SUBJECT SEARCHING BEHAVIOUR AT THE LIBRARY CATALOGUE AND AT THE SHELVES: EVALUATING THE IMPACT OF AN ONLINE PUBLIC ACCESS CATALOGUE

Micheline Hancock-Beaulieu

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Department of Information Science
City university
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A la douce mémoire d'Emile.
Il ne sera jamais grand, mais il m'a fait grandir.

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ABSTRACT

Searching behaviour in a university library is studied using a holistic approach encompassing the use of bibliographic tools and browsing at the shelves. The project was designed as a 'before and after' study to evaluate the impact of an online catalogue on subject searching behaviour. A combined methodology was devised using a talk-aloud technique, observation, and screen logging facility to elicit both verbal and non-verbal data from users in their searching activity at the manual bibliographic tools, including a microfiche catalogue and printed PRECIS index and at the online catalogue, as well as at the shelves. The data was recorded on a highly structured dual questionnaire and observation form with some real time expert interpretation.

The limitations of the methodological approach of previous catalogue use studies are highlighted suggesting that subject searching as a basic primary need had been previously underestimated. The online catalogue does not seem to have increased the extent of subject searching nor the use of the bibliographic tool. An extensive qualitative analysis correlating expressed topics, search formulation strategies and documents retrieved at the shelves reveals the adaptive nature of the subject searching process, whereby the user adapts to the structure of the tools available. The PRECIS index supports a contextual approach for broad search formulations and more interactive reformulations whereas the OPAC encouraged a matching approach and narrow formulations with fewer but user generated reformulations. The success rate of the online catalogue was slightly better than that for the PRECIS index but fewer items were retrieved at the shelves. Non-users of the bibliographic tools seemed to be just as successful.

The information retrieval task in both searching environments is tailored by the system to a single one dimensional sequential process. It is suggested that a major obstacle to subject searching effectiveness may lie in the lack of interaction between the different subject access elements: the indexing language, the classification and the titles.

The study concludes that to improve retrieval effectiveness online catalogues should cater for both matching and contextual approaches to searching. Recent research indicates that a more interactive process could be promoted by providing query expansion through a combination of searching aids for matching, for search formulation assistance and for structured contextual retrieval.

CHAPTER 1

INTRODUCTION

1.1 Subject access and online catalogues

The online library catalogue emerged as a new form of catalogue almost a decade ago as a by-product of the automation process of library housekeeping functions. Its more common name of online public access catalogue or OPAC alludes to its origins as well as to how it was perceived by library professionals.

Public access evolved in two different ways. Firstly it meant access to library circulation files designed primarily for staff use which could also serve as a rudimentary catalogue for the library user. The initial interest was not in the bibliographic data but rather in the circulation data which was being made available to the public, thus enhancing the catalogue's function as a finding tool. The second route was to give the library user direct access to those machine-readable bibliographic records from which card and computer output (COM) catalogues had been produced through shared centralized cataloguing.

It soon became apparent that the automated catalogue incorporating the card catalogue model, had much more potential than what was first intended. The first major survey on user response to the online catalogue commissioned by the Council on Library Resources in the

U.S. (Matthews et al 1983), revealed that users had other expectations from 'public access'. The demand for subject access expressed by users seemed to conflict with the findings of previous research on library catalogues and raised a fundamental issue: that is, the role of the catalogue in providing access to the library collection.

1.2 The traditional library catalogue as a finding tool

Previous catalogue use studies, particularly those undertaken in the early nineteen-seventies in anticipation of automation, had reinforced the assumption of the library catalogue as a finding tool for known item searching. Thus warnings about the inadequacies of subject searching (Atherton, 1978) were not heeded. This was coupled with the confidence that the open-access tradition of Anglo-American libraries was adequate provision for the direct shelf approach for subject searching favoured by the library user. However, the acknowledgment of users' need for direct access or browsing has not been supported by any analysis or evaluation of searching behaviour at the shelves.

1.3 A 'before and after' impact study of subject searching

In the light of the apparent discrepancy of findings relating to the role of the old and new library catalogue for subject searching, plans to install an online catalogue in the library at City University offered an opportunity to undertake a study to examine subject searching behaviour

before and after the installation of the online catalogue.

The manual bibliographic tools available were also of particular interest because they consisted of a unique combination previously untested, namely that of a microfiche divided name and classified catalogue, the latter of which could be accessed by a printed PRECIS index.

By comparing the different bibliographic tools and their effect on user behaviour, the impact study could provide evidence on the contribution of the new medium to subject searching. In addition a holistic approach was adopted to include searching activity at the shelves whether directly or as a follow up from the bibliographic tools. This would not only extend the comparative elements but could also inform on the more fundamental nature of subject searching as a whole process.

1.4 Previous research on the traditional and the online library catalogue

Previous research on both the traditional as well as the new online catalogue provided the relevant context for the study. Chapter 2 presents an overview of the results and methodological approach of traditional catalogue use studies. Each of the findings, i.e. the low usage and the dominance of known item searches are re-assessed. A close analysis of the methodology and research questions reveals shortcomings not only in the type of data collected but also in the interpretation of that data. It is suggested

that the quantitative approach of the large scale surveys yielded data on catalogue usage which may have led to misleading inferences about user behaviour and the extent of subject searching.

A detailed critical review and discussion of online catalogue research follows. Three phases of research are identified: exploratory studies, the national CLR survey, and post-CLR projects. Although these occur chronologically, they also show a development from quantitative to more qualitative research.

This is particularly evident in the post-CLR projects which are characterized by three different methodologies used to address the wider issues of searching behaviour and subject access. The first group of studies explores transaction log analysis as a means of obtaining more informative data on the actual search process. Secondly, prototyping is used as a method of developing experimental systems with new features to be tested by users. The third type of project explores the more cognitive aspects of searching behaviour through controlled experiments. The strengths and weaknesses of each of these approaches are discussed.

The transaction log studies identify a number of difficulties encountered by users of online catalogues. These fall into four categories, mechanical, retrieval, vocabulary and interface problems. Although the prototype experimental systems attempt to tackle elements of the

first three areas, the interface issues remain outstanding. Advances in the latter would appear to be dependent on gaining a better understanding of the fundamentals of information seeking behaviour. The few studies which attempt to deal with cognitive aspects represent a new and recent area of interest to which the present study hopes to contribute.

1.5 A combined methodology and holistic approach

Chapter 3 considers data gathering methods used in previous studies in greater detail. Means of eliciting information from users in the form of verbal and non-verbal data are discussed. These include the use of specific methods such questionnaires and interviews, protocol analysis, observation and transaction logs. This forms the basis for the combined methodology devised for the present study. It consists of gathering a combination of data from direct observation and talk aloud technique, and recording it on a structured dual purpose observation and questionnaire form with some real time analysis. For the online catalogue searches, this was supplemented with a screen logging facility which served as a more comprehensive record for analysis. This methodology was a unique attempt to record the entire searching process both at the bibliographic tools and at the shelves, with the minimal interference, for 'real' users undertaking 'genuine' searches in an operational setting. In all, three

data samples representing 299 individual searches were collected. An initial quantitative analysis was undertaken and then followed up by a more extensive qualitative analysis of the data.

1.6 Qualitative data analysis and findings

The findings presented in Chapter 4, were obtained from comparisons and correlations drawn at the various stages of the searching process, between the different bibliographic tools, as well as within and between the different combined searching environments, i.e. bibliographic tool and/or shelves.

In the first place the variety of searching patterns ~~are~~ *is* mapped out for the samples representing the manual and online searches. Particular attention is given to the identification of 'hybrid' searches, i.e. searches initiated as specific item searches but developing for whatever reason into subject searches. An overall predominance of subject searching is reported but, contrary to what might have been expected, the online catalogue did not account for any increase in subject searching.

Bibliographic tool consultations are then analysed in three steps to trace the transition of users' search formulations: a) from their expressed topic to the first access point, i.e. the initial search formulation, b) from the first access point to the point of exit, i.e. the orientation in the bibliographic tool and c) from the

expressed topic to the point of exit, i.e. the final search formulation. A hierarchical classification, (exact, narrow to broad and broad to narrow) is used to describe each of the search formulations. The PRECIS index appears to support broad search formulations whereas the online catalogue leads to the opposite narrow approach.

A next stage of analysis deals with the comparison of titles examined and selected at the shelves, with users' expressed topics and terms encountered in the course of the consultation of the bibliographic tools. Two categories of titles are identified, titles which contain original terms only and titles containing matching or partially matching terms. A separate analysis of titles with original terms only was undertaken to ascertain their relationship with expressed topics and search formulations. The influence of each of the bibliographic tools in retrieval at the shelves was definitive. Broad search formulations were the most successful at the shelves for searches using the manual tool and the reverse was true of the online catalogue with the narrow formulations being favoured although closely followed by broad search formulations.

User perseverance at different stages of progress in the search process was also examined in relation to success/failure. Users of the online catalogue tended to pursue their search at the shelves after an initial positive result at the catalogue. They also followed up specific references found in the catalogue at the shelves,

as opposed to class numbers only as with the PRECIS index. Overall success/failure rates for subject searching using the online catalogue indicate an improvement on the PRECIS index however, the direct shelf approach appears to be more successful.

In observing browsing behaviour at the shelves it was found that classification numbers played a minimal role in furthering searches. Cases who did follow up multiple class numbers extracted from the online catalogue tended to select a greater number of items. Finally a comparison between browsing at the shelves and at the online catalogue revealed little similarity between the two activities.

1.7 Subject searching: the tool tailors the task

In the discussion in Chapter 5 the findings of the different stages of analysis are drawn together to assess the searching process overall and the influence of the different bibliographic tools. Some of the results and issues discussed include: the need for subject searching, query formulations and the function of the bibliographic tools in supporting different formulation strategies, search formulations and documents retrieved, subject access elements in the bibliographic tools, and success and failure at the bibliographic tool and at the shelves. An assessment of the combined methodology devised for the study is also presented.

The general conclusions drawn in Chapter 6 highlight library users' primary need for subject searching and their dependence on searching at the shelves as a consequence of the limitations of the bibliographic tools. The online catalogue in its present form has not improved retrieval effectiveness for subject searching. It is suggested that to improve retrieval effectiveness, existing subject access elements should be explored to provide contextual query expansion online to complement the present dominance of the document based matching approach.

CHAPTER 2

RESEARCH CONTEXT

2. Introduction

The research context of the project is presented in this chapter. The findings of traditional catalogue use studies are first discussed together with the shortcomings of their methodological approach. A critical review of online catalogue research is also undertaken with an emphasis on evaluative methods applied. Subject access in terms of U.K. and U.S. practice is then considered, as well as shelf browsing. A final section deals with the research approach to information seeking behaviour adopted in the present study and the research questions and objectives which were formulated.

2.1 Traditional catalogue use studies

Studies in the use of library catalogues have proliferated since the 1930's. Those considered to have had some scientific basis number over fifty. Their findings have been well documented in three major reviews by Krikelas (1972), Hafter (1979), and Markey (1980). These studies indicate:

1. 25% to 50% of library users do not use the library catalogue,

2. students account for the largest group of library users,

3. known item searching accounts for the largest proportion of use and increases as the educational level of the user rises,

4. subject searching is higher in public libraries than in academic libraries.

2.1.1 The catalogue non-user

Repeated studies have shown the low usage of the library catalogue but little effort has been made to find out why. Only two studies (Maclean 1972 and Maltby & Sweeney 1972), have sought to find out reasons for not using the catalogue from library users themselves. Three common reasons given by non-users were that:

1. they could manage without it
2. they preferred to ask the staff
3. the catalogue was difficult to understand.

