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I. INTRODUCTION

“In today’s knowledge society, acquiring skills and abilities to find information will increasingly become a vital necessity, and the failure to acquire them will define a new type of illiteracy and alienation from society”¹

Document based hypermedia² environments such as the world wide web³, contain unparalleled amounts of information on any subject you care to choose. This ever-growing, complex, culturally multifarious on-line digital environment offers to a wider public, extraordinary opportunities to obtain information and to participate in global learning communities. Success in operating within this environment requires having effective information search strategies, knowing how to formulate these strategies, having favourable and user-friendly visual cues, knowledge and navigation tools and not becoming dispirited when seemingly reaching information dead-ends.

Education and training are increasingly dependent on this technology but there has been relatively little study within education on the specific methods and habits which different users employ to access and utilise the information, which, in principle, is accessible through these technologies. Many users seeking information from the Web find it a problematic exercise (Butler 2000). A great amount of software is written and many databases and websites are created without any consideration of what methods users, from a variety of learning and cultural environments, will really apply in using them, or on the assumption that users will employ the same strategies as the system designers use or think they do. There is a wide gap between the intended

¹ Monero, Fuentes & Sanchez :IEM 2000,1. 24-34

² Used interchangeably with the term hypertext (text not constrained to be linear) but includes other media such as video, graphics, sound etc.

³ A set of nodes (unit of information) interconnected by links: often the set of all the nodes which are interconnected.

and designed uses of ICT and the actual uses which are discovered or evolved by users themselves.

Software which encourages or frustrates particular types of information handling and information seeking strategies could lead to a differential take up in usage of the internet, exacerbating existing problems of social exclusion or disadvantage or creating new categories of exclusion.

There is a particular need for awareness of the problems that often occur when ICT use happens to coincide with a wider cultural transition for the individual, such as migration, moving from a structured school environment to more open higher education or directly to the labour market, returning to learning after work or unemployment or retraining to move from one economic sector to another. Difficulties often arise in accommodating to the predominant methods of information provision on the Web which can exacerbate feelings of incompetence rather than enhance confident use of new ICT tools and the development of universal digital literacy.

This project aims to develop a trans-nationally validated taxonomy of Information Seeking Behaviour, and will use this as a tool to carry out a census of the *Information Seeking Behaviours* (ISBs) of some those groups of ICT users which have been less well-studied in previous ISB research. As a result we may be able to indicate effective search strategy guidelines for educational software developers and ICT-based learning instructors to produce appropriate curricula and training content, which will assist in accelerating the integration of previously marginal or excluded groups into full use of ICTs and thus into the Information and Learning Society.

The background to this work is the competitive drive to move populations into the Information Society and, hopefully, the Knowledge Society. The political imperative for this was stated by the European Council when it hopefully determined that Europe must become:

“the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”⁴.

⁴ Lisbon March 2000 European Council Meeting

Such a process will involve not inconsiderable experimentation with new media and communication channels, with significant advantages for those societies which can generate the new information and communication technology systems and usages which will become the 'standard' modes for some decades.

The proliferation of new media must inevitably lead to the obsolescence of some of the old media. Governments, industries and standards bodies are therefore concerned to organise a number of transitions leading to the phasing out of analogue systems to be replaced by digital systems. At the same time they wish to achieve economies through the bundling of different media channels in broadband cabling.

It is therefore perceived as imperative that entire populations should be included in new media use, in order to prevent social exclusion, in order to keep the entire workforce in touch with new technologies, and in order to facilitate the transition from old media to new ones.

In this context citizens need to engage in a process of lifelong learning to acquire new skills and competencies in the context of a changing social, economic and technological environment. They need to maintain knowledge of markets, technology, education and training provision, law, and health and safety information on a daily basis. We might agree with Zuboff⁵ when he states ,

'To put it simply, learning is the new form of labour'.

This context creates the justification for adjusting the modalities of new media to the requirements and expectations of wider layers of potential users, even if these adjustments are only temporarily needed and will be superfluous for future generations of users who grow up using the media unproblematically. The optimisation of information seeking skills across a wider demographic becomes an important attribute both of an individual's technical

⁵ 1988 p.395 cited Marchionini 1995 p.1

skills and as a component of any system which claims to engender lifelong learning opportunities

Previous emphasis on investigation of the information seeking behaviours (ISBs) of students (Given 2000), indicates a tendency to concentrate on precisely bodies of students that fulfil the paradigm of school-leavers entering an institution of higher education, which completely determined their way of life for a number of years and which constitutes them as 'students', not merely as individuals but as bearers of a closed way of life which is often the dominant mode of life in university-dominated cities and quarters. Given contrasts this with the stated aim and expectation of governments that entire populations, including those active in work and in child-raising, should be involved in, '*lifelong learning*'. This has implications for the learners' needs and practices in ISB, both in terms of their economy of time and their estimation of the value of the activities in which they are involved.

This project is attempting to begin the process of developing guidelines for the development of ICT-based learning systems which will accelerate the integration of previously less-integrated and less-researched user groups. We aim to do this by observing their ICT-use behaviour, specifically Information Seeking Behaviour.

The first generations of Information and Communication technologies had a restricted range of hardware and software capabilities. 'Information Retrieval' was largely a technical topic, concerned with questions such as the relative speed of accessibility of different forms of data storage. As the amount of data available in '*cyberspace*⁶ has burgeoned, tools have been produced to select the data 'retrieved' in accordance with increasingly sophisticated specifications. These tools work either on the content of files, or

⁶ The "electronic" world as perceived on a computer screen- a term often used in opposition to the "real"world

increasingly also on the external information which files contain in their 'labels' or tags.

Research on the way in which users take advantage of the possibilities of Information Seeking has generally been centred on the use made of the latest most sophisticated forms of tools, and has therefore been concentrated on those groups of users who have most facility and access opportunity in using them, generally experienced professionals and students, or to some extent on those groups of school children who have been exposed to computer use at an early stage of their education. There has been little research on the behaviour of older, or less experienced users precisely because these groups were until recently unlikely to gain or require exposure to sophisticated searching tools unless it was as part of a process of learning to use ICTs in their profession.

The spread of the Web into private households and the potential for using the Web as an inexpensive and speedy medium for the dissemination of both public and commercial information, with a built-in, cheap and accessible form of feedback from the users, means that the professional needs of adults are no longer paramount in determining their degree of exposure to ICTs. This process, in itself, would justify investigation of the ISBs of older users being brought in the use of ICTs through the Web.

A wider issue arises when it is considered that the Information Society must also be a Learning Society. The Web exemplifies the breaking down of the barriers between the world of work and the world of learning foreseen under the rubric of 'Lifelong Learning'. When seeking information on the Web, the individual user does not simply 'access' and 'retrieve' a given body of information. The multiple ways in which information can be selected means that each individual, starting from the same given problem, will produce a unique outcome.

The outcome achieved by any individual will depend partly on the information 'in principle' accessible to them, partly on the particular tools which they may use, but also on their own prior knowledge, cultural formation and

learning experiences, which will influence them towards acceptance of different levels of outcome. At the same time it will be relevant to what degree they experience Web use either as a simply technical exercise, to be single-mindedly pursued, or as itself a potential learning experience. In the latter case, information incidentally encountered while Information Searching on a given topic may change their priorities or goals, leading to a re-assessment of their original intentions.

The foregoing points are equally true of persons of any age and under a wide range of circumstances and learning patrimonies. It is, nevertheless, the case that little work has been done on the potential effects of these processes outside the core group of scientific, academic and educational users of the Web. In particular there has been no research which sets itself the goal of finding positive, rather than merely negative, hindering, influences, in the previous life-experience of new users of ICTs and the Web. There is a danger that the pattern, often found in the 'induction' of individuals from pre-industrial or pre-informational contexts in to new skills, will be repeated, namely to treat such individuals as at best a 'tabula rasa' and to ignore the positive effects of transfer of existing skills and knowledge into a new context.

