Information Seeking and Mediated Searching. Part 4. Cognitive Styles in Information Seeking

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This is the fourth in a series resulting from a joint research project directed by Professor Tom Wilson in the United Kingdom and Dr. Amanda Spink in the United States. The analysis reported here sought to test a number of hypotheses linking global/analytic cognitive styles and aspects of researchers' problem-solving and related information-seeking behavior. One hundred and eleven postdoctoral researchers were assessed for Witkin's field dependence/independence using Riding's Cognitive Styles Analysis and for Pask's holist/serialist biases using items from Ford's Study Processes Questionnaire. These measures were correlated with the researchers' perceptions of aspects of their problem-solving and information-seeking behavior, and with those of the search intermediary who performed literature searches on their behalf. A number of statistically significant correlations were found. Field-independent researchers were more analytic and active than their field-dependent counterparts. Holists engaged more in exploratory and serendipitous behavior, and were more idiosyncratic in their communication than serialists.

Introduction

This article is the fourth in a series reporting the results of a joint research project supported in the United States by the National Science Foundation and in the United Kingdom by the British Library. The U.S. study was undertaken at the University of North Texas by Dr. Amanda Spink (now at The Pennsylvania State University). The UK study, headed by Professor Tom Wilson, was conducted at the

University of Sheffield, UK. The theoretical rationale and research design of the project are described in the first paper (Spink, Wilson, Ford, Foster, & Ellis, in press). The current article present the results of a sub project designed to explore the relationship between *cognitive styles* and problem solving and its associated information seeking. Cognitive style may be seen as one of the intervening variables identified by Wilson (1999) in the category "psychological." The research reported here, therefore, contributes to validating Wilson's model.

Cognitive Styles

Cognitive styles are tendencies displayed by individuals consistently to adopt a particular type of information processing strategy. Many such differences have been identified (Brumby, 1982; Entwistle, 1981; Ford, 1995; Jonassen & Grabowski, 1993; Miller, 1987; Riding & Cheema, 1991; Schmeck, 1988), and a number of them have been studied empirically in terms of their effects on information-seeking behavior and performance. A major focus of research into cognitive styles has been the study of what may be described as a *global/analytic* dimension of difference; notably work conducted and inspired by Witkin in the United States and Pask in the UK. Witkin investigated global/analytic differences in a very wide range of human activity from basic perception to career choice (Witkin, Moore, Goodenough, & Cox, 1977). Pask, in the UK, studied global/analytic differences in concept acquisition relating to complex academic subject matter (Pask, 1979, 1988). The dimensions of cognitive style identified by Witkin are most generally termed *field dependence* and *field independence*. Those identified by Pask relate to *holist* and *serialist* approaches to information processing.

Pask's Styles

In a series of experiments (Pask, 1976a, 1976b, 1976c, 1979, 1988; Pask & Scott, 1972, 1973), Pask and his colleagues monitored the routes taken by learners through a range of complex academic topics. In these experiments, people used one of two basic approaches. "Holists" tended to adopt a *global* approach to learning, examining interrelationships between several topics early in the learning process, and concentrating first on building a broad conceptual overview into which detail could subsequently be fitted. "Serialists" tended to use a predominantly *local* learning approach, examining one thing at a time, and concentrating on separate topics and the logical sequences linking them. The overall picture emerged relatively late in the learning process. When learning material that entailed theoretical and corresponding "real world" examples and applications, the serialist worked through either the theoretical or the real world topics, only bringing them together late in the learning process when absolutely necessary to achieve understanding. The holist, on the other hand, constantly moved between theory and real world right from the start. Holists also tended to look further ahead in the hierarchy of topics making up the subject (Entwistle, 1981; Robertson, 1977).