The U.K. catalogue use survey (Maltby, 1973) attempted to show that library instruction made a significant difference to the extent of catalogue use. However this causal relationship between catalogue use/non-use and instruction in catalogue use has not been substantiated. Cronin's study (1978) of catalogue non-users sought to determine the characteristics and attitudes of non-users and found that:

"Non use does not appear to be a function of personal dissatisfaction with any aspect of the library services or staff. The library and its catalogue do not warrant high priority rating simply because they are not central to the day to day survival of the non-user."

It is not clear from the evidence how catalogue usage could be increased. On the one hand the limitations of the catalogue had been recognized. Atherton (1978, 1980) advocated the need to improve subject access in library catalogues through contents notes, a synonym dictionary, classification schedule captions and updated subject headings. The major investigations of the early 1970's (Lipetz 1972, Palmer 1970, and Tagliacozzo et al 1970), were all carried out with the hope of providing some suggestions for improvements to be applied in automated catalogues. It appears that changes in the card catalogues were considered too difficult and costly to implement. On the other hand there was also some complacency in accepting the status quo and in the rationalization that the performance of the traditional catalogue was acceptable after all. As Hafter (1979) states:

> "The major conclusion that emerges from these studies is that the card catalog works. Even more importantly, users are skillful at manipulating it for their own purpose."

It would thus appear that low usage was not problematic and rather than seek to make improvements, user instruction was the best alternative. Lipetz (1972) explains the position as follows:

> "The modification or expansion of catalog entries in the existing catalog apparently has the least potential of all three possible approaches to improvement of catalog service (ie. coverage, user education and modification)."

2.1.2 Known item versus subject searches

The major result of the large scale catalogue use studies was to confirm the dominance of known item searching and the role of the catalogue as a finding tool. How can we then account for the high occurrence of subject searches on online catalogues as reported in the Council on Library Resources Survey (Kaske & Sanders 1983). There are two possible explanations: the online environment either created a new demand or stimulated an existing inherent need.

Markey's (1984) detailed analysis of subject searching in traditional catalogue use studies reveals that subject searching accounted for between 10% and 62% of searches. In half of those studies, subject searches equalled or exceeded 40%. Nevertheless it would seem that this was not considered to be a significant proportion.

The problem of identifying true subject searches is also of particular interest. The Yale (Lipetz, 1972) and Michigan (Tagliacozzo et al 1970) studies found that some searches initiated as known item searches could in fact be subject searches. Lipetz comments: "The underlying objective was to find information on a particular topic and looking up a known item was only an expedient approach." The use of a citation as a means of undertaking a subject search is an established approach. After all citation indexes are based on that principle. The significance of the user applying a similar strategy to library catalogues

has not been fully realized or appreciated. It is possible that in many studies such hybrid searches have remained undetected particularly if users were questioned prior to the catalogue consultation. Users looking for information on a particular subject did not restrict their consultation to the subject portion of the catalogue (Jackson 1958, Lipetz 1972). Title searches for instance are not necessarily specific item searches and could well be subject searches.

It may also be argued that the user's strategy adopted for subject searching is a response to the very design of the card dictionary catalogue. Tagliacozzo et al (1971) found that catalogue searchers were "inclined to use proper names rather than other types of entry, even when the latter may be considered a better choice". Using a proper name for a subject search may be easier for the user than attempting to guess at an appropriate subject heading, particularly if the object is to extract a class number to pursue subject searching at the shelves.

Moreover, users have been reluctant to experiment with subject headings as shown by over 50% of catalogue users consulting a single subject heading only, (Jackson 1958 and Tagliacozzo & Semmel 1970). The difficulties in matching LCSH subject headings have been highlighted by Bates (1977). In addition divided catalogues or separate classified catalogues could also have acted as a deterrent to subject searching. The U.K. catalogue use survey (Maltby

& Sweeney 1972) reports on the negligible use of the classified catalogue.

It seems that the catalogue's limited subject access could well have reinforced the user's apparent preference for known item searching and consequently may also partly account for the apparent increase of known item searching as the user's educational level rises.

2.1.3 Methodological shortcomings

The problems of low usage and the apparent discrepancy of known item and subject searching from the findings of traditional catalogue use studies, stem not only from methodological shortcomings but also from the research questions being addressed. The main objective had been to collect quantitative data on the use or usage of the tool as opposed to user behaviour or the user's task. The distinction between the study of catalogue use and the catalogue user is subtle but fundamental. To observe use by simply recording user actions does not necessarily provide explanations for the different types of usage. Moreover to draw conclusions on user behaviour would require further corroborative evidence.

The large scale surveys of the early 1970's marked a turning point in the research approach and yielded significant results. The Yale study (Lipetz 1972) was designed to obtain reliable statistical data, based on a carefully constructed random sample of 2,134 and

representative of the user population of a large library. It was hailed as a standard model and projects with substantial samples followed, i.e. 2,681 (Tagliacozzo et al 1970) and 5,602 (Palmer 1970). By their very scale these studies aimed to gather quantitative data on use and by the very nature and breadth of the sample, in-depth qualitative analysis of user activity was limited.

In addtion to sample size, the method of eliciting information from the user was also problematic. The aim was to get as close as possible to the search but falling short of the search process itself. Users were questioned either before and/or after searches had taken place, or were asked to generalize on how they 'normally' searched. The actual search process was not observed at first hand thus limiting the possibility of more fruitful qualitative analysis.

The experimental approach of the Bath University Comparative Catalogue Study (1975) was an exception to the usual quantitative survey method. User requirements were tested in terms of the acceptability of the different forms of catalogue formats as well as catalogue entries, i.e. card versus COM catalogues, full versus short entries (Seal et al, 1982). Keyword in titles was also tested. The emphasis was nevertheless on the structure of the tool as opposed to user searching behaviour and the retrieval task.

Variations in record displays and keyword access in titles have become important features in online catalogues, but their contribution to the searching process has yet to be

analysed.

Furthermore the searching activity of the non-user was also ignored. When catalogue non-users were considered, the interest has been in defining their characteristics and attitudes as opposed to investigating how the non-user does seek information. The information retrieval task in the library context can de divided between catalogue users and non-users but both end up searching the shelves as part of their information seeking activity.

The 'black box' approach to the assessment of catalogue performance may be giving an incomplete or even distorted picture of the information retrieval task itself. It would seem that the interdependence of catalogue performance and user performance requires closer examination. In one of the very first reported studies on the use of the library catalogue, Randall (1930) advocated that the improvement of the catalogue could not be done "by any study of the catalogs themselves" but required "an intelligent study of the patrons themselves, their mental equipment and their needs".

2.2 Online catalogue research

In the light of the findings and research approach to the traditional library catalogue it is apparent that fundamental issues have yet to be resolved. This section will examine to what extent research on online library catalogues have addressed these issues. Particular

attention is given to the evaluative research methodology of the studies which have provided evidence on OPAC usage, user information seeking behaviour and the retrieval task.

2.2.1 Initial investigations on user acceptability

Hildreth (1985) in his comprehensive state of the art report identifies three phases in the "beginnings" of OPAC research. The first phase consisted of exploratory studies based on interviews and questionnaires which sought to assess the acceptability and user preference for the new catalogue medium. (Dowlin 1980, Pritchard 1981, Moore 1982, Pawley 1982). Gouke and Pease (1982) conducted a comparative study with test title searches on a card catalogue as well as an online catalogue. They found that in spite of difficulties in locating titles, users preferred searching on the online catalogue. Markey (1984) using protocol analysis examined subject searching at the traditional catalogue environment in order to ascertain possible user requirements for the online catalogue.

The second phase centres on the Council on Library Resources national survey of online catalogue users in 29 American libraries (Matthews et al 1983). Together with its related studies consisting of features analysis (Hildreth 1982b), transaction log analysis (Tolle 1983, Larson and Graham, 1983) and focused interviews (Markey 1983), this project had a major impact and generated much discussion and debate on design issues. The main finding that the library patron used the online catalogue for subject

searching and wanted improvements in subject access, challenged the long held belief that the library catalogue was a finding tool for known items.

The third phase, which Hildreth refers to as the post-CLR phase, is of particular interest. The CLR study can be regarded as the baseline for OPAC research. The main survey and its quantitative data provided an overview on users' response to online catalogues. The supporting studies combined other methodologies which were to complement the aggregate findings and provide more qualitatitve data on those findings. The post CLR research in turn appears to have followed three different directions.

- Firstly there are those studies which further explore the potential of transaction log analysis as a means of extracting more information about usage of actual operational systems which could feedback to systems design.

- Secondly we have some projects which concentrate on the system design features, developing prototype experimental systems with new or improved features whose retrieval effectiveness could then be tested on real users.

- Thirdly several dissertations, using controlled experiments and test searches, explore the more cognitive aspects of searching behaviour and user interaction.

We shall consider each of these approaches in turn.

2.2.2 Monitoring systems' usage: transaction log analysis

Penniman and Dominick (1980) put forward automatic logging and monitoring as "an extremely powerful and potentially flexible technique for collecting data necessary to perform evaluations of information system

performance and analyses of user interactions with the information system". Objectives and parameters for the monitoring methodology as set out by the authors are two-fold, system performance and user behaviour. It is the latter which has dominated researchers' interest. Rice and Borgman (1983) expand on the type of data elements which can be collected and how these can be analysed. "The combination of pattern analysis, error analysis, and time analysis can lead to a helpful model of IR user behavior." Furthermore transaction logs were seen as the means of hopefully providing feedback for system design improvements. Although user performance and systems performance are interdependent, gathering information about users by observing their behaviour appears to be considered as a prerequisite for system development.

Transaction log data analysis has formed the basis of a number of online catalogue studies. The data elements contained in the logs vary according to what has been specified. The size and samples of data sets vary greatly according to the period of time covered by the logs selected for analysis and whether these include a single or multiple systems.

An early study by Norden and Lawrence (1981) recorded only the search type commands and found that title searches were the most favoured followed by subject and author searches. Although these results

differ from traditional catalogue use studies where author searches apparently dominated, they do not provide further insight into users' motivation behind that choice.

Tolle's (1983) approach was more comprehensive but did not prove to be more informative. The logs of six different systems were collated and search patterns or search states were analysed by markov chain analysis in an attempt to arrive at some probabilistic model whereby certain outcomes could be predicted by the occurrence of certain patterns of events. Extensive processing was required because the logs were not standard and there were variations in search commands across the different systems. This quantitative global approach over multiple systems did not prove to be fruitful. Information about search states transitions alone and the lack of data on individual user sessions shed little light on user behaviour to permit evaluation.

Borgman (1983) on the other hand, by combining data from direct user observation to determine search boundaries, was able to analyse individual search sessions for types of search commands, occurrence of errors and time factors. Most sessions lasted two to four minutes and one third of all sessions included multiple search types as well as at least one subject search command. The proportion of subject and call number commands increased with the length of session.

13.3% of all user commands were errors. Although these results are more informative about individual user actions the interactive nature of the transactions is not apparent because of the results displayed to the user are not logged. Two studies (Larson and Graham 1983, Larson 1986) on the Melvyl system at the University of California offer comparative data collected at different periods of time in 1982 and 1985. The results give us an idea of the learning ability of OPAC users. The need to call up help screens diminished from 14.25% to 7.35%. Perhaps more significantly the use of the "look up" or menu search mode, aimed at inexperienced users as opposed to the standard command search mode, dropped from 59.2% to 25%. Another surprising result is the apparent reduction of searches by subject (LCSH) down from 52% to 25%. This does not necessarily mean a drop in subject searching since disguised keyword in title subject searches are not detected by the logs. In fact keyword title searches increased from 18.8% to 26%. Larson suggests that users' difficulties in matching LCSH terms (49% failure rate) could be a contributory factor.

