*. Sheffield: University of Sheffield, Department of Information Studies.
- WILSON, T.D., STREATFIELD, D.R., & MULLINGS, C. (1979). Information needs in local authority social services departments: a second report on Project INISS. *Journal of Documentation*, 35, 120-13
- WITKIN, H.A., MOORE, C.A., GOODENOUGH, D.R., & COC, P.W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. *Review of Educational Research*, 47, 1-64.