The holist is cognitively complex, and likes to have several things "on the go" at the same time. In contrast to the steady "brick-by-brick" approach of the serialist, the holist adopts what is a comparatively high risk, exploratory strategy, switching attention across a range of tasks before any one is securely completed and checked as a sure foundation for further progress. The holist progresses in an exploratory fashion compared to the serialist's narrow focus and step-by-step logical progression, making sure to build solid foundations for each next move. Using the technique of "teachback," Pask and Scott found that extreme holists were distinctive in the personalized, often idiosyncratic way in which they related new information to their existing knowledge, making sense of it in ways often not easily understood by others.

Witkin's Styles

The dimensions of cognitive style identified by Witkin relate to what he termed *field dependence* and *field independence*. Relatively field-*independent* individuals are more adept at structuring and analytic activity when compared with relatively field-*dependent* individuals. Relatively field-*dependent* individuals thrive more in situations where learning is structured and analyzed for them. They tend to prefer a "spectator" approach to learning rather than the hypothesis testing approach favored by more field independent learners. They operate with a relatively external frame of reference, as opposed to the greater "inner directedness" of the field-independent individual. Field-dependent people tend to be more socially oriented than more field-independent individuals, and this may even be reflected in the type of academic study and employment they choose and in which they excel.

Essentially, field-independent individuals tend to experience the components of a structured field analytically, as discrete from their background, and to impose structure on a relatively unstructured field. By contrast, relatively field-dependent individuals tend to be less good at such structuring and analytic activity, and to perceive a complex stimulus globally as a *gestalt*. This dimension would seem to extend from perceptual through intellectual and social functioning. Witkin et al. (1977) published a detailed review of the educational implications of field dependence/independence. Riding and Cheema (1991) also include field dependence/independence in a comparative review of cognitive styles that also includes Pask's holist/serialist distinction.

Measurement

Pask developed a series of tests of including the *Spy Ring History* and the *Smugglers* tests. These are complex, lengthy to administer, and very demanding on learners. Relatively few studies using these measures (other than those conducted by Pask and his colleagues) have been reported (see, e.g., Coombs, Gibson, & Alty, 1982). Entwistle (Entwistle, Hanley, & Hounsell, 1979) developed a self-completion inventory, and a shortened version, the *Short Inventory of Approaches to Studying* (Entwistle, 1981), which was designed to assess, among a number of other constructs, Pask's comprehension, operation, and versatile learning styles. Although quick and easy to administer, and benefiting from reliability data and norms derived from large scale studies, this instrument was not designed directly to measure holist and serialist biases (even though arguably they could be inferred from comprehension and operation learning biases). Ford (1985) thus devised a measure specifically designed to assess holist and serialist biases: the *Study Processes Questionnaire*. Clarke (1993) investigated the reliability of this instrument, and it has been used in a variety of studies (e.g., Ford, 1985; Ford & Chen, 2001). However, its reliability has not been widely studied, and no published norms are available.

A number of instruments have been developed to measure field dependence/independence, one of the best known of which is Witkin's *Group Embedded Figures Test* (GEFT). More recently, Riding's (1991) *Cognitive Styles Analysis* (CSA) measures what the authors refer to as a wholist/analytic dimension, noting that this is equivalent to field dependence/independence (Riding & Sadler Smith, 1992). This instrument offers computerized administration and scoring, and has been designed to overcome a limitation affecting the most widely used measures of field dependence/independence. Tests such as Witkin's GEFT derive scores for field *independence* by requiring subjects to locate simple shapes embedded in more complex geometrical patterns. However, levels of field *dependence* are inferred from poor field-*independence* performance, that is, from poor performance on this disembedding task.

However, the *Cognitive Styles Analysis* differs from tests such as the GEFT in that its wholist/analytic test consists of

two subtests. In the first, subjects are required to judge the similarity of a series of complex geometrical figures, which is a task requiring field-*dependent* capacity. The second subtest requires subjects to determine whether a simple shape is contained within a more complex geometrical figure (as in the GEFT), which is a task requiring the disembedding capacity associated with field *independence*. In this way, field-dependent competence is positively measured rather than being inferred from poor field-independent capability.