The problem of subject searching through LCSH or keywords in title is examined by Kern-Simirenko (1983). The logs of three systems with different combinations of subject search features were compared for failure analysis. System A had keyword access to LCSH and

titles, System B had in addition a browse facility on keywords for LCSH and System C had only phrase matching on LCSH with truncation. Failure rates ranged from 46%, 35% and 39% respectively with between two thirds and one half of these failures occurring after the first try. Overall the system without keyword access did not fare worse but System B, where both LCSH and keywords in title were available, had a rate of 27% failure on keywords as opposed to 48% on LCSH alone. Searchers in systems A and B did not use Boolean, search subject headings or call numbers, or browse to expand their searches. They recovered from failed searches by changing their search terms.

Dickson (1984) carried out a similar analysis on author and title searches on Northwesterm University's online catalogue and also found miskeyings, mispellings, entering author names in the wrong order with incorrect initials and typing the first article in titles were all dominant errors.

Unsuccessful keyword searches were also studied by Henty (1986) at the Australian National University. Nine error types were identified in a sample of searches collected over a two week period. Obvious mispellings made up the largest proportion 37% of failures followed by 25.5% unidentifiable terms which could include mispellings or miskeyings and 14% legitimate terms presumably not in the database. Other categories included problems such as words with

hyphens, abbreviations, and words running together. Whether system dependent or user dependent, all of these error types appear to fall into two categories as Borgman (1986a) points out: mechanical errors ie. syntactic, mispellings or miskeyings, and conceptual errors, ie. not matching the language of the system.

The transaction log studies discussed above have identified some of the difficulties which users met in searching the online catalogue. They also reveal some of the limitations of this method of observing the user. We can further analyse findings as follows:

- Mechanical problems:

  A high proportion of failures are due to system induced errors or user mispellings and miskeyings

- Information retrieval problems:

  The true extent of subject searching is unknown. In particular more information is required on the use of keywords in title as a strategy for subject searching in relation to the controlled vocabulary of subject headings

- Conceptual vocabulary problems:

  A high proportion of subject searches fail because the user's language does not match the system's language.

- Interface problems:

  The interface does not encourage users to exploit search options and may bias users' searching behaviour

Transaction logs have thus been useful as a diagnostic technique for detecting and analysing symptoms. However further refinements are necessary before we are in a position to define the full nature

of the problem and suggest effective treatment and remedies. Although a massive amount of data is collected it may not be the right data. For example, failure is defined as no hits. Too few or too many hits could also result in a failed search for the user. The more data is collected, the more difficult it becomes to analyse it and obtain significant selective results. It would therefore appear that transaction logs alone may not be adequate and that other complementary methods of enquiry or further analysis are needed.

Following on from initial transaction log failure analysis, some studies have carried out secondary analysis or feasibility tests for possible solutions to user problems. The relative merit of postcoordinate keyword subject searching and precoordinate subject indexing has been one area of interest. This problem also relates to name and subject authority control. Taylor (1984) used the same data as Dickson (1984) and examined whether or not failed author searches could have succeeded by having an authority file for preferred entries. For 46% of failed searches authority control would not have helped but flip programmes (to reverse the order of user entered author names) or right truncation programmes would have been more effective.

Jamieson et al (1986) analysed a sample of 1000 bibliographic records to see how many non-preferred

terms in cross-references could be found in the body of the record. The result for subject 'see references' in particular was significant in that 84.5% of these could not be matched with the catalogue records even with truncation. The authors concluded that "keyword searching is a powerful retrieval technique, but it cannot compensate for the lack of database structure", i.e. a cross-reference structure for subject authority control. Taking into account the Kern-Simirenko (1983) study it would appear that both a controlled vocabulary and keywords are valuable in subject searching. It may not be a question of determining which is more effective than the other but rather how to implement and integrate both means of subject access so that the searcher can use them more effectively.

2.2.3 Assessing retrieval effectiveness: experimental prototype systems

The design of experimental systems and prototyping as a methodology for developing and testing design features respresents not only a second approach but also a second stage in the post-CLR research on online catalogues following transaction log studies. Online catalogues were first developed as in-house systems in large academic libraries. Since the mid 1970's much experimentation has been carried out on these already operational systems and continues to do so. Although some internal reports may have been produced, for the

most part only descriptive accounts of features and implementation have been published. Likewise reports on research and development on commercial systems are not available. A valuable contribution to future developments could be made by the systematic testing and evaluation of prototype systems.

Although all the experimental systems discussed below are concerned with improving subject searching as an overall research objective, two different approaches have been adopted in attempting to meet that objective. The first tackles the more system orientated problems of improving retrieval techniques and mechanism, ie. term weighting, stemming, spelling corrections. The second explores the potential of the database structure for query expansion through classification. Both approaches would be considered to be moving towards the development of a third generation of online catalogue.

The online catalogue at the National Library of Medicine, CITE, was the first and remains the most advanced operational third generation catalogue. It was installed after it had been tested and compared with another system in a preliminary trial (Siegel et al 1983). Test subject searches were given to both library staff and library users to assess retrieval effectiveness and user satisfaction. Its success is not surprising since CITE offered far superior searching capabilities than its rival. These include natural

language imput which links automatically to Mesh Headings, a spelling error detector, closest match search, weighting for document output and relevance feedback (Doszkocs 1983). Some of these features even go beyond those available on online bibliographic databases. Unlike other online catalogues to general library collections, CITE covers a single subject domain which is highly structured and is used by expert users. Unfortunately, no further evaluation has been carried out on CITE beyond the initial tests.

The British Library funded project based at the Polytechnic of Central London has developed several versions of a more general knowledged based experimental system (Mitev et al 1985). The first version, Okapi'84 was evaluated in an operational setting and failure analysis of the transaction logs then led to further refinements of the combinational search mechanism for partial matches.

To improve recall the second version, Okapi'86 introduced automatic stemming or truncation, cross-reference tables, and spelling corrections (Walker and Jones 1987). This linguistic computing links morphologically related words, creates look-up tables to handle semantically related words and corrects miskeyings and other mispellings by mapping orthographically related words.

The experimental system consists of two catalogues

for subject searching only. EXP uses all the devices including weak and strong stemming, CTL does weak stemming only. Weak stemming removes regular English plurals, ing and ed endings, whereas strong stemming removes other endings such as tion, ness, ist. The choice between strong and weak stemming will affect recall and precision respectively.

Again the system was made available to users in the library for evaluation. This was done by a combined methodology consisting of user observation to determine search session boundaries and transaction log analysis to permit the repetition of searches from one version of the catalogue to another by the experimenter. A third version 'OSTEM', containing none of the retrieval aids was also used to repeat searches. In addition short interviews were conducted to assess users' perception of the system but these provided only general indications of opinion and reactions. The main data was obtained not only from the quantitative analysis of the logs, but also from some extensive manual qualitative analysis. For example, specific title searches were carefully differentiated from subject searches and searches within a search session were coded in relation to each other. From this qualitative analysis it was possible to select searches which could be repeated reliably. The repeat searches were a good way of isolating variables so that the

retrieval effectiveness of the different devices could be compared.

The case for weak stemming for increasing recall without affecting precision appears to have been proven. Strong stemming however was much more tenuous. This could be more a function of how weights were assigned. Moreover the present system does not provide for relevance feedback from users, which could in turn verify term weighting. Feedback is in fact under consideration in the next phase of development. With regards to spelling corrections, the EXP system corrected 50% of errors with favourable results. The cross-reference table on the other hand was never detrimental. This is not surprising since in effect it acts as any subject authority file. The question remains to what extent it could be extended and how efficiently it could be implemented. This would go beyond making simple semantic links to improve 'matching' but could also provide for a more 'contextual' subject approach. Overall the study establishes that linguistic retrieval aids warrant further investigation and could be viable as one of a number of ways of improving subject retrieval in online catalogues.

Okapi'86 was the subject of a further evaluative study (Jones 1988). The system was compared with an operational catalogue Libertas to determine: 1) User

preference for specific features, 2) User assessment of performance, 3) user attitudes to Okapi's recall improvement devices.

It was found that users with previous computer terminal experience objected to the use of coloured keys instead of standard function keys. Okapi's clearly formatted screens and Libertas' display of subject, location and circulation information on one screen was favoured. With regard to selection menu design there was a preference for specific choices for access points in Libertas ie. author, title etc. as opposed to Okapi's more general approach to access mode, i.e. 'find a book about something'. It is pointed out "that this preference is at odds with current interest in the design of transparent systems whose operations are invisible to the user". User assessment of the recall improvement devices supported the previous Okapi study. Searchers suggested that the facilities should also be extended to name and title searches as well. By contrast it was also suggested that these features should not necessarily be automatic but the user should be given the option to use them or not. It would appear that the debate on system versus user control will not be resolved without further study on user feedback in the search process.

Improving subject searching through retrieval aids or mechanisms supports the matching principle of

information retrieval. Whether an exact match or a closest match, success is dependent on the user knowing the language of the information system either the controlled vocabulary of the indexing language or the words in titles. Searchers have difficulty in matching either. The first step would be to attempt to provide users with new suggestions or alternatives to their own terminology. These contextual aids, by placing the user query in a subject context, could further assist searchers to reformulate their query and position it in a broader/narrower/related subject field. One approach to enhancing existing structures has been to explore the use of classification.

An early project at Bell Laboratories (Geller & Lesk 1983) produced a prototype which included menus for browsing Dewey classification hierarchies. Although users preferred keyword searching, the authors forsaw the potential of subject access through classification as a valuable complementary approach and recommended the need for further work.

The Dewey Decimal Classification (DDC) Online Project (Markey & Demeyer 1986) made a major contribution in this area. The experimental online system consisted of two separate catalogues: one the Dewey Online Catalog (DOC) incorporated the DDC classification for subject access, browsing and display: the other Subject Online Catalog (SOC) had the

traditional online subject searching capabilities, i.e. alphabetical subject headings, keywords in title and subject headings and class numbers. Online retrieval tests were carried out with library staff and patrons in four libraries on both systems followed by a post-search interview. As with CITE tests (Siegel et al 1983) both comparative and sample search experiments were performed. Although estimated recall and precision in the traditional catalogue (SOC) was overall significantly greater than the DDC enhanced catalogue, the latter retrieved items which were unique, ie. DDC gave access to a different set of references. A comprehensive failure analysis of individual subject search options revealed that searches dependent on keyword matching of user terms in DOC produced more relevant items, evidence of some improvement in subject access. With regard to the subject outline search option, unique to DOC, it wasn't the most successful but the key feature is that it wasn't dependent on user-entered terms and allowed the user to further specify and search. The inherent limitations in the wording of DDC schedule captions and the grouping procedure of leading searches to the shortest class number retrieved (ie. the broadest class number) account for the failures. The authors suggest (a) enriching the vocabulary of DDC captions to better reflect the subject matter of the items assigned to

those class numbers and (b) increasing the specificity of DDC by adding more levels of hierarchy in highly posted DDC numbers. They also recommend users to be directed to class numbers with the highest postings and that first items displayed should contain the user-entered terms.

These experiments also gave insight into user behaviour and expectations. For example searchers mistook the alphabetical lists of subject headings for lists of related terms and expressed the need for these. Faced with so many different search options they also wanted the system to identify the optimal choice automatically. Obviously it is not enough to introduce new search features. How these are integrated to ensure an effective search strategy is of paramount importance.

2.2.4 Examining searching behaviour: controlled experiments

The third approach in OPAC research is concerned with investigating the cognitive elements of searching behaviour. Through controlled experiments and searching performance tests, these studies aim to gain a better understanding of how users search in order to ascertain how they can be assisted to search more effectively.