We feel it would be useful to proceed on the assumption that Information Seeking can be seen and determined within the wider context of Human Problem Solving⁷ activities and that work on ISBs should contribute to a Unified Theory of Cognition⁸. This means that, while the work will proceed on a simple level within a specific field, we will be aware of the implications of a wider problematic and of how our results could contribute to wider questions and problematics.

In this procedure, we will be following in the footsteps of researchers such as Marchionini and Wilson, who have found that research on ICT-based Information Seeking Behaviour, while beginning from the '*nuts and bolts*' of the possibilities offered by the technologies and therefore from Information

⁷ see Newell & Simon 1972

⁸ see Newell 1990

Retrieval science, must integrate considerations of the mental models, experiences, abilities and preferences of users⁹.

This would seem to be particularly relevant if we are to contribute to integrating older population groups into ICT-use with all of the implications for access to e-commerce, e-governance, e-democracy and e-learning.

In a series of studies of Information Seeking among students, Marchionini found that older learners, compared to younger ones, were more successful in a shorter time despite less expert use of query formulation and refinement, basically because their heuristics¹⁰ of examination and evaluation of the information was superior. From a study directly comparing use of paper and on-line encyclopaedias, he concluded:

"Information Seekers must be guided in adapting their mental models of manual systems if they are to take full advantage of the features of electronic systems"¹¹

Starting from the most basic findings of cognitive science that ,

"past experience can help in tasks that are similar to the past, it can hinder when novel tasks come along"¹²

we can draw the conclusion that part of the problem is helping users to identify analogies between old and new when they are valid and transfer of existing mental models is appropriate, as much as to emphasise the genuinely new where old models are not valuable.

This suggests that we should not merely attempt to integrate older users into ICT-use, but that we should specifically aim to help them to carry over their stock of experience and expertise into this new context. We should be looking for examples of ICT-use, particularly within the area of ISBs, which

⁹ see Marchionini 1995 p.33.

¹⁰ taken in this context to mean skills learnt from wider past experience

¹¹ Marchionini 1995 pp.92-93

¹² Newell & Simon pp.136-137

facilitate the integration of valuable domain expertise and heuristics of older users and enable them to exploit their fund of knowledge in the evaluation and rapid assimilation of the results of Information Searching.

In this context, the report will begin with an overview of the SEEKS project, its proposed stages, methodologies, outcomes, and products. We will then examine the most widely accepted models of Information Behaviour and the taxonomies of ISBs which they propose, in order to decide which will be taken as the framework for our work. In the course of this discussion, we can identify both the strengths of the proposed model, and the weaknesses, or, from the point of view of our research, the open questions which must be addressed.

Drawing on the results of this process, we will discuss the problems of distinguishing between those sources of different patterns of ISB behaviour which are extraneous to our purpose, and the results of which should therefore be filtered out of our results, and those which identify specific characteristics of those groups of users and learners with whom we are concerned.

While we should have no illusions about the practical difficulties of separating these factors, either statistically or impressionistically, we should consider it necessary to make ourselves and others aware of the factors which we expect to have an influence on our observations. Final sections will discuss the implications of the foregoing for the taxonomy, census and guidelines to be developed.

2. AIMS, METHODS, AND PRODUCTS

The over-arching objective of the project is to elucidate the need for recognition of previously unidentified differences in Information Seeking Behaviours, and to offer guidelines to instructors and developers of educational software, educational websites and portals offering pathways into education and training which take into account different information-seeking behaviour in varied learning environments with differing resources in culturally diverse settings.

Most of the previous work in this area derives from Information Science, specifically from Information Retrieval, and has often been concerned with achieving a model for a single information-seeking event. There has been little cross-over into application of use within education where a repertoire of information-seeking activities is often in operation. We are interested in capturing data concerning the information-seeking behaviour of users beyond the groups of established professional ICT-users. It is clear that the actual practices and attitudes of these individuals may be influenced by their experiences in using ICT-based resources for any purpose. While we can concentrate our observation on ICT-use within defined contexts, we are of the view that the behaviour being observed may have been influenced by experience in different information-need contexts and by the effect of different learning patrimonies. For this purpose we are concerned with the development of taxonomy of ICT related information-seeking behaviour among adults in formal and informal distributed learning environments.

During the initial period of the project, the purpose, within our work plan, of the open research review, will in part attempt to extract a viable *beginning* framework for a general model of information-seeking behaviour from which we can build our own taxonomy and glossary of information-

seeking behaviour. It is essential to understand that this review is on-going and will be amended and added to during the progress of the project.

The methodology we are following for involves gathering information from searches of library holdings, EU databases on ongoing research, literatures of regulatory, industrial and professional bodies and keyword searches. Practitioners are being asked about the level of awareness of and implementations of existing guidelines for courseware development and what kinds of information would be useful and have a real effect on developers: projects registered within the European Survey of the Information Society are also being circulated for this purpose. Correlation of this ongoing data and analysis of models of information-seeking behaviours has lead us to a number of variables which we consider may be the useful fundamentals of the emerging SEEKS model for a taxonomy which will inform the empirical data and later the guidelines for developers, teachers and instructors. These are briefly –

- context of information need,
- activation levels determined by stress/coping strategies, intervening variables of the information-seeking situation,
- the feedback into activation levels from risk/reward factors in the resultant information-seeking situation and arising from the learning process.

The most basic components within the information-seeking taxonomy which can currently be specified are related to patterns of

- starting,
- chaining,
- browsing,
- differentiating,
- monitoring,
- extracting,
- verifying,
- ending.

The method adopted for the research review is to maintain it as an open discussion area between the partners until month 12 of the project when a structured reported output will be published.

The methodology for deriving the taxonomy and consequent glossary of terms is based on evaluation of search engines and software specific interfaces to see what type of information behaviour is implicit in the design. The value of selected existing taxonomies is currently evaluated by observation among learners in a variety of individual and group project work situations in the five partner countries. The adjustment of the taxonomy will be iterative in order to achieve a metric of assignment of behaviours to the categories and grades which will constitute the SEEKS taxonomy, and this process will proceed through the period of the Census.

The methodology adopted for the Census is based on observation of groups of not less than 5 and not more than 15 users in each of the partner countries in their use of information using the internet, a specific e-learning system, or a CD-ROM based encyclopaedia.

The current context of the users would not be a restrictive factor and they could be observed within formal, non formal or informal learning environments. Cases will be examined in five countries and will be drawn from adults as learners in adult education, tertiary level students in the social sciences with low IT skills, teachers in primary and secondary education with low IT skills, women returners to the labour market and ethnic minority adults attending voluntary basic IT Skills courses.

A generic scenario will be followed in all transnational cases of working through three kinds of seeking tasks:

1.	to find a factual answer to a specific question
2.	to assemble a list of possible alternatives for subsequent choice (this

	could involve lists of possible purchases, jobs, accommodation offers, holidays, training courses)
3.	to assemble material to solve a problem such as a medical or household emergency.

As resources available for these tasks are grossly different within different national languages the *seeking tasks* will be customised to be do-able within the resources available. The preliminary stages would be deliberately impressionistic observation of users to discover if the basic components of the taxonomy display glaring omissions or inaccuracies. Beyond this stage, collection of data will be effected, where appropriate and feasible, by direct observation, web-cam recording, software registration of user behaviour, user interviews and questionnaires and mediator interviews and questionnaires.