Related Studies

Cognitive styles have been the subject of many studies relating to library and information studies (LIS). These extend from early studies linking cognitive styles with document relevance judgements (Davidson, 1977), through surveys of the incidence of different styles among reference librarians (Rholes & Droessler, 1984) and librarianship students (Johnson & White, 1981) and the application of cognitive style data to enhance LIS teaching (Johnson & White, 1982), to studies linking cognitive styles to levels of cooperation between teachers and library media center specialists (Montgomery, 1991). Recent years have seen an increasing diversity of LIS-related studies including investigations of cognitive styles and preference for display layouts (Huang, 1998), decision making in geographical information systems (Crossland, Herschel, Perkins, & Scudder, 2000) and choice of metaphor for describing the Web (Palmquist, 2001).

More closely related to the focus of the present research are studies that have explored the effects of cognitive style on information seeking. The information-seeking context of such investigations has ranged from databases, hypertext, and virtual information environments to on-line and Web-based searching. Ford and Ford (1992), for example, conducted an experiment with postgraduate students to discover how they might go about learning from an "ideal" database. A system was created which preserved the characteristics of a computer-based environment, but freed itself from the constraints of current technology. Although not realizing it at the time, 30 postgraduate students were, in fact, interacting through a computer screen with two human subject experts. The students were asked to interrogate the database, using whatever language and approach they wished, to learn about the document indexing system, PRECIS. At the end of the session, they were asked to write what they had learned about the system. The students displayed significant differences in database interrogation strategies, which mapped well on to Pask's holist and serialist distinction.

In the same year, a study by Ellis, Ford, and Wood (1992) investigated hypertext navigation by 40 postgraduate students. Students were tested for Pask's styles using Entwistle's *Short Inventory of Approaches to Studying*. The *Study Preference Questionnaire*, a non standardized test devised to assess holist and serialist strategic biases was also used. A hypertext system was used in this experiment,

navigation tools being provided in the form of a self-orienting, global concept map, keyword index, menus, and a back tracking facility. The subject matter of the hypertext was the European Single Market. The students were given the task of using the system to answer a number of questions requiring (a) specific factual recall, and (b) generalization using information from more than one location in the hypertext. All interactions were automatically logged. Holists made significantly greater use of the global map; serialists of the keyword index. No significant differences were reported for field dependence.

A later study by Chen and Ford (1998) also investigated hypertext navigation. Twenty postgraduate students were tested using the *Cognitive Styles Analysis*, then learned from a hypertext system designed to give an introduction to the field of artificial intelligence. Navigation patterns were logged for analysis. It was found that field dependent individuals made significantly greater use of the main menu, their field independent counterparts making more use of the relatively sequential Previous/Next buttons. Chen and Lin (1998) studied the effects of navigation map types and cognitive styles on performance by 121 university students in searches for information and cognitive map development using a hypertext system. Implications were drawn for the design and development of navigation maps.

Cutmore, Hine, Maberly, Langford, and Hawgood (2000) report five experiments studying the effects of cognitive style, gender, navigation strategies, and hemispheric activation on the acquisition of route and survey knowledge two types of navigational knowledge—in a virtual environment. They found that men acquired route knowledge from landmarks faster than women. Subjects scoring high on visual spatial cognition performed better in tasks requiring the use of survey knowledge. Greater activation was also observed in the right cerebral hemisphere (associated with relatively global intellectual activities) than the left (associated with relatively analytic intellectual activities) during navigation in the virtual environment.

In a study of on-line searching behavior (Wood, Ford, Miller, Sobczyk, & Duffin, 1996) statistically significant differences were found between global/analytic differences and aspects of information searching including awareness of broadening and narrowing search techniques; levels of satisfaction with search results; number of different terms used in the search formulation; number of new terms introduced during the search; number of relevant references retrieved; and perceived search success. Some 105 undergraduate students carried out on-line searches of CD ROM databases for information on topics relating to their coursework. Databases included Inspec, Biological Abstracts, Social Sciences Index, Compendex, ABI Inform, General Sciences Index and Modern Languages Association. The students completed the *Short Inventory of Approaches to Studying* and the *Cognitive Styles Analysis*. Search strategies were logged for analysis.