Work undertaken by Borgman (1986b) is based on the theory that the user builds a mental model of the internal workings of the system. A person with a correct model has a conceptual understanding of how the system works and

therefore should perform better. A person with only a procedural knowledge will not possess a framework to relate to in different situations. In a benchmark performance test comparing procedural and conceptual training (i.e. Boolean logic and operators), more than a quarter of subjects failed to pass the pilot. Greater variance was found amongst the individual subjects than between the experimental variables. Science and engineering students passed the test whereas those in the humanities and social sciences tended to fail (Borgman 1986a).

Although individual differences may be pursued as one line of enquiry it must not deflect from the main issue. The question is whether users can be trained to develop a 'correct' model of the system outside the system per se, or should the system enable users to acquire a conceptual model through using the system itself, i.e. through interaction at the interface. The onus would therefore seem to be back on system design.

Another study assessed the performance of first time users in a controlled setting (Janosky, Smith & Hildreth 1986). Subjects were assigned five searches and given access to both online and off-line printed help. Although 24 out of 30 searchers tried the online help, search success rates ranged from 0% to 58%. Some problems arose in misinterpreting information on help screens as procedural instruction, for example subjects literally typed in "author" instead of the name of the author in author

searches. Users didn't read the entire context of help screens but stopped as soon as they thought they knew enough to continue. They also missed information and had difficulty in recovering from errors.

In identifying some of these difficulties it is becoming obvious that providing help is a complex cognitive process and differentiating between procedural and conceptual knowledge is certainly not easy. It may be that the naive user can with experience overcome the procedural problems in searching online, but there is every indication that the conceptual problems of the search task itself remain.

Measuring the effectiveness of catalogue instruction has been the object of a major project at Northwestern University (Nielsen, Baker & Sandore 1985). Two types of instruction, a brochure and a workshop, were given to two test groups of first year undergraduates. A third group receiving no instruction served as a control. Written tests as well as searches online were then administered. The analysis of written data and transaction logs showed that the group receiving instruction performed better in written tests and marginally better on the online searches. The control group however performed better than the group who had read the printed guide.

These inconclusive results raise questions about the content as well as the method of instruction and evaluation. The five learning objectives for the instruction programme include some daunting "enabling

objectives" (Baker 1986). For example distinguishing between terms which are meaningful as keywords for searching and those which are not, selecting controlled vocabularies as appropriate, using truncation and Boolean logic. These proved to be high expectations for first year students and may well be so for most end users. Baker points out: "One of the most important functions of the user interface is to provide some procedural training. In fact it is suggested that these techniques might be more easily acquired from instruction embedded in the system, once a conceptual model has been learned." If both procedural and conceptual knowledge are required it is nevertheless unclear how either can best be learned.

Looking more closely at the conceptual level and the searching task, Dalrymple (1987) using a combination of observation and protocol analysis, compared how users reformulated a set of assigned searches in a card catalogue and in an online catalogue within an operational setting. The study found that the online catalogue seemed to stimulate more reformulations but the card catalogue led to the retrieval of more items. The author concluded that "it is not known how the internal cognitive reformulation process interfaces with the external system." It appeared that the difficulty lay in isolating independent variables in the interaction and identifying the different types of feedback.

In an attempt to define characteristics of searching

behaviour, Sullivan (1986) designed a search planning exercise in which 6 expert and 6 novice users were asked to plan 32 assigned searches. From the verbal protocols, search plans were produced which the experimenter then used to carry out the searches. The findings reveal significant differences in the planning process between experts and novices in terms of understanding the query, how they simulated the search and how they evaluated their likelihood of success. Experts demonstrated greater planning skills and five types of decision rules were identified: to start, to restart, to avoid, to reach a goal and to reach a sub-goal. Novices concentrated on starting rules whereas experts focused on setting goals and planning alternatives in case of failure.

2.2.5 Summary of online catalogue research

Prototyping as a methodology for investigating different approaches to developing subject access has had some degree of success in addressing some of the problems highlighted by transaction log analysis. The different lines of enquiry into overcoming the mechanical problems, improving retrieval techniques and finding means of expanding searching vocabulary, certainly all need to be pursued further. But there remains an even greater obstacle in seeing how these improvements can be implemented and integrated to take full account of human factors. The issues of the user interface first discussed by Hildreth

(1982) have yet to be addressed. It would seem that development at the interface will depend not only on the enhancement of system features but also on having a good understanding of searching behaviour. The studies undertaken so far represent a beginning in finding means of acquiring that knowledge and understanding.

2.3 Subject access: U.K. and U.S. approach

The present study aims not only to further explore the methodological approach to research into traditional and online library catalogues, but in doing so it is necessary to take into account the different practices for subject access namely, the role of the classified catalogue and classification, the PRECIS indexing system and shelf browsing.

2.3.1 Classified catalogues

The majority of traditional catalogue use studies have been undertaken in American libraries on dictionary card catalogues. In the United Kingdom, libraries have favoured divided author and classified catalogues either on cards or microfiche, with separate subject indexes. Surprisingly there seems to be no data available on subject searching using classified catalogues and subject indexes. The U.K. catalogue use survey (Maltby & Sweeney 1972) reported minimal use of classified catalogues but no mention was made of the use of subject indexes. The issue of subject

access raised by online catalogues has revived an interest in classification for subject access in the U.S. The abiblity to browse by shelf-mark on the online catalogue is being advocated. However there are no indications that users are choosing that option when it is made available (Markey & Demeyer 1986).

2.3.2 PRECIS and LCSH

PRECIS (Preserved Context Index System) unlike LCSH (Library of Congress Subject Headings) has not been adopted as a standard indexing system by libraries. The Wollongong University Subject Catalogue Study (Hunt et al 1977) was an extensive experimental analysis of the use of PRECIS in a subject catalogue compared with LCSH and KWOC. It put forward a good case for the viability of PRECIS as a subject retrieval tool. Although PRECIS has had little impact in practice, discussions on the deficiencies of LCSH continue to cite PRECIS as a possible alternative (Williamson 1985). UK MARC records contain PRECIS strings and an experimental project is currently exploring the use of PRECIS for subject searching online (Congreve 1986). The present study will compare the use of PRECIS within the whole subject searching process in a traditional operational library setting as well as in the context of an online catalogue.

2.3.3 Shelf browsing

Users' apparent preference for the direct shelf approach in subject searching can be considered either as a negative response to the catalogue or as a positive response to the shelves. Even if subject searches are initiated at the catalogue, it has been found that users look for a shelf number location and proceed to the shelves to continue their subject search (Markey 1984). The inadequacies of library catalogues in supporting subject access have thus been tolerable because of the open access tradition of Anglo-American libraries which encourages the direct shelf approach for subject searching (Hyman 1971). Users' freedom to browse in a library collection is considered not only desirable but essential.

The acknowledgment of the user's need for direct access or browsing has not been coupled with any analysis of searching behaviour at the shelves or evaluation of the approach. The few studies that have been undertaken, have been carried out from a management perspective in terms of stock management or to quantify overall use of library materials apart from items recorded in circulation statistics (Fussler & Simon 1961, Slater & Fisher 1969). The observation of browsing in the shelf consultation has shown that the user handles a limited number of items in the process and ultimately selects but a few. Shelf browsing seems to produce not only low recall but also low precision. The searcher who depends solely on browsing at

the shelves, can also miss other related items scattered elsewhere in the collection.

With automated bibliographic files and online catalogues, browsing has also been applied to searching in computer systems. However the behavioural aspect of browsing as part of the information seeking activity is far from understood. Hildreth (1982) discusses mechanisms in online catalogues to support browsing, such as features for term selection and result manipulation and displays. It may be of value to examine the browsing activity in relation to both the retrieval tool and the shelves within the single context of subject searching as a whole. Rather than consider browsing at the shelves as an alternative to catalogue use, browsing support at the catalogue could perhaps improve retrieval effectiveness at the shelves.

2.4 Holistic approach to information seeking in the library

Information seeking in the library context can be divided between the catalogue user and the non-user, but the catalogue user also searches beyond the catalogue. The latter initiates the search at the shelves and the former completes the search at the shelves. It may be valuable to examine not only the differences between the two approaches to searching but also the common ground, since each is part of one and the same process.

The catalogue is a tool or an aid to searching. To observe searching behaviour solely at the catalogue

provides a partial picture of searching behaviour and the retrieval task. Furthermore behaviour at the shelves may be influenced by the use or non-use of the catalogue.

As a process, information seeking consists of a series of events and the seeker's pattern of behaviour depends on what comes before and after the different stages. The links between each step of the searching process are just as much an integral part of the search as the individual steps. To isolate one stage i.e. the catalogue consultation without reference to searching at the shelves would appear to confuse the means with the end.

Moreover to apply performance measures to the catalogue separately from the user's objective can only produce limited results as manifested by the findings of traditional catalogue use studies. Sub-goals may be set but these should be assessed in relation to the overall goal as set by the user himself.

In adopting a holistic approach to the library searching activity, the present study aims to observe user behaviour in terms of the user's perspective rather than that of the system's perspective as advocated by Dervin and Nilan (1986). In comparing subject searching behaviour in both the traditional and online library environment, in an operational setting with 'real' users generating their own searches, some insight may be gained on some of the fundamental characteristics of user information seeking behaviour. Furthermore it is hoped that the emphasis on

qualitative analysis will provide more information on how users search.

2.5 Research questions and objectives

The study addresses the following research questions:

1. What is the real extent of subject searching at the library catalogue?

2. What is the nature and effectiveness of subject searching via the catalogue?

3. What is the nature and effectiveness of searching at the shelves?

The objectives of the project are defined as follows:

1. To examine the searching process for monographic materials in the context of the library as a whole.

2. To gather qualitative and quantitative data on searching behaviour before and after the implementation of an online catalogue.

3. To determine which elements of user behaviour are influenced by the bibliographic tool.

4. To assess which aspects of user behaviour could provide feedback to the future design of online interactive catalogues.

CHAPTER 3

METHODOLOGY

Introduction

The experimental design of the present study aims to capture as much of the searching process as possible both in breadth if not in depth. A holistic approach and combined methodology have been adopted in an attempt to circumvent the methodological constraints of previous studies. Some of those constraints and limitations have stemmed from:

a) a dependence on the catalogue consultation alone to inform on information seeking process as a whole,

b) a reluctance to use more direct or diverse means of eliciting information from users for fear of interfering with the search process,

c) a reliance on users themselves to provide adequate information before or after the event.

In this chapter specific data gathering methods used in catalogue studies are considered in greater detail. This provides the background and basis for the combined methodology which has been devised for this study. Each aspect of the methodology is then described including the experimental context, the procedures followed for data gathering and the method of analysis.

3.1 Verbal data: eliciting information from users

3.1.1 Questionnaires and interviews

In past catalogue use studies, questionnaires and interviews have been the dominant data gathering methods. The point at which the searcher was interrogated has varied and has to a large extent determined the type, amount and reliability of data collected.

In the U.K. catalogue use survey (Maltby, 1973), library users were interviewed as they left the library and were asked to recall their last search as well as to generalise on how they would normally search. Lipetz (1972) in the Yale study, interviewed users before and after they had consulted the catalogue and focused on a more immediate and specific search. In doing so he was able to ascertain whether or not users really did what they set out to do and discovered that searchers had immediate and underlying objectives in searching.

Tagliacozzo et al (1970) went further by questioning subjects about success and failure at different stages during their consultation and thus partly followed the progression of the search by identifying the different strategies adopted by searchers after their initial access to the catalogue. They also followed up the catalogue consultation by questioning users when they returned from the shelves and found that subsequent shelf-browsing was widespread.

The objective in these studies was to examine the usage of library catalogues i.e. how catalogues were used. The indirect and partial approach provided an incomplete picture of catalogue searches. As a result little is revealed about searching as a process and the interactive nature of user searching behaviour. Nevertheless some significant clues as to possible lines of enquiry are to be found.