The Census should highlight any indications of national differences which might be the result of different learning patrimonies, whilst attempting to correct for ephemeral factors such as different levels of technological delivery systems and intermediate factors, which might be the limited amount of cyber-space data available to smaller language communities.

3. INFORMATION SEEKING AND INFORMATION SEEKING BEHAVIOUR

Research on Information Seeking Behaviour, as we have noted, began by treating its subject as the converse of Information Retrieval. We mean by this, that among the options for accessing data which were available, it studied the take-up and success of different patterns of use. As the amount and variety of data and of search systems proliferated, this approach became outdated. We take up the subject as it has developed in the last two decades, during which there has been wide-scale acceptance of the need to contextualise Information Seeking research in a wider picture of the user's needs and actions.

Marchionini¹³ has situated Information Seeking within the context of Learning activities. Within the wider context of Information Seeking, he identifies Information Retrieval (relative to a particular source) as breaking down into Analytical Strategies and Browsing Strategies. His presentation suggests that these categories should not be seen as linear steps but as areas each of which remains in continuous interaction. He later maps these strategies onto a series of dichotomies:

ANALYTICAL STRATEGIES	BROWSING STRATEGIES
Planned	Opportunistic
Goal Driven	Data Driven
Deterministic	Heuristics
Formal	Informal
Discrete	Continuous

¹³ 1995 p.9

This does not mean that heuristics play no role in analytical strategies, but that they are more relevant before and after the execution, during planning and evaluation, whereas in browsing strategies they play a continuous role in guiding the process.

Marchionini identifies the elements of ISB as

- the Problem (which itself is seen as arising from Needs),
- the Task,
- the System ,and
- the Outcome.

He proceeds to state that each set of these elements may or may not require access to more than one domain.

This raises the question of the transferability of IS skills between domains, and whether obstacles to such transferability arise on the side of the System or on the side of the person¹⁴. Marchionini later draws the conclusion that domain expertise and system characteristics are more important for successful outcomes than ICT knowledge, suggesting that so long as the system is not a source of positive frustration, basic ICT moves are adequate for individuals who are able to autonomously evaluate the information provided and seek appropriate levels of information depth.

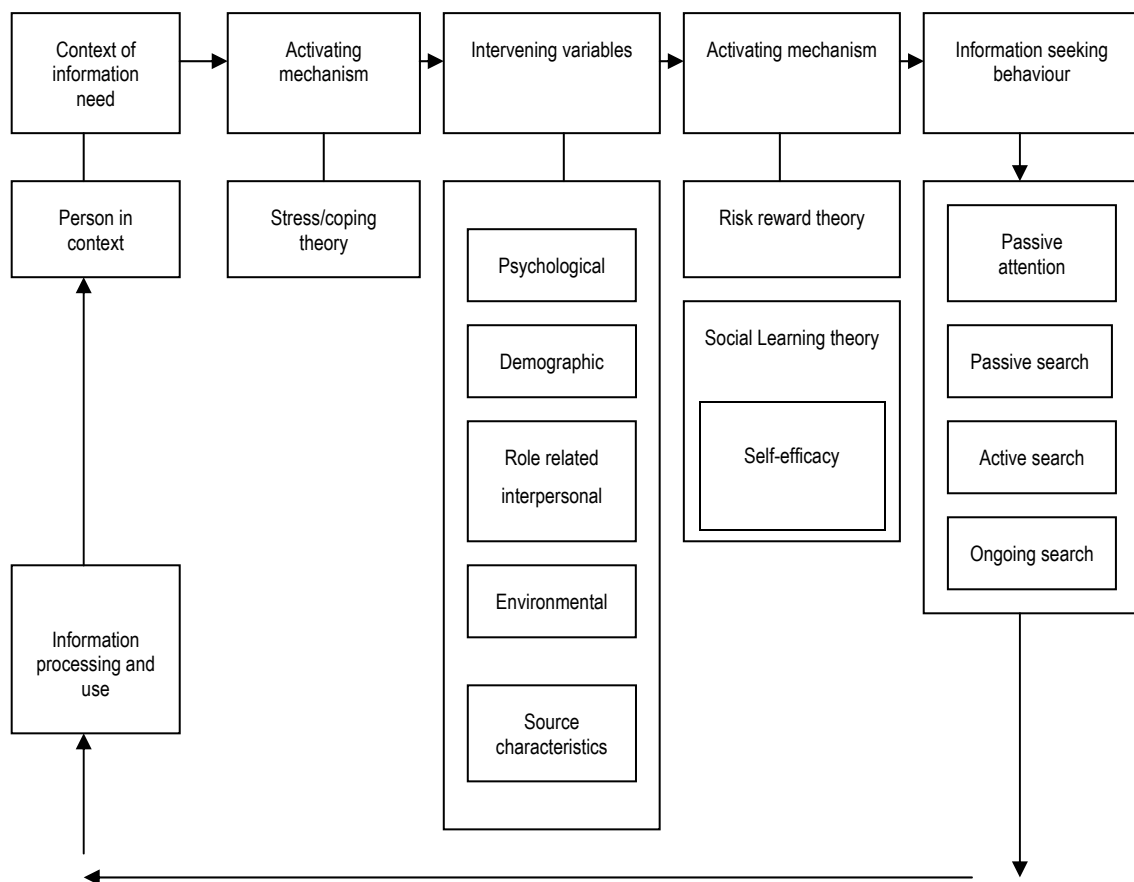
Wilson's Model of Information Seeking.

F.N. Wilson¹⁵ developed a model of Information Seeking which encompassed the loop from information need to information need satisfaction. Drawing on a model first proposed in an earlier work (1981), Wilson proposed changes based on subsequent research which led to a 'revised general model of information behaviour'.

¹⁴ Marchionini and Komlodi, (1998 p.94) attribute a system of four components Task, User, Terminal, Content to Bennett (1972) while suggesting that '*most researchers would add a context component*'.

¹⁵ In a report to the British Library Research and Innovation Centre (1996),

WILSON'S MODEL OF INFORMATION BEHAVIOUR (1996)



Using this model, the 'taxonomy' of ISBs which we intend to establish will fill out the right-hand box in greater detail than that presented by Wilson. On the other hand, the 'census' which we will initiate should produce data on the relative presence of particular ISBs among different national user groups.

In Wilson's model, the final mix of ISBs will be determined by a number of processes or contexts, which are the content of the first four columns of the loop:

- context of need;
- activation levels determined by stress/coping strategies;
- intervening variables of the situation;
- the feedback into activation levels from risk/reward factors in the resultant situation and arising from the learning process.

In our model, we would look for national differences which might be the result of different learning patrimonies while attempting to correct for ephemeral factors such as different levels of technological delivery systems. Intermediate factors might be the limited amount of cyber-space data available to smaller language communities.

In view of the time constraints on the project, it seems worthwhile to adopt the latest version of the Wilson model as our basic framework model of information seeking and information seeking behaviours. We will be able to test this model and consider the need for amendments.

The model is not claimed to be completed, so there is scope for simple addition of further factors within the categories of intervening variables and information seeking behaviour. It will be a problem, but hopefully a useful and fruitful problem, to investigate possible national differences in the working out of the information need context, the stress and coping mechanisms and the risk/reward and learning theory aspects of the model. If the SEEKS project is unable to situate its findings within the context of this model this would in itself be a valuable outcome.

4. THE WILSON MODEL IN DETAIL

In this section we will look examine the Wilson in detail. If we decide to use the Wilson model as the basis for our taxonomy of information seeking behaviour, then we must be clear where the various factors which we wish to investigate fit into the Wilson schema. Deciding these issues will help us to formulate our own ideas, and conversely if we find that some of the issues with which we are concerned do not easily fit into Wilson's model, then we must consider whether this arises from a defect of Wilson's reasoning or from a basic divergence in our purpose and approach.