A previous study (Ford, Wood, & Walsh, 1994; Wood, Ford, & Walsh, 1992) had revealed significant links be-

tween global/analytic differences and search behavior. Relatively global individuals used significantly broader search strategies than their analytic counterparts. The behavior studied in this experiment related to the searching of a CD ROM database, containing 105,482 bibliographic records. Sixty-seven postgraduate students conducted 275 searches on Silver Platter's CD ROM-based Library and Information Science Abstracts (LISA) database on subjects related to their coursework. Students were tested using the *Short Inventory of Approaches to Studying* and the GEFT. Their searching strategies were classified in terms of relative breadth and depth. A high use of the word *OR* to link keywords represents a relatively broad strategy: a high use of *AND* a relatively narrow strategy. Other measures of the breadth or narrowness of search included *truncation* and generic *descriptors* (which broaden a search), and use of *date* or *language qualifiers* (which tend to narrow a search).

Wang, Hawk, and Tenopir (2000) investigated cognitive and affective aspects of Web searching by 24 Masters students. They found interactions between cognitive style and both difficulty and confusion experienced field-dependent students experiencing more difficulty and confusion than their field-independent counterparts. Levels of anxiety were linked to negative feelings, which in turn, could affect levels of persistence in searching.

Palmquist and Kim (2000) studied the effects of both experience and cognitive style on Web searching. They investigated searching by 48 undergraduate college students of a university Web site when conducting factual and topic searches. Search performance was measured in terms of time required, and the number of nodes traversed, to locate a relevant information item. They found that cognitive style interacted with experience of on-line database searching. Field-dependent novice searchers took longer and traversed more nodes in locating relevant information than field-independent novices. No significant cognitive style differences were found among experienced searchers.

The studies of information seeking, along with the generic descriptions of the essential characteristics of the different cognitive styles provided by the research reviewed in the previous section, formed the basis for the hypotheses tested in the present research, described below.

Research Design

The overall research design for the project, including data collection instruments and procedures, is described in detail in the first article (Spink, Wilson, Ford, Foster, & Ellis, in press). The present article reports the results of an analysis of a subset of these data. Because, as described below, this part of the study entailed the testing of a number of specific hypotheses, only those variables related to the hypotheses were used. (The research instruments used can be found at: http://www.shef.ac.uk/~is/publications/unis/.)

Research Aim and Objectives

The aim of the research reported here was to discover the extent to which cognitive styles may affect an information seeker's perceptions of the nature of his or her research problem and of progress in its solution through information seeking. The objectives were to test the following hypotheses, derived from descriptions of cognitive style constructs in the research literature.

(1) Compared to their field dependent counterparts, relatively field independent individuals will: (a) be more analytic in their behavior; (b) display more active behavior; (c) report less uncertainty in their problem solving; (d) report less valuing of serendipitous information encounters.
(2) Compared to their serialist counterparts, relatively holist individuals will: (a) display more exploratory behavior; (b) desire a more comprehensive information search; *c) employ more personalized and/or idiosyncratic forms of explanation; (d) will report greater uncertainty in their problem solving.

Although the study adopted a hypothesis testing approach, it was at the same time exploratory in that each dependent concept contained in the hypotheses was not coextensive with only one variable. For example, "uncertainty" (hypothesis *1d*) consisted of a number of measures relating to a range of problem solving stages (problem recognition, definition, resolution, etc.), taken at different times (before and after the search).

Cognitive style theory is not developed to a sufficiently fine-grained stage to render productive the specification of hypotheses coextensive with these individual variables. While it may be reasonable, based on cognitive style theory, to hypothesize that styles may affect "levels of uncertainty," it would be less reasonable to generate more specific hypotheses, for example, for each of the proposed stages of problem solving. Therefore, the study sought to discover the nature (as well as the strength) of evidence for each hypothesis, in terms of which (all, some or none) of a range of potentially contributory variables provided support.