3.1.2 Protocol analysis

Experimenters avoided a more direct approach to eliciting information from the user on the grounds that it would interfere and possibly distort the search process. Ericsson and Simon's (1980) seminal paper on verbal reports as data has led to the use of protocols or spoken thoughts in task analysis in a number of fields involving man-machine interaction or decision making processes. Markey (1984) applied protocol analysis to study manual subject searching at the library catalogue. With minimal prompting by the experimenter, the searcher was encouraged to talk aloud as the search was carried out. The proceedings were recorded on a tape recorder and from the transcript a flow chart of the different steps in the complete search was produced indicating all the decision points and actions taken by the searcher. From the coded protocols, searching patterns of behaviour emerged and models of different types of searches were identified.

This method of eliciting information from the user does generate a vast amount of data. It appears to be an effective way of obtaining a typography of searches but the transcription and subsequent coding are very time consuming. The combined observation and talk aloud technique with real time interpretation adopted in the present study was a means of capturing the same essential data relating to search patterns and overall search progression without having to deal with an excessive amount of data for analysis.

3.2 Non-verbal data: observation and transaction logs

In addition to verbal data in the study of catalogue use, observation both direct and indirect, has also been used as a method of obtaining evidence. For example Lipetz (1972) used this approach to establish catalogue traffic flows. He also observed users during catalogue consultations as a means of obtaining clues on search outcome.

With the advent of the online environment came the possibility of observing the user directly and unobtrusively without interrupting the search process. Automatic monitoring of activity on the computer system, i.e. logging transactions was regarded as a powerful technique for evaluating user system interaction and performance. However the type of quantitative global data elements recorded, i.e. search commands, occurrence of

errors, number of hits and time factors, did not provide sufficient information or the right type of data to inform adquately on how or why users searched the way they do. As a diagnostic tool for failure analysis the emphasis remains on the system's perspective rather than on the user.

It would appear that more qualitative data is required focusing on the user as a starting point, and on individual searches in their entirety. The linking of verbal and non-verbal data in the combined method described in sections 3.4 and 3.5 of this chapter is an attempt to get a more complete and reliable picture of the search process and thus overcome some of the problems and inherent limitations of previous data gathering methods.

3.3 Experimental context and variables

The present project was designed as a 'before and after' study to evaluate the impact of an online catalogue on subject searching in the library at City University.

The experimental variables for determining differences in searching behaviour were concerned with comparing:

a) the use of the different bibliographic tools, manual and online,

b) users as well as non-users of the bibliographic tools in the manual and online context,

c) searching behaviour at the shelves for both users and non-users of the bibliographic tools

3.3.1. Bibliographic tools

Before the installation of the CLSI CL-Cat online catalogue, a number of bibliographic tools were provided by the library. A printed PRECIS index was the major subject access tool and others included a printed subject guide, and separate classified and author/title COM catalogues. All of these bibliographic tools were still available after the installation of the online catalogue, except for the PRECIS index which had been withdrawn. The microfiche catalogues however were no longer being updated and at the time of the data collection after the installation, these were already three and eight months out of date.

3.3.2 Users and non-users

In adopting a holistic approach to searching behaviour users and non-users of the bibliographic tools were taken into account. It was therefore necessary to select library users as they entered the library and follow them until they were deemed to have completed their searching activity. This meant accompanying them throughout their search regardless of whether they used a bibliographic tool or went directly to the shelves. If they did use a bibliographic tool they were also followed if they pursued their search at the shelves.

3.4 Combined methodology for collecting verbal and non-verbal data

In order to capture the search process in its entirety as well as to extract and record informative data on the searching activity in the different environments, i.e. printed bibliographic tools, microfiche catalogues, online catalogue and the shelves, a combined methodology was devised in the 'before' study and then adapted and further developed for the 'after' study which focused on the online catalogue.

This consisted of verbal and non-verbal data being collected in a combination of direct observation and talk-aloud technique together with a highly structured dual purpose observation and questionnaire form incorporating some real time interpretation. In the case of the online catalogue searches, each screen display in the search session at the terminal was also logged and these transaction logs served as a more comprehensive record of each of the search sessions for the purpose of analysis.

3.4.1 Observation and talk aloud technique

Subjects were encouraged to talk aloud as they searched merely to give an indication of what they were looking for and to confirm whether or not they succeeded. The direct observation of searchers' actions provided the experimenter with the framework of the activity whilst the verbal data gave the details which could not be easily observed or

which were not observable. Searchers' actions confirmed what they said they were doing or vice versa. For the most part subjects spoke easily as they searched and described their immediate activity in a procedural way without offering any in depth explanations. Non-directional questions or prompts were only asked by the experimenter at an opportune time for clarification or when the search session was over. Great care was taken not to interfere with the searching process. A certain element of artificiality cannot be denied but it did seem more 'normal' for the user to talk in the presence of the experimenter than to be observed in silence.

In the before study, the experimenter noted the catalogue and indexes used, the information brought to the catalogue, the access points and the information recorded and taken to the shelves. In the case of the PRECIS printed index, searchers tended to point to relevant entries which made it easy for the data collector to note.

At the shelves, the starting point, the order and number of shelves scanned, and the titles on the spines of the books taken off the shelves for examination, were some of the main features which were observed and recorded. Any further selection criteria indicated by the user were also noted particularly if they consulted contents pages or back of the book indexes.

In the online environment, the experimenter was less dependent on the users' verbal evidence because the screen

displays made the searching process much more observable than with the microfiche catalogue.

The keyboard of the PC used for searching the catalogue in the study differed slightly from that of the normal OPAC and an initial explanation of the function keys was given before the start of the session. Assistance was readily provided by the experimenter whenever users had any difficulty in finding the appropriate function key. Very few comments were offered by users on the procedural or mechanical operation of the system. Whenever such problems arose, these did not seem to distract the user from the main task at hand.

3.4.2 Screen logging facility

Unlike transaction logs in other studies which provide a form of coded partial record of search sessions, the facility used in this project captured all the screen displays intact without any reformating for output. The experimenter called up the library catalogue from the opening menu of the logging programme at the beginning of each user session, and explained to the user that the system being searched was exactly the same as that available from the other terminals close by. The experimenter marked the end of the session by pressing a function key. By this procedure individual sessions were clearly identified and a time stamp also recorded the length of the session. An exact record of screen

transactions was available for printing and analysis, thus complementing the data collected from the observation and talk aloud technique.

3.5 Data recording

A colour coded, highly structured, dual questionnaire observation form was devised to record the data collected from the observation talk aloud technique (Appendices 1 and 2). Through this instrument it was possible to carry out some real time interpretation and analysis. The initial version used for the manual study was adapted for the online study. Although the screen logging facility provided a complete record of the OPAC searches, it was still necessary to record in real time all of those elements of the search which would have some bearing on the continued activity at the shelves. Furthermore the logs provided information on what was viewed but gave no indication of users' final decisions on what was selected.

To assist in the analysis of the PRECIS index searches, a photocopy of the relevant pages consulted by the user was made after each search. Entries were highlighted in the context and order in which they were selected by the searchers, (Appendix 3).

3.6 Samples of library users

Three data collection exercises were undertaken. The first, which will be referred to as the 'pre-OPAC sample',

was carried out before the installation of the online catalogue. The second, the 'OPAC2 sample' was collected after the installation of the online catalogue and replicated the holistic approach of the first sample in order to provide quantitative comparative data on the impact of the online catalogue on the overall searching activity, (Sections 4.1 to 4.1.4). In addition a third sample, the 'OPAC1 sample', was also used in conjunction with the 'OPAC2 sample' for the more in-depth qualitative analysis of searches on the online catalogue, (Sections 4.2 to 4.6). Procedures for the collection of each of these samples are described in detail below.

3.6.1 Pre-OPAC sample

The 'pre-OPAC sample' was a random sample of library users accrued over a period of six weeks in the second term of the academic year 1985-86 at the City University Library, before the installation of the online catalogue. Data collection was carried out during one-hour sessions dispersed throughout opening hours 9 am to 9 pm, although the bulk was done during the most active period between 10 am and 4 pm. Every fifth person entering the library was approached. The experimenter explained that "a survey is being conducted on the use of the library and is linked with the library's intention to install a new computer system". Library users were then asked why they had come to the library. Those who indicated that they intended to look for library book material in any fashion were invited to

participate. Those who intended to carry out other activities i.e. photocopy, return books, study or look for periodicals, were simply thanked for stating the purpose of their visit and were not selected.

The ninety-eight cases who qualified were asked to carry on with their intended searching activity and permission was sought to accompany them and observe as they carried out their task. The wording took the following form: "Do you mind if I come with you and see how you go about finding what you are looking for? I only want to observe and won't be able to assist you. If you could just talk aloud as you go along would that be OK?" Only three individuals refused and the remaining ninety-five agreed readily.

3.6.2 OPAC1 sample

This sample took four weeks to collect during the summer term in June 1988, in the third month after the installation of the online catalogue. Although the intention at the time was to approach users as they entered the library and to replicate the pre-OPAC sample in all procedures, it was found that being examination time, a very high proportion of users were coming to the library for study purposes and indicated that they would not be looking for book materials. Selecting users was proving to be very slow and therefore it was decided to select users as they approached the online catalogue instead.

Library users who were about to consult the catalogue were intercepted and invited to conduct their search on a PC which was installed alongside a bank of OPAC terminals. Although the equipment looked slightly different than the rest of the terminals at hand, users were reassured that they would be searching exactly the same system. Users were led to believe that the experimenter's interest was in the performance of the hardware. Permission was sought to observe them as they interrogated the system and they were also asked to talk aloud as they proceeded. Ninety-one users were asked to participate and no-one declined. As in the other samples users were also followed to the shelves after the consultation.

The data from this sample served to support the qualitative analysis of subject searching behaviour on the online catalogue (Sections 4.2 to 4.6) and did not contribute to the analysis of the comparative 'before and after' impact study of the overall searching activity (Sections 4.1 to 4.1.4), represented by the 'pre-OPAC' and 'OPAC2 samples.

3.6.3 OPAC2 sample

This second OPAC sample was collected over a period of three weeks in the middle of the first term in autumn 1988. The online catalogue had been installed in March 1988. The same procedure was followed as with the 'pre-OPAC sample' with the exception that every third person entering the

library was approached and in the preamble no mention was made of the computerized library system in order to ensure that library users were not being influenced or in any way predisposed towards the use or the non-use of the catalogue. Eight persons who could have qualified, declined to participate whereas 100 others accepted.

For those who chose to search on the online catalogue, these cases were observed under the same conditions as described in section 3.6.2 for the OPAC1 sample.

3.7 User sessions and individual searches

The analysis of data collected from all three of the above samples was based on the number of individual searches as opposed to the number of searchers or user sessions. A small number of subjects did carry out multiple searches during a search session and these were counted separately. Multiple searches were identified as searches carried out within a single session but which could be considered independently. However if a searcher looked for a number of items listed on a reading list for example, if these were on the same subject the search was defined as a single search. If on the other hand they were substantially different dealing with different topics on a course of study, the search was considered as a multiple search and counted as such. The final count for each of the samples, taking into account all of the multiple searches within individual sessions, stands as follows:

Pre-OPAC sample: 95 searches (95 user sessions)

OPAC1 sample: 100 searches (91 user sessions)

OPAC2 sample: 104 searches (100 user sessions)

3.8 Methods of data analysis

A quantitative macro analysis of the pre-OPAC and OPAC2 samples was undertaken initially to inform on the overall approaches to searching adopted by library users before and after the installation of the online catalogue. This was followed by a qualitative micro analysis of subject searching in particular, both at the bibliographic tools and at the shelves.