The Wilson model grew out of information science concerns. In its first stages it was quite close to being a model of ICT-based information retrieval, but it has gradually been supplemented by modules concerning the prior internal state of the user and the way in which the user's processing of information gained, feeds back into subsequent search behaviour.

We might begin by discussing each of the stages of his model and attempting to identify those factors which we had *naively* identified as relevant to us which could be assigned to this area of his model.

We should structure our discussion around his final schematic diagram, whilst bearing in mind that some of the components of this were originally discussed by him in a different order, since his final schema only emerges in the course of his discussion.

(a) CONTEXT OF INFORMATION NEED.

Wilson begins by stating that information may be required for the gratification of a number of different needs, which he specifies as:

- **Diversion** (escapism, emotional release);
- **Personal Relationships** (companionship, social utility);
- **Personal Identity** (comparison with life, reality exploration, value reinforcement).

He does not proceed to develop this point further. However, from our point of view it is immediately apparent that we can draw a number of conclusions as we are interested in capturing data concerning the information-seeking of users beyond the groups of established professional ICT-users. It is clear that the actual practices and attitudes of these individuals may be influenced by their experiences in using ICT-based resources for any purpose. We can concentrate our observation on ICT-use within defined contexts but we should bear in mind that the information seeking we are observing may have been influenced by experience in different information-need contexts.

Wilson continues to specify categories of information need. He distinguishes three kinds of need:

- for new information;
- for elucidation of existing information;
- for confirmation of existing information.

He adds to this a parallel set of needs for elucidation and confirmation of existing values and beliefs (in passing it might be noted that for some reason he seems to suppose that everyone already has as many values and beliefs as they need, and that they know this).

He then proceeds to a different topic, the '*mode of questioning*', and uses the distinctions between questions relating to 'orientation', 'reorientation' and 'construction' within the cognitive process. He further adds the distinction of 'extension' - questions to build one's knowledge of a subject. We can welcome these distinctions and categories. **The methodological problem seems to be how many of such distinctions are usefully situated in this module of**

the model. Some of the topics touched on here may seem to be closely parallel to the classifications of sub-processes within the information searching behaviour itself. In placing these kinds of questions within the 'context' box, Wilson may be constrained by the historical origin of the model as a list of add-ons to a model of a single run of an information search.

When investigating real behaviour, we may need to use several of these distinctions within a single cascade of information behaviour. So we may find that the internal structure of the right hand column, the information seeking behaviours themselves, will duplicate much of the structure which has been proposed for one of the external stages of the loop. But this structural mirroring may be acceptable. It must be decided after full consideration of the rest of the model.

The following considerations presume various restrictions on the kind of information seeking considered relevant within the SEEKS project. Essentially this means that we are looking at information seeking by individuals within the contexts of personal need, whether this is in an educational context or in the context of e-commerce, e-government, e-democracy, health care, leisure, emergencies, etc. We would want our work to contribute to, *knowledge on the transferability of information skills between these areas*¹⁶.

The top level of information seeking may be taken to be constituted

¹⁶ We may not be looking directly at ISB within employment, although we will have to control for the individual's familiarity with ICTS within employment.

by a definition of the nature of the information sought. One useful way of beginning such a classification would be by scope of information required. One parameter of scope could be as follows:

- To find a factual answer to a specific question. This could be a yes/no answer or a specific fact which has been asked for.
- To assemble a list of possible alternatives for subsequent choice. This could involve lists of possible purchases, jobs, accommodation offers, holidays, training courses etc.
- To assemble material to solve a problem such as a medical or household emergency.
- To assemble material to support a case in a dispute.
- To acquire the essential background knowledge of a given field of knowledge.

In each of these cases, further specifications of the task could involve the level of resources and time to be devoted to the task and/or the degree of reliability to be assigned to the information produced.

The next level of information seeking is determined by the type of resources available. The first question is whether only one source of information is available i.e., the whole web, a specific learning system or a CD-ROM based encyclopaedia, and in each case whether there is also access to non-ICT based resources. Allowing for those characteristics of information seeking which are determined by the nature of the task or by the resources available, we reach the level of information seeking approaches which may be the result of inherent personal preferences and habits, previous learning experiences or reaction to the constraints and possibilities of the media used.

(b) ACTIVATION MECHANISM : STRESS & COPING

The stress and coping referred to here is not the stress and coping

with use of ICTs or other information sources. The reference is to a much earlier stage namely, whether the person is stressed by or coping with their total situation in the context of their existing state of knowledge concerning a particular subject. Basically, if they are 'coping', they have an existing knowledge base within which they can accommodate new knowledge and they will therefore be motivated to acquire new knowledge, whereas if they are 'stressed', then new knowledge may be unwelcome since it would increase the uncertainty which they already have concerning the value of their existing knowledge. A '*stressed*' person will therefore either avoid or ignore sources of information which would overload their 'coping' mechanisms.

This factor is very relevant wherever ICT use happens to coincide with a wider cultural transition for the individual, such as:

- migration;
- transition from structured school environments to more open higher study;
- return to learning after work or unemployment;
- retraining to move from one economic sector to another, etc.

All such transitions may be associated with information overload and cultural dissonance and may be exogenous sources of stress for the information seeking of precisely the kind of individuals with whom we are concerned.

(c): INTERVENING VARIABLES.

This unit of the model is called, 'intervening variables', but it seems to have grown out of a simpler version of the Wilson model in which this element was simply called 'barriers' and several of the variables discussed are still called 'barriers'. Wilson is aware of the

problem with accommodating the different elements of the model in a linear progression, and points out that some of the 'barriers' may already have been relevant in preventing individuals from achieving a 'coping' strategy. Wilson lists the following variables as relevant:

- Personal;
- Emotional;
- Educational;
- Demographic;
- Social and Interpersonal;
- Environmental, Economic;
- Source Characteristics.

It can be seen that many of these 'variables' or 'barriers' are identical with many of the factors which we hoped we might be able to identify as causes or correlative factors with different kinds and modes of information seeking, and conversely with some of the factors which we thought we would need to factor out or remove. (Source Characteristics).

Wilson discusses various sub-categories of intervening variables but it is clear that these are exemplary rather than exhaustive. For instance his discussion of Personal Characteristics seems to be largely based on data concerning health care information, while his discussion of Economic Variables largely discusses the supposed cost/benefit analysis of consumer market search. We need to return to his classification when we review our own list of the variables and barriers relevant to our research. Methodologically, the same caveat may be raised as with the previous section, because Wilson's discussion of Information Source Characteristics, with the (presumably non-exhaustive) headings Access, Credibility, and

Channel of Communication, concerns many factors which will necessarily reappear within the module of 'Information Processing and Use' and may even reappear within more complex versions of the information seeking process itself.

There may be some effects of the personal characteristics of users which are specific to the novice ICT user situation and which should be seen as temporary problems to be overcome during the learning process. Other personal differences in the use of ICTs may be more persistent and information source structures and interfaces should therefore be designed to take these into account and accommodate the information seeking which they produce. This is why it is necessary to capture and analyse the information seeking of those population groups which have previously been less researched. Persistent findings of different patterns of ICT use among older users and other groups of currently lower use should be the basis for designing systems to accommodate the expectations of these groups if their integration within the Information Society is to be accelerated.