Variables

Variables may be grouped as follows:

(1) *Global/analytic cognitive style* in the form of: field dependence/independence and holist/serialist differences.
(2) *Problem stage*, classified in terms of: problem recognition; problem definition; problem resolution; solution statement.
(3) *State of personal or internal knowledge* in terms of: level of conceptual knowledge of the domain; specific knowledge or expertise of the problem; familiarity with the language or terminology used in the problem or domain.
(4) *Uncertainty* that: the researcher had recognized a real problem to investigate; the researcher had defined the problem appropriately; the problem could be resolved; an effective way of presenting the results could be found; relevant information was available and could

be found. Uncertainty is explored further in the second paper in this series (Wilson, Ford, Ellis, Foster & Spink, in press).

(5) *Complexity* of the search, as judged by the intermediary.

(6) *Definition* the degree to which the intended use of the information was well defined at the outset.

(7) *Desired comprehensiveness of the search*, in terms of the extent to which the researcher wanted a narrow search (in which a few representative items would suffice) or a comprehensive search (in which most if not all relevant items were desired).

(8) *Changes due to interaction* in terms of: level of changes in the information seeker's perception of the problem; changes in the question since the outset of the search; changes in personal knowledge of the specific problem at hand, due to the interaction and/or the feedback during the ongoing search; changes in criteria for relevance judgements due to the interaction and/or the feedback during the ongoing search.

(9) *Effectiveness of communication*, in terms of: the level of effectiveness of the information seeker's explanation to the searcher; the level of understanding by the information seeker of the search procedures being used by the intermediary; understanding by the intermediary of the information seeker's problem (as perceived by the information seeker); the effects (negative or positive) of the intermediary's nonverbal communication as perceived by the information seeker.

(10) *Clarity and focus of thought*. Participants were asked "How would you describe your thinking about the problem at this stage?" and to indicate their position between the two extremes "general or vague" and "clear or focused."

(11) *Ellis's information-seeking activities*. Participants were also asked to indicate their engagement in each of these are: chaining (following the chains of citations or other forms of referential connection between documents); browsing (semidirected searching in an area of potential interest); differentiating (distinguishing between different sources of information on the basis of the nature and quality of the material examined); maintaining (keeping awareness of developments in relation to the topic through the monitoring of particular sources); systematically working through (systematically examining a particular source to locate material of interest); and verifying (checking the accuracy of information).

(12) *Kuhlthau's stages*. Participants were asked to indicate which of the following stages they were currently at: initiation (having recognized that they needed infor-

TABLE 1. Number of participants by subject discipline.

	Number of participants	Percent
Humanities and "pure" social sciences	20	18%
Applied social sciences	40	36%
Pure science and medicine	23	20.7%
Engineering	28	25.2%
Total	111	100%

TABLE 2. Correlations with *Field dependence/independence* (Spearman).

Relative *field independent* users	Significance	Data relates to
Problem stage less advanced	−0.2245 $p < 0.05$	Reference interview
Change in problem perception (as judged by intermediary) higher	0.2115 $p < 0.05$	Postsearch interview
More engagement in Ellis' differentiating activity	0.2273 $p < 0.05$	Reference interview
Greater change in the search intermediary's perception of the problem	0.2251 $p < 0.05$	Postsearch interview
Greater change in the search intermediary's own perceived personal knowledge	0.3918 $p < 0.01$	Postsearch interview
Greater clarity/focus of thinking at this stage	0.2649 $p < 0.05$	Reference interview

Variables in the left column reflect the subjects' (as opposed to the searcher's) perceptions unless otherwise specified.

mation), selection (having identified the general area in which information is needed), exploration (identifying potentially useful information sources), collection (collecting specific information, having focused the problem), formulation (having formed a clearer focus on the problem on the basis of information found), or presentation (in the process of finishing the collection of information).