3.8.1 Quantitative analysis

In the quantitative analysis the progress of each search in the pre-OPAC and OPAC2 samples was categorized by steps and the data sets were mapped out and then compared: firstly, to provide an overview of searching patterns and approaches with regard to the use and non-use of the different bibliographic tools; secondly, to identify the types and extent of searches, i.e. specific item or subject searches in the context of the whole searching environment inclusive and exclusive of the bibliographic tools, (Section 4.1-4.1.4). The aim was to ascertain the impact of the online catalogue on the occurrence of subject searching.

3.8.2 Qualitative analysis

For the qualitative analysis, subject searches were considered in two stages representing the searching activity at the bibliographic tool and at the shelves. Attention was given to the evolution of searches at the different bibliographic tools, the transition from the PRECIS index or the catalogue to the shelves and the relationship between searching behaviour at the bibliographic tool and at the shelves.

This linear approach was used to examine four different aspects of the searching process. The first was concerned with the linguistic development of subject searches, i.e. the language and terms used to formulate searches including users' own descriptions and the vocabulary of the bibliographic tool. These were in turn compared with the words in titles of books examined and selected at the shelves. The progression of searches was also analysed to show the relationship between success and failure and users' motivation and perseverance in searching and furthering their search at different stages in the search process. A third aspect was to assess the role of classification and class numbers in subject searching, both at the catalogue and at the shelves. Finally browsing behaviour at the shelves was examined to ascertain whether any parallels could be drawn with browsing on the online catalogue.

A more detailed description of the analysis for each of these aspects is presented in the next chapter together with the results.

CHAPTER 4

ANALYSIS AND RESULTS

4. Introduction

In this chapter the results of the study are presented together with a detailed description of the method of analysis for each of the data sets. The first section reports on the macro quantitative analysis of the searching activity before and after the installation of the online catalogue, focusing on the extent of subject searching, searching patterns and the use of the bibliographic tools. The comparative results of the qualitative analysis which follows, cover four aspects of the subject searching process: search formulation approaches in the use of the bibliographic tools and their correlation with documents examined and selected at the shelves, success and failure rates and user perseverance at the bibliographic tools and at the shelves, the role of classification in subject searching, and browsing at the shelves and on the online catalogue.

4.1 Searching Activity

The searching activity of library users was observed in its entirety in two main data gathering exercises:

a) before the installation of the online catalogue when the following manual bibliographic tools were available, i.e. pre-OPAC sample:

   1. author/title microfiche catalogue
   2. Precis printed index
   3. Subject guide
   4. Classified microfiche catalogue

b) after the installation of the online catalogue, when the following bibliographic tools were available, i.e. OPAC2 sample:

   1. Online catalogue
   2. Author/title microfiche catalogue
   3. Classified microfiche catalogue

Although the microfiche catalogues were still available in parallel with the online catalogue, none of the subjects in the after study used them.

The observation of the entire search process revealed that users looked for book materials in a variety of ways. They differed not only in their use or non-use or choice of bibliographic tools but also in the way they initiated their search, the number of steps they followed and the sequence or combination of those steps.

Tables 1A and 2A categorize the different approaches in the use of the bibliographic tools and the shelves that

were observed, and Tables 1B and 2B map out the initial approach and progress of all the searches in the pre-OPAC (See section 3.6.1) and OPAC2 samples (See section 3.6.3)

In addition to the two main data sets, a third subsidary set represented in Table 2C and referred to as the OPAC1 sample, (See section 3.6.2) was also collected. The data from this sample is combined with that of the OPAC2 sample to support the qualitative analysis of searching behaviour presented in sections 4.2 to 4.6. It is not however included in the more quantitative analysis of the overall 'before and after' searching activity discussed in section 3.8.1 and treated in sections 4.1.1 to 4.1.4.

TABLE 1A. Steps in searching manual bibliographic tools and the shelves, grouped by category

Step	Description
A	Author/title microfiche catalogue
A1	Author/title microfiche catalogue, lead term search
B	Shelves, specific item search
C	Shelves, subject search
D	Precis index
E	Subject guide
F	Classified microfiche catalogue

TABLE 2A. Steps in searching the online catalogue and the shelves, grouped by category

Step	Description
AA	Online catalogue, author/title specific item search
B	Shelves, specific item search
C	Shelves, subject search
DD	Online catalogue, subject search

TABLE 1B. Analysis of searches in the manual bibliographic tools and at the shelves, showing the order of steps: Pre-OPAC sample

Steps used in search, in order																								No. of searches
A																								6
*A		A1		B		C																		1
A				B																				15
*A				B		C																		8
*A						D																C		2
*A								E		F												C		1
		A1																						1
		A1				C																		7
		A1		B		C																		3
				B																				5
				*B		C																		3
				B						F														1
						C																		15
						C		D														C		1
						C				F														1
						C				A1												C		1
								D				F												1
								D														C		11
								D		A1														1
								D		A		B												1
								D		A		B										C		1
						D		F		B												C		1
								E		B														1
								E														C		3
								E				D										C		2
								E				F										C		1
								E		D		F		A1				B				C		1
Total number of searches																								95

*Searches initiated as specific item searches and then developing into subject searches.

TABLE 2B Analysis of searches in the online catalogue and at the shelves, showing the order of steps: OPAC2 sample

Steps used in search, in order											No. of searches
AA											12
AA	B										12
*AA	B										1
*AA	B	C									3
*AA	B	C							B	C	1
*AA		C									4
*AA		C	AA						B	C	1
AA				DD	AA						1
*AA				DD	AA	DD	AA	DD	B		1
*AA				DD					B	C	3
*AA				DD	AA				B	C	1
	B										11
	B		AA						B		4
	*B	C									7
	*B	C	AA								1
		C									19
		C	AA	DD					B	C	1
		C		DD					B		1
		C		DD	AA				B		1
	C			DD					B	C	1
	C			DD						C	1
				DD							1
				~DD							1
				DD					B		5
				DD					B	C	4
				DD						C	3
				~DD	AA						1
				DD	AA	DD	AA		B	C	1
				DD	AA					C	1

											104

Total number of searches

*Searches initiated as specific item searches and then developing into subject searches.

~Apparent subject searches which were specific item searches

TABLE 2C Analysis of searches in the online catalogue followed at the shelves, showing the order of steps: OPAC1 SAMPLE

Steps used in search, in order										No. of searches
AA										24
*AA										3
AA	B									20
*AA	B	C								7
*AA		C								4
*AA			DD							3
AA			DD	AA						1
*AA			DD	AA				B		1
*AA			DD	AA				B	C	1
*AA			DD	AA	DD			B	C	1
			~DD							4
			DD							3
			DD					B		8
			~DD					B		2
			DD					B	C	11
			DD					B	C	B 2
			DD						C	3
			DD	AA				B	C	1
			DD	AA	DD	AA		B	C	1
							Total number of searches			100

*Searches initiated as specific item searches and then developing into subject searches.
~Apparent subject searches which were specific item searches

To ascertain the overall impact of the installation of the online catalogue on library users' searching behaviour, the pre-OPAC and OPAC2 samples were first analysed to compare:

a) the extent of subject searching as opposed to specific item searching, before and after

b) the use or non-use of a bibliographic tool in subject or specific item searching

c) the dominant combination of steps or searching patterns adopted

4.1.1 Defining subject searches

The true identity of the different types of searches was not always evident at the outset of a search. To establish the type of search, the initial approach through to the final outcome had to be taken into account. In the pre-OPAC sample it was found that out of a total of 42 cases initiated as specific item searches, (Table 1B initial categories A or B) 15 cases (36%) developed into subject searches (including any subsequent category A1, C, D. or E, Table 1B). Similarly in the OPAC2 sample, 23 out of 63 cases (37%) initial specific item searches (Table 2B initial categories AA or B) also subsequently contained subject search characteristics and were thus regarded to be subject searches (including any subsequent category C or DD Table 2B). Cases thus classified as subject searches are marked with an asterisk in Tables 1B, 2B.

Searchers who initiated a search for a known item:

a) looked for alternatives at the catalogue or at the shelves if they failed to find the intended item;

b) having found the intended item, looked for additional works either in the catalogue or at the shelves;

c) intentionally used a known item as a means of locating a relevant area at the shelves to carry out a subject search.

Such searches, in spite of their initial objective or tactic, taken as a whole, have been deemed to be essentially subject searches and thus have been classed as such.

The reverse, i.e., specific item searches disguised as subject searches did not appear to occur in the pre-OPAC sample but 2 cases did occur in the OPAC2 sample (Category ~DD, Table 2B).

Table 3 compares the occurrence of hybrid and pure subject searches before and after the installation of the online catalogue. Pure subject searches contain categories A1, C, D, E, or F in the pre-OPAC sample (Table 1B, 53 cases), and categories C, or DD only in the OPAC2 sample (Table 2B, 39 cases). A higher proportion of hybrid subject searches occurs in the OPAC2 sample 37% as opposed to 22% in the pre-OPAC sample.

TABLE 3 Hybrid and pure subject searches

Sample	Hybrid subject searches	Pure subject searches	Total no of cases
Pre-OPAC sample	15 (22%)	53 (78%)	68
OPAC2 sample	23 (37%)	39 (63%)	62

Hybrid subject searches initiated as specific item searches at a bibliographic tool are divided in Table 4 into those where the subject searching element occurred at the bibliographic tool (initial category *A followed by category A1, D, or E, 4 cases Table 1B: initial category *AA followed by category B only or DD, 6 cases Table 2B) and those where the subject searching was introduced at the shelves, (initial category *A followed by B and C, 8 cases Table 1B; initial category *AA followed by B and C or C, 9 cases Table 2B).

TABLE 4 Hybrid subject searches initiated at a bibliographic tool

	Hybrid searches subject searching at a bibliographic tool	Hybrid searches subject searching at the shelves	Total no of cases
Pre-OPAC sample	4 (33.3%)	8 (66.7%)	12
OPAC2 sample	6 (40%)	9 (60%)	15

Although the subject searching element tends to be introduced at the shelves, its occurrence at the online catalogue is slightly higher than previously, 40% as opposed to 33.3%. (In the subsidary OPAC1 sample it is also comparable at 45%, initial category *AA only or followed by DD, 9 cases out of 20, Table 2C). However if all hybrid subject searches, initiated both at a bibliographic tool and at the shelves, are taken into account, the distribution in the pre-OPAC and OPAC2 samples is very similar, with subject searching occurring at the shelves being dominant, 73% and 74% (Table 5).

TABLE 5 Hybrid subject searches initiated at a bibliographic tool and at the shelves

	Hybrid searches initiated at a bibliographic tool	Hybrid searches initiated at the shelves*	Total no of cases
Pre-OPAC sample	4 (27%)	11* (73%)	15
OPAC2 sample	6 (26%)	17* (74%)	23

*Includes searches undertaken at the shelves only (Initial category *B followed by C, 3 cases, Table 1B, 8 cases Table 2B).

4.1.2 Extent of subject searching and the use of bibliographic tools

One of the objectives of the project was to establish the extent of subject searching and its relationship with the use of bibliographic tools. Table 6 compares the subject and specific item searches and the type of approach adopted by the user in initiating the searches.

The data relates to Tables 1B and 2B as follows:

- Subject searches at a bibliographic tool:

  initial categories *A, A1, D, and E, 47 cases, Table 1B

  initial categories *AA and DD, 30 cases, Table 2B

- Subject searches at the shelves:

  initial categories *B and C, 21 cases, Table 1B

  initial categories *B and C, 32 cases, Table 2B

- Specific item searches at a bibliographic tool:

  initial category A, 21 cases, Table 1B

  initial category AA and ~DD, 27 cases, Table 2B

- Specific item searches at the shelves:

  initial category B, 6 cases, Table 1B

  initial category B, 15 cases, Table 2B

TABLE 6 Subject and specific item searches initiated at a bibliographic tool and at the shelves

Type of search	Pre-OPAC sample no. of searches	%	OPAC2 sample no. of searches	%
Subject searches at a bibliographic tool	47	50	30	29
Subject searches at the shelves	21	22	32	31
Specific item searches at a bibliographic tool	21	22	27	26
Specific item searches at the shelves	6	6	15	14
Total no. of cases	95	100%	104	100%

We find a predominance of subject searching, 72% (50% + 22%) and 60% (29% + 31%) and the use of bibliographic tools stands at 72% (50% + 22%) for the pre-OPAC sample and 55% (29% + 26%) for the OPAC2 sample.