The other set of factors dealt with under Intervening Variables is that of Source Characteristics. The relevance of these factors for us is primarily methodological, because we should not be misled into identifying as patterns of use of particular groups, information seeking approaches which are actually constrained by the technology, software or interface. For this reason we need to identify a taxonomy of interfaces and system usability which will allow us to adjust for the ways in which user behaviours and decisions may be constrained and formed by the system in use.

(d): ACTIVATION MECHANISM: RISK/REWARD THEORY

Using a wide contextual background of theory concerning the risk/reward balance in undertaking any action or enterprise, Wilson narrows down quite rapidly to the question of whether a particular

information search is perceived as likely to succeed or fail in the context of the effect of success or failure in confirming or disconfirming the individual's view of themselves as competent or incompetent.

Whereas in the first level of activation, 'coping' was concerned with the effect of acquiring new information, here 'coping' refers to the individuals' ability to undergo experience of instrumental failure without feeling threatened in their 'self-efficacy'. Wilson takes up the work of Bandura, which developed the theory of 'self-efficacy' in a psychotherapeutic context, and argues that it has more general applicability. He reports that,

"Bandura notes that efficacy expectations can be based on four major sources of information: performance achievements ...; vicarious experience (or learning from others); verbal persuasion (which may include self-instruction); and physiological states, particularly emotional arousal."

(Cited Section 5.3).

There are clear implications in the project for the relevance of pedagogic interventions and/or the structure of learning environments on these factors. In the guidelines to be produced it would be possible to develop the positive implications of the lessons learnt concerning the value of pedagogic interventions and other forms of learning process in widening users' patterns of ISB. However, from a methodological point of view the initial relevance of capturing these factors would be to allow us to adjust for the possible effects of different learning contexts and experiences so that the spread of information seeking observed would not mistakenly be classified as the result of unchanging personal characteristics.

(e) : INFORMATION SEEKING BEHAVIOUR

Wilson draws the conclusion that it is necessary to build a model which accepts that information does not only arise from 'active searching'. He proposes to distinguish four modes of information seeking behaviour:

- Passive Attention, in which the individual is attuned to absorb information relevant to a particular problem from randomly experienced sources;
- Passive Search, which he accepts is a clumsy phrase, but which he intends to cover the discovery of information relevant to one problem while actively investigating another one;
- Active Search, the paradigmatic active seeking of the answer to a given question;
- Ongoing Search, the updating of the individual's knowledge of the state of the art or the market.

The 1996 model proposed by Wilson should not be seen as a simple replacement for that which he proposed in 1981. Rather the 1996 model must be understood as including the distinctions between Information System use (i.e. ICT-based), other Information Resource use, and Information Exchange with other people, as different modalities within the right-hand column of Information-Seeking Behaviour.

Although it is not made explicit in the diagram, Wilson includes in the text chapter on this module, discussion of the 'Preferred Information Sources and Channels', so that choice of source is clearly seen as part of this module. This will be relevant for us if we are able to extend our research to investigate the choices made between using web-based and non-web-based resources, which would be

particularly important in the context of contributing to overcoming the barriers to ICT use among previous non-user population groups (of course, this is a dynamic process within which access to information exchange, namely information about the Information Systems themselves, may actually increase Information System use by removing sources of frustration due to lack of success).

At this point we need to return to Wilson's diagram of his previous model (reproduced in 1996 chapter 2) to fill in the precise content of the 'Active Search' component, which is here taken for granted.

The information seeking behaviour which he reports is taken over from Ellis he specifies as:

- Starting,
- Chaining,
- Browsing,
- Differentiating,
- Monitoring,
- Extracting,
- Verifying,
- Ending,

This is a basic 'taxonomy' of information seeking, which we could supplement by the subsequent classifications of Kuhlthau (1992), and further specified and used in a research context similar to our own by Choo, Detlor and Turnbull 1999.

Unfortunately, the models of Wilson and Kuhlthau appear to cross over the barrier between 'searching' and 'processing and use' as presented in Wilson's model¹⁷. Here again, in terms of utilising Wilson's model we face the methodological difficulty that the entire

¹⁷ See Hayden Information Seeking Models EDCI 701

construction appears to be built around the 'bottleneck' of the single information searching event understood as an information retrieval algorithm. Wilson's attempt to include a wider range of factors leads to the result that it is no longer obvious what level of iteration of ISBs and what level of feedback looping and cascading within the 'information-seeking' module counts as a single event.

However, these problems are acknowledged in Spink, Wilson et al. 1998, which outlines programme of future work concerned precisely with the 'modelling of users' successive searches'. Another project by Spink, Bateman, & Jansen (1998) proposed some changes in interface design on the basis of investigation of users' iterative searches and reflexive learning, suggesting both pre-editing prompts in the design of Boolean searches, and an immediately available record of user's past searches for consultation. Some of these features have since appeared in generally current interfaces, e.g. a drop-down menu of recent search items, with the ability to re-select and re-run or re-edit previous searches.

Within the project we would want to construct a taxonomy of information seeking which can easily be mapped onto those in general currency. Any resultant guidelines cannot be easily assimilated and effected unless they connect with the established structures of discourse and analysis in this area. The lowest level of any taxonomy of information seeking within ICT will necessarily consist of the pre-given 'atoms' of what operations it is possible to do with the software, although we should bear in mind that not all possibilities may have been envisaged and described by the developers. It is the higher levels of integration of these 'moves' into tactics, strategies, and patterns¹⁸ which will produce interesting variations in information seeking between individuals and possible groups. (although this may find expression in different patterns of 'moves'). It is particularly at these levels that we may expect to see

¹⁸ see Marchionini 1995 pp.71-75

the influence of heuristics and habits from other domains of life carried over into ICT use with positive or negative effects on the efficacy of this use.

(f): INFORMATION PROCESSING & USE

Wilson reports that Information Use was and is still under-researched. His discussion of the topic in Wilson 1996, presupposes the context of medical information in an institutional context. It is therefore largely concerned with the effect of innovation and the resistances to innovation within such a context. Relevant for this project are the cognitive learning effects which he describes in terms of the individual. However, it is precisely here he encounters the problem that there is no clear distinction to be made between the individual's learning, arising from the content encountered, i.e., the explicit answer to the original question or problem, and the learning arising from the information-seeking process itself and from peripheral information encountered during it.

He is aware that individuals will both consciously and unconsciously adjust their values and beliefs and their model of the world in reaction to the information-seeking experience and its outcomes, but there is no discussion of the extent to which these effects take place during the information seeking processes themselves and have effects within them rather than simply being observable as subsequent outcomes.

The project will be observing behaviour within a number of pre-given and relatively artificial contexts of information need. We should consider the possibility of carrying the observations through into a phase of off-ICT information use. One possibility to achieve this within the constraints of the project could be a trans-national exchange of information between the user groups which have worked on the same scenarios.

To economise our own efforts, to present our results in an easily comparable and transferable form, and to make a contribution to an ongoing process of elucidation of information seeking we should try to use the model of ISB proposed by Wilson while being aware of the problems identified. We should be particularly aware of the need to specify what we consider as a single information seeking 'event' or whether we need to conceptualise the different modules proposed by Wilson as operating in parallel rather than in the linear loop which he illustrates in his diagram. We should not do this in a vacuum but should try to open dialogue with Wilson and other researchers active in the field.

5. "INTERVENING VARIABLES" AND THEIR PLACING IN THE MODEL:

Among the aims of the project is to tabulate and census individual information-seeking styles, and to make recommendations on the design of delivery systems based on the assumption that software should accommodate as many different styles as possible. One consideration is to ensure that different information processing styles are not constrained by the partial, biased, or simply inadequate design of the systems. At the same time, we will be attempting to identify and correct for various influences from previous learning effects.