Data Analysis

Data were analyzed using SPSS for Windows (version 9). Correlations were sought between the independent variables relating to cognitive style, and the dependent variables relating to information-seeking and problem-solving behavior introduced above. A level of significance of $p < 0.05$ was adopted for this study.

Results

On hundred and eleven literature search topics were taken through to completion from the subject disciplines shown in Table 1. Age varied widely, from 22 to 76, with a mean value of 39. Forty-two (37.8%) of the participants were female, 69 (62.2%) male.

A number of statistically significant correlations were found. These are presented in Tables 2 and 3 below. Because the majority of the variables did not fit the Gaussian distribution, the nonparametric Spearman test was used.

Discussion

The findings relating to the hypotheses concerning field dependence/independence are shown in Table 4.

The finding that field-independent individuals report clearer, more focused thinking is in line with the greater

TABLE 3.   Correlations with Holist/Serialist learning style (Spearman).

Relatively *Holist* users	Significance	Data relates to
Fewer changes in the question (as judged by search intermediary)	0.2410 $p < 0.05$	Postsearch interview
	0.2819 $p < 0.05$	Followup interview
Higher value placed on serendipity		
More engagement in Kuhlthau's "exploring" activity	0.3059 $p < 0.01$	Reference interview
Poorer quality of explanation given to the intermediary	−0.2458 $p < 0.05$	Postsearch interview
Intermediary's perception of higher own understanding of the problem	0.2778 $p < 0.01$	Postsearch interview
Intermediary's perception of user's higher familiarity with domain language	0.2219 $p < 0.05$	Postsearch interview

Variables in the left column reflect the subjects' (as opposed to the searcher's) perceptions unless otherwise specified.

analytic competency associated with them in the research literature. The greater levels of change in perception of the problem and in own personal knowledge reported by the intermediary resulting from the interaction may also be at least circumstantial evidence of more analytic and clearer thinking on the part of the field-independent researcher when describing and explaining the problem to the intermediary.

The tendency of the more analytic field-independent researcher to perceive him/herself to be in an earlier problem-solving phase seems counter intuitive. However, if indeed the field-independent individual is likely to break a problem down early into its constituent parts, he or she may perceive more clearly the number of subtasks requiring attention before the problem can be solved. Thus, it is compatible with theory that field independent individuals should tend to perceive themselves at an earlier stage of problem solving (being more acutely aware of the complexity) than field-dependent individuals relative to the same time frame. It may be relevant in this context to note that most work relating field dependence/independence to behavior has used objective measures of ability as opposed to measures of perception as used here.

Conversely, the field-*dependent* individual may have a more fuzzy, less differentiated view of the problem to be solved. At a given point in time, he or she is less likely to be aware of a number of discrete stages of problem solving awaiting solution. Thus, arguably it may be that the field-dependent person perceives himself/herself to be less far away from the goal, possibly therefore, as at a less initial stage of problem solving.

There would seem to be some evidence to support the notion that field-independent individuals take a less passive, less reproductive approach to research than their field-dependent counterparts. They report more of Ellis's "engaged differentiating" activity, and the higher reported levels of change in perception of the problem are compatible with the more active transformational engagement with, and questioning of new information characteristic of the relatively field-independent person.

No evidence was found to support the hypotheses relating to uncertainty and serendipity. Results relating to the holist/serialist dimension of style are shown in Table 5.

The finding that holists reported greater valuing of serendipity, and greater current engagement in Kuhlthau's "exploring" stage, is in line with the notion of the holist's preference for, and greater competence in, engaging in relatively exploratory activity. Their greater valuing of serendipitous information encounters is also in line with theory in that holists are more likely to be open to indeed seek out such relatively unplanned encounters, in comparison with their serialist counterparts, who are more likely to prefer a more secure and predictable step by step approach. However, the finding that, according to the perception of the intermediary, holists exhibit fewer changes in their questioning does not seem to support the hypothesis, in that changes would seem particularly compatible with the notion of relatively speculative exploration.