It would appear that the online catalogue did not promote an increase either in subject searching or in the use of the bibliographic tool. In the pre-OPAC sample 50% of searches were subject searches initiated at a bibliographic tool whereas in the OPAC2 sample there were 29%. A number of reasons could account for this difference particularly with this type of sampling where numerous variables cannot be replicated or controlled. A more detailed analysis of the searching patterns within the broad categories brings further differences to light.

4.1.3 Subject searching patterns

In addition to hybrid searches discussed earlier, library users adopted a number of strategies in searching for books as shown in Tables 1B and 2B. Searching directly on the shelves remains the dominant single approach for subject searching (Category C, 15 and 19 cases, Tables 1B 2B). In the pre-OPAC study the second preferred option for subject searching was to consult the Precis index and then to proceed directly to the shelves (Categories D + C, 11 cases, Table 1B). The majority of searchers used the subject index or guide or the catalogue to extract a class-mark identifying an area of the shelves where they could pursue their subject search (Searches including any of the following categories A1, D, E, and F, with C but not B, 29 cases, Table 1B).

In the OPAC2 sample the opposite occurs. Searchers who

used the online catalogue for subject searching tended to find a specific item(s) and then proceeded to look for them at the shelves (Category *AA + B, and searches including both categories DD and B, 20 cases, Table 2B). Table 7 compares the different types of search outcomes for the two samples.

TABLE 7 Outcomes of subject searches using bibliographic tools*

Search outcome	Pre-OPAC sample no. of searches	OPAC2 sample no. of searches
Class no(s).	29	9
Specific item(s)	9	20

*Hybrid subject searches initiated at a bibliographic tool but with the subject searching element carried out at the shelves are not included.

Specific items as an outcome of subject searching at the online catalogue is significant in view of the predomiance of 'shelf-browse' searches reported in traditional dictionary catalogues (Markey 1984), where bibliographic references were used merely to confirm the relevant subject areas. The divided catalogue and separate subject index in the pre-OPAC study may encourage a 'shelf browse' approach but apparently does not fully account for this phenomenon.

This must also be considered in the light of the negligible

role of the classified catalogue and the shelf-mark search option on the online catalogue. No subject searches were initiated at the classified catalogue and when the classified catalogue was consulted in the course of a search (6 cases, category F, Table 1B) none of the consultations resulted in a search for a specific item at the shelves. Moreover the class mark search option available in the opening menu of the online catalogue was never used to initiate a search and was used only once in the progress of a search.

4.1.4 Specific item searching patterns

In the case of specific item searching, the straight forward path from bibliographic tool to the shelves appears to be the norm (Categories A + B, 15 cases and AA + B, 12 cases, Tables 1B 2B). There is a difference between the two samples in the number of cases which do not go further than the catalogue, i.e. all failed searches, 6 cases in the pre-OPAC sample and 12 cases in the OPAC2 sample (Categories A and AA Tables 1B, 2B). The availability of circulation data on the OPAC partly accounts for this, 9 out of the 12 searches found item(s) on loan and 3 were failed searches. Such searches are even more evident in the OPAC1 sample where out of 24 cases 16 found item(s) on loan (Table 2C, initial category AA only).

Another difference lies in the number of specific item searches initiated at the shelves (Initial category B, Tables 1B, 2B), 9 cases in the pre-OPAC sample and 23 cases

in the OPAC2 sample). Searchers were asked if they had consulted the catalogue on a previous occasion in relation to their current search. In the pre-OPAC sample 3 out of 9 had consulted a bibliographic tool and in the OPAC2 sample 13 out of 23 had used the online catalogue at some stage beforehand. It was not ascertained whether the previous related searches had been for the same specific item searches, or subject searches resulting in the current specific item searches. A few searchers did remark that they knew when certain items on loan were due to be returned and they were going directly to the shelves where they expected to find them. Clearly library users are taking into account circulation data available on the online catalogue.

4.2 Search formulation and orientation in the use of the PRECIS index and the online catalogue

Having identified subject searches in the initial quantitative analysis of the data sets, the next stage was to carry out a qualitative analysis on the search formulation of those cases.

From the pre-OPAC sample only those subject searches initiated at the PRECIS index were selected, i.e. 22 cases (Category D, Table 1B). Five other cases, which were not included in the pre-OPAC sample because they were recruited directly at the PRECIS index and not as they entered the library, were also added to make a total of 27 cases.

For the online catalogue, all searches which included a

subject searching element at the catalogue in both samples, OPAC1 (Category DD, 36 cases, Table 2C), and OPAC2 (Category DD, 26 cases, Table 2B), were combined into one data set totalling 62 cases.

The first step of the analysis of search formulations at the bibliographic tool examined how a user's query or expressed topic is related to the initial access to the bibliographic tool, i.e. whether or not it is modified and if so how is it modified, is it broadened or narrowed? This corresponds to Taylor's (1968) formalized need (Q3) and the compromised need (Q4) and is referred here as 'the initial search formulation'. Unlike the case of a reference enquiry, the query here is presented directly to the system without the benefit of an intermediary to allow for negotiation.

The second step looked at the subsequent orientation within the bibliographic tool to see whether or not the tool provided an opportunity for experimentation or negotiation in refining or expanding users' requirements. Subsequent access points during the consultation which were deemed by the searcher to be relevant or of interest at the end of the consultation, were compared with the initial access point to see how they related in their context.

The third step then compared the access points deemed relevant at the point of exit from the bibliographic tool with the expressed topic declared by the user at the outset. This determined the 'final search formulation'.

The comparison of the 'final search formulation' with the 'initial search formulation' was intended to show how the bibliographic tool could influence the formulation of subject searches and to what extent or at what stage search formulations were indeed 'a compromise'.

The three steps in the search formulation analysis are summarized below. They consist of:

1. the transition from the expressed topic to the first access point, i.e. the initial search formulation,

2. the transition from the first access point through subsequent access points to the exit point(s), i.e. the orientation in the bibliographic tool,

3. the overall transition from the expressed topic to the exit point(s), i.e. the final search formulation.

The results of the analysis are presented in sections 4.2.2 to 4.2.5.

4.2.1 Classification of search formulations

Each transition was classified as exact, narrow to broad, or broad to narrow, according to the contextual relationship between the terms of the expressed topic, initial access point, subsequent access point and exit point. In some cases the contextual relationships could have been described by categories other than exact, broad, and narrow, however it was found that the hierarchical interpretation suited the majority of cases. A few cases could also have been assigned more than one classification, however the more dominant approach was chosen. The

classification for all of the subject searches undertaken in the PRECIS index and the online catalogue are included in Appendices 4 and 5.

For the PRECIS index only those entries or access points which were singled out in a positive fashion by the searcher in the course of the consultation were noted. The exit points were easily identified in that they corresponded with the user noting specific class numbers verbally or written.

In the online consultations, the initial access is represented by what the user typed in first. Subsequent access points are a mixture of what users input and the system's responses. Successful user search terms may or may not have led to useful titles. Titles which were taken into consideration by the searcher are listed and underlined for each access point. Unsuccessful access points are starred. System's output (i.e. subject headings) which didn't exactly match user search terms are marked with crosses; one cross indicates a direct system response, two crosses indicate that the user found the heading by browsing the display of subject headings. Exit points are also a combination of successful search terms or titles, the latter are underlined. If a subject heading is given as an exit point, it implies that only the corresponding class number was noted by the user and no specific title was selected.

4.2.2 Initial search formulation: expressed topic and initial access to the bibliographic tool

Subject interests were expressed in a very concise manner. 'Expressed topics' averaged 2.4 terms for users of the PRECIS index and were even fewer for the online catalogue users, 2 terms only. Access to both bibliographic tools revealed an interplay of two approaches: contextual and matching. In the former searchers altered the expressed topic in order to find relevant terms in the tool and in the latter they attempted to match the expressed topic directly with the tool. Initial access terms which were partially different from the expressed topic may have encompassed either or both approaches, straight matching and/or contextual. It was not possible to ascertain in which circumstances a user would adopt a matching approach as opposed to a contextual one or vice-versa. For example in the case of 'short term and long term memory' being given as an expressed topic, it is unclear whether the choice of the term 'memory' only as an access term instead of 'short term memory' was an attempt to find the most appropriate term to match the language of the index or whether there was a attempt to place the query in a broader context to include both specific aspects, i.e. short term and long term memory.

Tables 8A and 8B show the contextual relationship between the expressed topic and the terms chosen for the initial access to the PRECIS index and the online

catalogue.

TABLE 8A Expressed topic and initial access to the PRECIS index

Type of approach	No. of cases	%
Exact	14	52
Narrow to broad	12	44
Broad to narrow	1	4
Total	27	100%

TABLE 8B Expressed topic and initial access to the online catalogue

Type of approach	No. of cases	%
Exact	36	58
Narrow to broad	17	27
Broad to narrow	9	15
Total	62	100%

Having chosen their initial access point, 22 out of 27 cases in the PRECIS index then succeeded in finding them, and 5 cases failed (18.5%). In the online catalogue 12 out of 62 cases (19%) didn't succeed in their initial access, whilst another 15 cases partially matched their initial access points, either through the system displaying a closest match or the searcher browsing subject headings. Partial matches were not as apparent in the PRECIS index consultation since the searcher's intention was not as explicit as in the online catalogue where the user typed in the initial search terms.

Although the approaches to the initial search formulation in both bibliographic tools are comparable, with exact formulations amounting to more than half, the narrow to broad initial search formulations in the online catalogue are less dominant than those in the PRECIS index. This is coupled with a 11% higher occurrence of a broad to narrow approach in the online catalogue.

4.2.3 Orientation in the bibliographic tool

The second stage of the analysis examined how searchers fared once they had accesssed the bibliographic tool. The various tactics followed are given in Tables 9A and 9B. A change in search strategy in the context of the online catalogue, refers to switching from a strict subject approach to include a specific item approach or vice versa, i.e. a hybrid search.

TABLE 9A Orientation tactics in the PRECIS index

Tactic	No. of cases	%
Consulted the initial access point only	4	15
Browsed only	9	33
Browsed and followed cross-references	3	11
Browsed, followed cross-references, and generated new search terms	5	19
Browsed, and generated new search terms	6	22
Total	27	100%

TABLE 9B Orientation tactics in the online catalogue

Tactic	No. of cases	%
Consulted initial access point only	11	18
Browsed subject headings	12	19
Browsed subject headings and generated new terms	11	18
Browsed subject headings, generated new search terms and changed search strategy	6	10
Browsed subject headings and changed search strategy	3	5
Generated new search terms only	9	14
Generated new search terms and changed search strategy	9	14
Changed search strategy only	1	2
Total	62	100%

Table 9C indicates the system options users selected in carrying out subject searches on the online catalogue. These represent the means by which the various tactics were undertaken. In addition 16 out of the 62 cases also iterated between subject headings and titles in the course of their search.

TABLE 9C Orientations options in the online catalogue

Option	No. of cases	%
Searched by subject headings	34	55%
Searched by keyword access	19	31%
Searched by both	9	14%
Total	62	100%

The PRECIS index would appear to provide more opportunity for interactive refinements in the search orientation. 85% of cases browsed and followed cross-references to compare, select and reject terms and strings of terms. Only 41% demonstrated a priori refinements by generating their own new search terms.