The following constraining factors on information seeking should be assigned to suitable sites on the overall Information Behaviour model adopted. The suggested categorisation is provisional, since there are some factors which are 'purely' personal or technologically determined, while some characteristics of the source may already be the result of the developers' understanding of an attempts at adaptation to or modification of user characteristics and behaviours.

a) Literacy.

Literacy is of relevance on two levels. On the simplest level it is relevant whether systems provide information in verbal-symbolic or graphic form. This may be true irrespective of the level of user literacy, since excessive use of small text may cause eye fatigue etc. But achievement of levels of literacy may in any case disguise a distinction between 'oral' and 'literate' brain functioning. This relates to whether individuals are primarily oriented to absorb information through the flow of spoken language, with the possibility of several different streams being heard and processed simultaneously, but with a time window through which all data must pass, or to scanning data on a surface, with the features of mono vocality and reduced redundancy, but with the potential to move back and forth and to summate the likely information value before committing to deep analysis.

A further question would involve distinguishing between resources which aim to be primarily 'libraries', i.e. which provide mainly literary sources, as

opposed to those which aim to be 'museums', displaying artefacts and images.

The question of 'literacy' in approach thus relates to both the navigational access systems and the nature of the content of information sources.

A sub-topic within this area, would be the distinction between three different methods of labelling: purely verbal-symbolic (script), purely graphic (abstract), and iconic (using graphics which are or become familiar named objects).

A more sceptical view suggests that many of the supposed effects of literacy can be ascribed to more general influences of modern, especially urban, life. Research which factors out formal schooling and urban residence has found little residual distinction between literate and illiterate individuals in logical and classificatory thinking. It is not clear how this work¹⁹ which 'replicated' but disconfirmed that of Luria (1976), relates to the questions of learning and information access which concern us in this project. Rubin (1995) reported research which indicates that 'literacy' is actually composed of a number of independent skills, e.g., training in remembering numbers does not carry over into remembering letters. We might therefore expect that 'literate' skills are granular in their value for ICT-based information seeking, and that there is no simple profile of a 'literate' ICT user produced by averaging out all the various sub-skills of literacy.

The discourse of orality and literacy achieved public notoriety through the highly contested work of Marshall McLuhan 1962 and 1964, later formulations McLuhan & McLuhan 1988, McLuhan & Powers 1989. Wider scholarly recognition has been accorded to the work of Ong 1982. The application of the concept to learning theory has been primarily associated with the work and school of Olson, e.g. Olson 1994, Olson & Torrance 1991, 1996a, 1996b, 2001, and Astington 2000. A different approach within pedagogic theory is found in Illich & Sanders 1988. Heim 1993 suggested that hypertext would create a new kind of literacy and have profound effects on thought habits. A sceptical discussion of these possibilities is Dreyfus 2001. A different

¹⁹ mainly Scribner and Cole

approach to the 'constructionist' perspectives of computer-based learning is found in Papert 1980 & 1993.

b) Gender differences.

There is a large body of accepted evidence that there are cognitive differences leading to path-dependent choices of further developmental pathways as a result of gender-biased differences in the relative strength of verbal and non-verbal cognition, spatial cognition, and related areas of short and long-term memory.

An obvious application of this to software systems is the relative balance of verbal and non-verbal information provided. Another is related to whether individuals experience cyber-'space' as a real space and if so of what kind. There is evidence that the male-structured brain interprets space geometrically, tending towards the production of abstract maps, while the female-structured brain prefers to use narrative or verbalised pathways, i.e. named landmarks to orient within a space. If software systems attempt to simulate real 'space', then there is a danger that the space created will be predominantly of one or the other kind. Ideally it should accommodate both styles (which is equivalent to a cyber-space 'mapping' of two or more configured spaces)

The basic summaries of research on the biological basis of sex difference in cognition are Halpern 1992 and Kimura 1999. Both authors are active researchers in the field, Halpern from cognitive psychology perspective and Kimura from a neurological perspective.

c) Tacit Knowledge.

This is taken to refer to the way in which human beings mutually adjust complexes of mental and physical processes and artifactual tools to sensitise themselves to the relevant variables in recurrent, but often highly contextualised processes. It is related to context-dependent memory but also encompasses physical habituations. Tacit Knowledge is a topic in the literature of transferability of skills but also in the pedagogic literature on the

'hidden agendas' of teaching. It is also related to the theme of implicit learning, although tacit knowledge is not necessarily acquired implicitly but may be learnt explicitly up to a point and subsequently become tacit. It may be unhelpful to create a dichotomy between tacit and explicit knowledge but to view it as a constant dialectic in which the two work together to promote new knowledge that then becomes codified.

Polanyi 1958, 1966, 1969 introduced the concepts of Tacit Knowledge and Personal Knowledge, and developed them within a context of the situated nature of knowledge and the individual's 'commitment' to a particular context. Reber 1993 investigated the connections between Polanyi's concepts and the research which had been carried out in the field of 'implicit learning'; the latest updates on this are in Berry 1997 and Sternberg 1999. Hogarth 2001 discusses similar topics under the rubric of 'intuition' while not using the term tacit knowledge.

d) Attention Theory.

The psychological literature of attention theory has obvious relevance. The degree to which the attention of the user is held or lost, and directed towards or away from certain structural features or contents of the system will depend on the design of the system and on interference effects which may not be intentional. It remains to be investigated what aspects of the structure or mode of use of a system might distract the user and lead to suboptimal decisions based on misleading surface features of the system. Systems which primarily activate or 'prime' some brain areas or 'modules' may be found to reduce the effectiveness of other areas competing for resources e.g., for access to short-term memory or information channels.

Fodor 1983, originated contemporary discussion of the modularity of mind, with the implication that different modules might be competing for the inputs of cognitive channels and for the use of short-term memory. The neurological implications of this were developed by Norman & Shallice 1986 and Shallice 1988. Mayer 2001 applies attention theory to multi-media learning and

explains how over-use of irrelevant attention-grabbing devices is counter-productive for learning outcomes.

e) Decision Theory.

Ideally, the user will make the best decisions about what are the most relevant, accessible and potentially fruitful lines of enquiry within a given context. In reality, limitations of time and resources, and lack of adequate prior 'baseline' background knowledge and data on the reliability of information sources will lead to sub-optimal decisions. Marchionini²⁰ identifies a problem in the bias towards 'first experiences' giving too much weight to initial hypotheses and too little to new evidence

There is considerable literature on the reality of sub-optimal choice in real contexts, e.g. Kahnemann, Slovic & Tversky 1982, popularised by Piatelli-Palmarini 1994, and updated by Kahnemann & Tversky 2000 and Gilovich, Griffin & Kahnemann 2002. The main writers of this school believe that they have discovered a human weakness which disposes us to certain 'cognitive illusions' which are comparable to visual illusions in that even after we have understood the way in which the illusion arises, we cannot help continuing to see the illusion. On the other hand there is some evidence that 'simple heuristics' are often the most effective way of making the best use of limited information, e.g. Gigerenzer et al 1999, Gigerenzer 2000. Gigerenzer argues that the Kahnemann & Tversky 'Heuristics and Biases' school have allowed themselves to be misled by ignoring the importance of the format in which information is presented. He and his team argue that the presentation of data in forms which resemble the kind of choices which arise in natural foraging situations makes problems with complex formal characteristics manageable for most people (He appears unaware of the literature which compares information seeking behaviours with foraging). In these terms much of the older research which Gigerenzer criticises could be reinterpreted as evidence, not that humans are unable to use particular kinds of reasoning and

²⁰ 1995 p.64 citing Kahnemann et al. 1982

calculation in everyday life, but that their ability to use the appropriate heuristics is dependent on the form of presentation of the problem.

f) Personality Theory.