It is acknowledged that the correlations reported above could have been at least partially due to the effects of other interacting but uncontrolled variables. Parametric tests including partial correlation and regression may be used to control for such intervening effects. However, they require that the relevant data conform to a Gaussian distribution.

TABLE 4.   Evidence supporting the hypotheses concerning field dependence/independence.

Hypotheses	Evidence
Field-independent individuals will be more analytic in their behavior	—Field-independent individuals report more clear/focused thinking —Greater change in intermediary's perception of the problem —Greater change in intermediary's own personal knowledge —*BUT* Field-independent individuals perceive themselves to be at a *less* advanced problem solving stage
Field-independent individuals will be more active in their behavior	—Field-independent individuals report more engagement in Ellis' "differentiating" activity —Greater change in perception of the problem
Field-independent individuals will display less uncertainty in their problem solving	—No evidence
Field-independent individuals will be more effective in interpersonal communication	—No evidence

TABLE 5. Evidence supporting the hypotheses concerning holist/serialist biases.

Hypotheses	Evidence
Holists will display more exploratory behavior	—Holists report more engagement in Kuhlthau's "exploring" activity
	—Holists report more valuing of serendipitous information encounters
	—BUT Fewer changes in questioning as perceived by the intermediary
Holists will desire a more comprehensive information search	—No evidence
Holists will employ more personalized and/or idiosyncratic forms of explanation	—Poorer explanation by holists of the problem perceived by the search intermediary
	—DESPITE Intermediary's perceived higher understanding of holists' problems AND Intermediary's perception of holists as having higher familiarity with domain language
Holists will report greater uncertainty in their problem solving	—No evidence

Because the data gathered for the analysis presented here did not display such a distribution, nonparametric tests that make no such assumptions about the data were applied, thus precluding further validity checking via partial correlations and regression.

Conclusions

The present study complements and extends other work linking cognitive styles with information behavior in that the analysis suggests a tentative mapping of stylistic differences on to a range of factors relating to researchers' problem solving activities, perceptions, and attitudes. A number of significant results have emerged that (a) are generally in accord with the picture emerging from other empirical studies reported in the literature, but (b) extend these studies in that they relate to an area that has not been widely investigated in terms of cognitive styles and other individual differences, namely the effects of literature searching during the academic research process.

It is acknowledged that the study also found a number of nonsignificant correlations. Although these by no means contradict the significant ones, they must be taken into account in any judgement of the strength of evidence in support (or otherwise) of the hypotheses. Of the two significant findings that were not in accord with the theoretical propositions, one could be explained in terms of a slightly more subtle interpretation of the theory that inspired the original hypothesis.

This was an exploratory study, and as such was designed to elicit what Olaisen (1991) has termed "sensitising" as opposed to "definitive" concepts, which:

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

The analyses presented here combine with those of a number of other studies to suggest coherent emerging patterns of interactions between cognitive styles and aspects of information behavior. But the evidence is suggestive rather than in any sense conclusive. Ford (2000) has described the nature of evidence to some extent characteristic of so called positivist and illuminative research approaches:

> The limitations associated with research may be thought of as a curtain preventing us from viewing the reality beyond, that we seek to understand. Our existing knowledge ranges between two extremes, which to some extent mirror . . . different research approaches . . . One may be characterised as scattered pinpricks in the curtain, allowing clear and deep, but narrow and unconnected views through to the reality beyond. The other may be characterised as more extensive areas where the curtain is thinned, allowing complex, inter connected but hazy shapes to show through, inviting us to trace them onto the curtain, elaborating their detail to represent what we imagine to be their reality.

The evidence of the study reported here is very much of the latter type. Nevertheless, such essentially sketched patterns may be useful in the development of models of information behavior that may eventually help us respond more effectively to people's information needs. Such responses may emerge in the form of improved information systems, quality of response by human information intermediaries, and/or helping end users enhance their own information-seeking skills. However, it would seem that the notion of cognitive style is likely to form an important building block in the development of such models.

Acknowledgments

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