Several of the preceding topics may be seen in the wider context of personality theory. This is a psychological discourse which starts from a holistic approach to individual's overall patterns of choice and behaviour, rather than from attempting to discover the neurological or neuro-chemical mechanisms which might or might not underlay them.

There is robust agreement between a wide range of observational data and self-reported preferences and attitudes which suggests that it is useful to use the personality 'types' as heuristic predictors of behaviour in a wide range of situations. However, there is continuing divergence between those schools of personality theory which use four (Myers-Briggs) and those which use five different vectors (e.g. Howard & Howard), whereas neurological research has only discovered physiological confirmation for the existence of three of these (Zuckermann 1991)

Heinström 2000, argues for the use of the five-factor model as a basis for investigation of ICT-related Information-Seeking Behaviour. The five factors she selects are those of Howard & Howard 1998, for which she reports that Revelle & Loftus 1992 have discovered a physiological basis, referring to a paper on the authors' own website. These are Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. Heinström reports on an on-going study of 500 university students using three questionnaires: The Five-Factor Inventory Personality test, the Approaches and Study Skills Inventory for Students learning style test, and a specially constructed questionnaire on ISB practices and preferences. A pilot study found some significant correlations between individual items in the tests, such as between high scores on the Conscientious personality factor and the Strategic Approach to learning. The problem with the presentation of the project in this paper is that it also presents three- and four-factor models of personality types and learning

types, without explaining how these are produced by combinations of the five basic factors. Under these circumstances it does not seem that anything more than interesting correlations between individual traits could be achieved.

g) Learning Theory

The aspect of learning theory which is most relevant to this project, is the question of whether ICT users can develop an ICT-specific version of learning-to-learn or meta-learning, that is, or would be, whether they develop specific heuristics for interpreting ICT-based problems as learning experiences.

This would be the basis for expanding the conceptualisation of each particular information seeking event into a learning experience with a reflexive element. The question is then whether users become autonomous not only as Information Seekers but also as reflexive learners.

Bateson 1973, (see pp. 133-149 & 250-279, based on papers written in the 1940s and 1960s) introduced the concept of Deutero-Learning and levels of learning. By Deutero-learning he meant learning-to-learn, initially in terms of realising that different learning tasks could have the same logical structure, which itself could be 'learnt' and then applied to different learning contexts. Since he considered that all mammals and possibly other animals could achieve Deutero-Learning, the 'learning' of this logical structure was obviously not regarded as a conscious process of abstraction. When we take a further step back and make a conscious decision to develop a strategy for learning, we are not moving on to Bateson's Learning III, but only seeking for the more general logical structure which underlies all specific learning experiences. But we can only do this by averaging or generalising from our own past experience (it would be logically indifferent if we also had some innate learning patterns). Thus, for instance, 'problem-solving' constitutes only one class of 'contexts' within Learning II. Learning III is not about 'learning-to-learn-to-learn' as such, but about taking a step back from one particular aspect of the contexts of learning, namely the sets of goals which we consider

constitutive of our 'self'. Bateson considers that only some humans autonomously achieve Learning III, although there are social institutions which attempt to induce experiences which lead to Learning III. All research on information seeking behaviour will be concerned with how to generalise from particular experiences within the ICT-context; our special concern will be to see if there is specific potential for transferring the logical structures of heuristics from non-ICT experience into ICT-use and ISBs, and specifically if adult and other non-conventional learner groups have such heuristics and can achieve access to them in the ICT-context. However, it has been necessary to mention Bateson's Learning III, precisely in order to distinguish it from goal-switching, giving up one goal in favour of another from our given set of goals, or even adopting a new goal on the basis of what we have learnt from new experiences. This latter kind of behaviour is quite likely to occur in longer sessions of information seeking, and it is building this kind of change (which may or may not be undertaken reflexively) into our models which poses a problem for ISB models which tacitly assume that there is a given goal which is or is not 'achieved'.

h) Source related factors:

i) Design features.

The simplest approach is to ask whether apparent preferences in information-seeking styles are actually artefacts of design faults. Individuals may use pathways which work in preference to pathways which are defective within the systems used. There may also be differential use of various pathways because of bias in the internal signposting or the external documentation of systems. We may not be able to provide for equality in these areas, but we should be aware of problems and make allowance for the effects of deficiencies.

The layout of a system should provide meaningful differences between different kinds of commands and between different areas and routes. Icons and text should be used in ways which make clear what level of the system the user is on. Failure or omitting to do this will interfere with the user's ability

to construct meaningful analogies between schemas and procedures used in familiar areas and those to be followed in new areas.

Norman 1998, provides an introduction to the problem of design which is relevant to the iconic features of interfaces (also keyboard and mouse features); Haramundanis 1998, is an introduction to technical documentation which discusses the role of text, icons, illustrations, and their dynamic interplay in complex documents. Mayer 2001, is a targeted discussion of research on the use of multi-media programming in learning systems which argues that excessive use of competing media channels can harm learning outcomes. There are many practical handbooks for learning how to design User Interfaces (e.g., Preece et al.) several of which have chapters on the neurological and cognitive basis of interface use.

ii) Analogy.

One aspect of use and/or design which should be investigated is whether people form analogical schemas of how different parts of systems should operate, and whether designers take advantage of this to design analogical ease into systems. As with geometric versus landmark-based mapping, designs should accommodate different predominant models of analogy-creation.

We perhaps should attempt to elicit the analogy-forming processes of users. Systems should establish reliable correlations between the structures and codes used on distinct levels in order to aid the establishment of analogies. (Is fluidity of analogies itself related to literacy/orality?)

Hofstadter et al. 1995, is dedicated to the study of how individuals can rapidly deduce interpretative schemas from one context and transfer them by 'fluid analogy' to another.

iii) Relevance.

The use of systems and the degree of absorption of information offered by them will also depend on the manifest level of relevance to the users. This will depend on three factors:

- the correct estimation of what is relevant to the users,
- the correct selection of input on this basis;
- the degree to which the relevance is successfully communicated to the user.

Failure in any one of these steps will reduce the effectiveness of systems for all but the most experienced and autonomous users.

The basic work in the modern discussion of relevance is Sperber & Wilson 1986.

6. METHODOLOGICAL APPROACH: INITIAL FRAMEWORK

a) HIERARCHIES OR MULTIPLE MAPPING OF ISB COMPONENTS

We need to discuss the question of whether the following kinds of dichotomies are to be taken as basic, defining parameters of a multi-field model, or whether they can be arranged in a hierarchical branching pattern:

- Systematic listing of available resources and working through such a list versus link-hopping (analogous to paper-based footnote-hopping).
- On-line judgement on the usefulness of different resources versus downloading (or maybe book marking) for subsequent comparison.
- Use of external criteria for the pre-judgement of the likely value of information from different sources versus trial and error. Whether the criteria used are methodological or ideological (adherence to a particular school or approach) or technological or media-based i.e., use of tools which grade hits for relevance.
- Level of awareness of the disparity in the value of information from different sources, and reasons for this differential appreciation.

b) STOPPING RULES AS A THEME FOR INVESTIGATION

A major element of the investigation of information seeking must be to discover the *stopping* criteria of participants, and whether these are pre-determined or are produced during the searching behaviour and if so whether by the nature of the information found or by media-technological factors.

These factors are all located on the operational arm of the Information-Behaviour model used as a wider context. That is, they do not concern the nature of the motivation for the information-seeking behaviours in the wider context of the participants' life.

We need to consider whether it is relevant and practical for us to investigate the possibly different behaviours particularly concerning stopping rules and value attached to information from different sources in real-life existentially significant choices compared to behaviour in experimental and educational contexts.

c) WHAT METHODS WILL BE USED IN THE 'CENSUS'

The purpose of the 'census' of new users of ICTs will be to discover the widest possible range of behaviours actually used by newer, less experienced users. It might seem that the range of such behaviours is simply determined by what the technology makes possible, and that an investigation of the use of any particular group of users could only discover their preferences within this pre-determined range. Even on a purely technical level this may be inexact, since the range of possible uses of a technology may be greater than that intended by the developers, discovered during development, or reported in the documentation. Nevertheless it is true that naive users may not be the most likely group to discover any otherwise unknown ways of using the technology.

The question is not so simple as this however, since the formulation of Information Seeking and Searching procedures is inseparable from the question of the different ways in which the initial question or problem is understood and conceived by the users. It is in this area that we may expect to find unusual or not previously envisaged behaviours on the part of naive users, possibly using analogies or heuristics derived from situations unknown to the developers of the systems. This becomes more relevant and pressing when the conceptualisation of ISBs is extended to encompass the ways in which users develop searches over an iterative period of searching or when learning processes take place during the execution of a search.

Allowing for our technical opportunities, we should therefore attempt to capture these processes by all available technical and non-technical means. Such means might be questionnaires, observer protocols from live observation or from video, analysis of logs of websites accessed and time spent on them, searches entered, etc..

However, if feasible the most promising approach might be to combine one or more of these external means of monitoring with voice-recorded subject protocols in which participants would talk about their activities, reporting their technical choices and decisions, successes and frustrations, but primarily in order that we could have access to the processes by which the

choices and preferences of the participants are moulded by their perception of the nature of the underlying problem.

Analysis of this material would be directed towards discerning the interrelationship between the participants understanding of the three factors of the nature of the problem posed, the range of Information Seeking options open to them, and the value of the information retrieved. At the same time, we would be looking not just at the adequacy of the methods chosen or available for the 'solution' of the given problem, but also for evidence of the influence of IS experiences on the participants' following choices.

d) THE INFLUENCE OF NATIONAL FACTORS

The research would take place initially in five EU member states. These member states have uneven development of ICT infrastructure and WWW content. This creates a dilemma for our research. In order to elicit the widest possible range of ISBs, we would like to be able to analyse participant use of the full resources of the WWW and possibly also of other resources. However, comparability of results between the different test sites will be compromised by the lack of a level playing field in terms of the resources to which users have access in different nations.

One way to reduce the effect of this without directly limiting the participant access to different resources would be to use a common problem base or scenario which directs the users towards areas of information in which the different nations do have roughly equivalent resources available. We should therefore seriously consider the use of a travel-based scenario for our research, since this is the area in which there is greatest international standardisation of information resources.

The use of a broadly comparable scenario with the potential of a resulting equivalence of resources available both in terms of search engines, content availability and content quality, would provide a degree of comparability which could make any appearing differences in ISB preferences between the different groups interesting for further research in their own right. It would be at this level that we could encounter differences in ISB between

groups differing by nationality or by some other characteristic, which could be traced back to national, cultural or social differences in the effects of one or more of the 'intervening variables' which our model has identified.

7. DESIGNING GUIDELINES

Detlor 2000, explores the problems which arose in the development of organisational intranets from the failure to clearly define the information needs and practices of users, or even to define the user group itself. This led to the 'traditional data-driven approaches to 'portal and intranet design'.

Marchionini & Komlodi 1998, provide an overview of trends in interface design and related research literature on user practices and responses. They identify four themes which could provide a useful framework for guidelines, namely Interaction, Human Augmentation, Usability, and Multi-media. Interactivity concerns the development of a symbiotic relationship between user and system and relates to the question of improved learning outcomes when systems mobilise human actions. Augmentation designates the possibility that new forms of organising information will create new possibilities of knowledge, as in hypertext (We should draw attention to the fact that indexes, concordances, cross-references are already manual forms of hypertext with which users may be familiar from other contexts). Usability has been distilled into a number of robust ergonomic metrics which provide the basis for objective comparison of different systems. Multi-media primarily concerns the use of graphics, video and sound alongside text, but can be taken further in the production of instant user-generated simulations and statistical graphic displays.

The overall impression from reading Marchionini and Komlodi 1998, is that the rapid developments in new interfaces which they envisaged has not occurred. This may be the result of the relative freezing of innovation due to the establishment of standards within the commercial services of the WWW and failure of new hardware such as WAP phones or interactive TV to challenge PCs. The last five years have thus been a period of consolidation in mass user interfaces despite the continued work on development of new virtual interaction technologies.

GUIDELINES FOR DEVELOPERS

There are a number of institutionalised guidelines for general software and interface development. There is also a wide range of commercial literature which provides an introduction to the material in these guidelines in 'tutorial' formats. Several of the major books of this genre contain extensive and worthwhile chapters on the psychological and neurological basis of ICT use and Information Seeking. Our guidelines will not replace such existing material, but if found adequate, will feed into future revisions of these existing resources.

In the meantime, our published guidelines will be primarily aimed at the developers of on-line or intra-net-based educational systems and will have the aim of alerting these developers to the special characteristics of 'new' ICT user groups with older age profiles and different educational and life backgrounds to the conventional student and higher professional learner.

In preparing guidelines using the information which we gather from our investigations, we will have to make decisions as to the direction of our recommendations. Taking as our primary aim the rapid induction and integration of new groups of users into the Information Society through the provision of software and interfaces which allow these users to achieve their given ends, there may be different methods for achieving this.

Prima facie, we would like to sensitise developers to the widest possible range of approaches and methods of Information Seeking used, and suggest that as many as possible of these should be accommodated within new systems in order that users may follow their inclinations to achieve their goals. On the other hand, if we discover that some of the heuristics used by members of these groups are genuinely counter-productive for them, and apparently resistant to change, then we must consider how to achieve the most painless transition to new approaches, which may mean the use of 'bridging' analogies which help them to 'transfer' their existing skills into the new environment in stages, or conversely it may in some cases mean drawing a direct contrast between the expectations of the user and the most effective alternative means of achieving their goals.

We should also draw particular attention to the possible differences between older and younger users, or users with different educational and life backgrounds, in the degree to which the information provided by different channels of multi-media can be absorbed and integrated.

GUIDELINES FOR INSTRUCTORS

By *Instructors* we mean all professionals who may be working with learning groups using software in an educational context, whether this means commercial or in-house packages, disc-based tutorial or encyclopaedic systems, or simply using the Web within a project-based course. Compared to many professional software and interface designers, such instructors could often benefit from the material on user needs found in existing guides to interface development, and our guidelines could usefully include much of this material.

The primary purpose of the guidelines however would be to sensitise instructors to the widest possible range of approaches found in ISB among non-conventional users of ICTs and the Web. While 'instructors' in this sense might have a limited access to technicians able to alter the format and linking of their in-house Web pages, we assume that in the majority of cases we are dealing with individuals who have to work with existing resources and who have a limited ability to select and change the resources available to them.

Taking advantage of the information which we might make available to them would therefore initially take the form of attempting to ensure that the selection of material proposed for use by students should include modules which exploit and exercise the full range of ISBs of non-conventional users. We would also provide guidelines for pedagogic interventions in terms of exercises which might facilitate or speed up the transfer of users existing heuristics and action schemes into ISB adaptations. As with the developer's guidelines, we would also identify those commonly found heuristics which are found to be counter-productive in the ICT/ISB context and which should be

confronted and contrasted with more productive approaches, while attempting to utilise the user's existing skills and knowledge.

SOURCES

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