In the online catalogue, a priori and interactive refinements were more evenly distributed between 63% of cases who generated new terms and/or changed search strategy and 52% who browsed subject headings.

Tables 10A and 10B classify the type of orientation

resulting from the consultations of both bibliographic tools. This represents the transition from the initial access to the exit point(s).

TABLE 10A Orientation in the PRECIS index

Type of approach	No. of cases	%
Exact	8	30
Narrow to broad	6	22
Broad to narrow	13	48
Total	27	100%

TABLE 10B Orientation on the online catalogue

Type of approach	No. of cases	%
Exact	18	29
Narrow to broad	12	19
Broad to narrow	32	52
Total	62	100%

The overall distribution of types of approaches in searching the PRECIS index or online catalogue appears to be very similar with a broad to narrow orientation being favoured in both tools. The number of broad to narrow search formulations in the PRECIS index increased from 4% to 48% whereas in the online catalogue these increased

from 15% to 52%, (Tables 8A, 8B, and Tables 10A and 10B).

A closer analysis of the movement between the different types of approach for each case is found in Tables 11A and 11B.

TABLE 11A Development from the initial search formulation to the orientation in the PRECIS index

Type of initial search formulation	No. of cases	Orientation in PRECIS	No. of cases
Exact	14	Exact	3
		Narrow to broad	5*
		Broad to narrow	6*
Narrow to broad	12	Exact	5*
		Narrow to broad	0
		Broad to narrow	7*
Broad to narrow	1	Narrow to broad	1*
Total	27	Total	27

* 24 out of 27 cases are reformulated 89%

TABLE 11B Development from the initial search formulation to the orientation on the online catalogue

Type of initial search formulation	No. of cases	Orientation on the online catalogue	No. of cases
Exact	36	Exact	11
		Narrow to broad	6*
		Broad to narrow	19*
Narrow to broad	17	Exact	4*
		Narrow to broad	4
		Broad to narrow	9*
Broad to narrow	9	Exact	3*
		Narrow to broad	2*
		Broad to narrow	4
Total	62		62

* 43 out of 62 cases are reformulated 69%

The initial search formulations for the online catalogue appear to be more stable with 69% being reformulated as opposed to 89% in the PRECIS index. Exact initial search formulations are slightly more reliable in the online catalogue where 31% (11 out of 36) remained unchanged, followed by narrow initial formulations where 24% (4 out of 17) remained unchanged.

4.2.4 Final search formulation and exit from the bibliographic tool

The final search formulation resulting from the consultation of the bibliographic tool can be determined by comparing the expressed topic and the point(s) of exit from

the tool, (Tables 12A and 12B).

TABLE 12A Final search formulation and exit from the PRECIS index

Type of approach	No. of cases	%
Exact	5	18
Narrow to broad	14	52
Broad to narrow	8	30
Total	27	100%

TABLE 12B Final search formulation and exit from the online catalogue

Type of approach	No. of cases	%
Exact	13	21
Narrow to broad	22	35
Broad to narrow	27	44
Total	62	100%

In the final search formulations of the cases using PRECIS, the narrow to broad approach dominates with a slight increase from that of the initial search formulations from 44% (Table 8A) to 52%. The greater change however, occurs for broad to narrow search formulations which rise from 4% (Table 8A) to 30%, a 26% increase.

With regard to the online catalogue, a similar increase for broad to narrow search formulations also occurs from 15% (Table 8B) to 44%, a 29% increase, making this approach the more dominant one. The narrow to broad approach is also slightly increased from 27% (Table 8B) to 35%.

In both tools the changes to other approaches in the final search formulations are at the expense of exact initial search formulations which lose 34% in the PRECIS index and 37% in the online catalogue. Therefore in the final search formulation we find a complete reversal in the order of approaches with the exact search formulations being least favoured and the narrow to broad search formulations most favoured in the PRECIS index whilst the broad to narrow approach takes the first place in the online catalogue.

TABLE 13A Development from the initial search formulation to the final search formulation in the PRECIS index

Type of initial search formulation	No. of cases	Final search formulation	No. of cases
Exact	14	Exact	3
		Narrow to broad	5*
		Broad to narrow	6*
Narrow to broad	12	Exact	1*
		Narrow to broad	9
		Broad to narrow	2*
Broad to narrow	1	Exact	1*
Total	27	Total	27

* 15 out of 27 cases reformulated 56%

Tables 13A and 13B compare the initial and final search formulations for each type of case. A greater number of reformulations occur in the PRECIS consultation, 56% as opposed to 44%. In both tools, the narrow to broad initial search formulation seems to be the more stable of the three approaches with only 25% being altered in the PRECIS index and 6% in the online catalogue. The broad to narrow approach in the online catalogue is also quite stable with only 11% being reformulated.

TABLE 13B Development from the initial search formulation to the final search formulation on the online catalogue

Type of initial search formulation	No. of cases	Final search formulation	No. of cases
Exact	36	Exact	11
		Narrow to broad	6*
		Broad to narrow	19*
Narrow to broad	17	Exact	1*
		Narrow to broad	16
		Broad to narrow	0
Broad to narrow	9	Exact	1*
		Narrow to broad	0
		Broad to narrow	8
Total	62		62

*27 out of 62 cases reformulated 44%

4.2.5 Summary of search formulation approaches

In Table 14 the extent of search reformulation in each of the transitions of the consultations of both bibliographic tools, are summarized in rank order.

Searchers' order of preference in approach to their initial formulation for both bibliographic tool is the same. However there is a higher proportion of the broad to narrow approach in the use of the online catalogue, (15% as opposed to 4%, Tables 8A and 8B).

TABLE 14 Search formulation approaches

Formulation	Type of approach in rank order			Bibliographic tool
	1	2	3	
Initial formulation	E	N - B	B - N	PRECIS index
	E	N - B	B - N	Online catalogue
Orientation	B - N	E	N - B	PRECIS index
	B - N	E	N - B	Online catalogue
Final formulation	N - B	B - N	E	PRECIS index
	B - N	N - B	E	Online catalogue

E = Exact
N - B = Narrow to broad
B - N = Broad to narrow

In the orientation stage, identical changes in the order occurs in both tools. Exact search formulations move from first place to second place and broad to narrow approach moves from third to first place. In the PRECIS index however we do find greater movement between the categories even though the final order at this stage is the same as in the online catalogue.

In the final search formulation stage, exact search formulations drop further down to third place for both tools. This results in the broad search approach coming first in the Precis Index and the opposite, the narrow search approach being first in the online catalogue.

4.3 Document selection at the shelves

The second stage of the search term analysis sought to correlate search formulations, for subject searches using a bibliographic tool or the direct shelf approach, with titles of actual documents found on the shelves. Keywords in the titles of books removed from the shelves to be examined as well as those selected for further use were compared with the terms originating from both the expressed topics and those encountered during the consultation of the bibliographic tool, i.e. terms included in the various access points whether or not these were actually selected

at the point of exit. The purpose of the comparison was to establish:

a) to what extent searchers looked for terms already familiar to them and how successful they were at finding them in titles of documents on the shelves

b) what other items did searchers examine which didn't apparently match their declared need and how did these relate to their expressed topic and their initial search formulations

c) what search formulation strategies overall, whether through the use of a bibliographic tool or a direct shelf approach, were most successful at retrieving items on the shelves

d) what initial and final search strategies generated from the consultation of the different bibliographic tools were most successful for retrieval at the shelves

The data set included all the cases which undertook subject searching at the shelves regardless of how the search was initiated, i.e. whether at a bibliographic tool or directly at the shelves:

- For the manual environment, 63 cases

  all cases which include category C in the pre-OPAC sample Table 1B,

- For the online environment 98 cases

  all cases which include category C in the OPAC1 and OPAC2 samples combined, 31 cases, Table 2C and 54 cases, Table 2B,
  subject searches which were initiated at the online catalogue and which followed up specific references at the shelves, categories DD + B, OPAC2 sample Table 2B, 5 cases and OPAC1 sample Table 2C, 8 cases

Two categories of documents were differentiated. Firstly documents which contained terms which matched or partially matched searchers' expressed topics or terms which they encountered in the course of the consultation of a bilbiographic tool. A title with 'matching terms' was defined as broadly as possible to include at least one single exact matching term or word root. For example if the term 'electrical' was expressed or encountered before searching at the shelves, titles containing the terms 'electricity' or 'electric' were considered for our purpose as matching.

The second category consisted of titles which contained original terms only, i.e. new, not expressed or encountered previously.

4.3.1 Titles examined and selected at the shelves

Tables 15A and 15B provide a breakdown of the two categories of titles examined and selected for each of the searching environments.

TABLE 15A Titles examined and selected at the shelves in the manual environment

	No. of titles examined		No. of titles selected		Drop out rate
Titles with original terms only	109	(27%)	32	(25%)	71%

Titles with matching terms	288	(73%)	98	(75%)	66%
Total	397	(100%)	130	(100%)	67%

TABLE 15B Titles examined and selected at the shelves in the online environment

	No. of titles examined		No. of titles selected		Drop out rate
Titles with original terms only	89	(21%)	28	(16.5%)	68.5%
Titles with matching terms	339	(79%)	142	(83.5%)	58%
Total	428	(100%)	170	(100%)	60%

On average searchers examined 6.3 items on the shelves and selected 2 in the 63 searches in the manual environment, whereas 4.3 were examined and 1.7 selected in the 98 searches in the online environment. Titles which contained only original terms made up a smaller portion of the total number of titles examined in both environments but a greater percentage were examined and selected (27%, 25% Table 15A) in the manual study as opposed to the online one, (21%, 16.5% Table 15B). On the other hand more titles with matching terms were examined and selected in the online environment.

4.3.2 Titles with original terms only

Titles with original terms only were compared with searchers' expressed topics to extablish their contextual relationship. Tables 16A and 16B show that more titles having a broader context than searchers' expressed topics were examined and selected in both environments. However in the online environment a greater proportion of titles with a narrower context were also examined (24%, Table 16B) in comparison with the manual environment (14%, Table 16A) but more significantly the percentage of those selected (39%, Table 16B) were almost as high as those with a broader context (43%, Table 16B). Overall the percentage of titles with original terms which were selected from those examined was comparable 29.4% (Table 16A) and 31.4% (Table 16B).

TABLE 16A Titles with original terms only compared with the expressed topic in the manual environment

	No. of titles examined		No. of titles selected	
Broader context	67	(61%)	16	(50%)
Narrower context	15	(14%)	4	(12.5%)
Synonymous context	27	(25%)	12	(37.5%)
Total	109	(100%)	Total 32	(29.4%)

TABLE 16B **Titles with original terms only compared with the expressed topic in the online environment**

	No. of titles examined	No. of titles selected
Broader context	51 (57%)	13 (46%)
Narrower context	21 (24%)	10 (36%)
Synonymous context	17 (19%)	5 (18%)
	Total 89 (100%)	Total 28 (31.4%)

If the initial search formulation strategy is taken into account (Table 17A and 17B) we find that searchers who took a broader search formulation approach than their expressed topics, examined and selected more titles which contained original terms only, but in addition those titles were also broader in context than their expressed topic. However in the case of the online environment, the narrow to broad search formulation strategy also resulted in the selection of titles with a narrower context than the expressed topic with all of the five items examined being selected, (Table 17B).

TABLE 17A **Initial search formulation and titles selected with original terms only in the manual environment**

Initial search formulation	Title context	No. of titles examined	No. of titles selected
E	S	3	2
E	B	4	0
E	N	3	0
N - B	S	24	10
N - B	B	63	16
N - B	N	2	2
B - N	N	10	2
	Total	109	Total 32

E = Exact B = Broad N = Narrow S = Synonymous

TABLE 17B Initial search formulation and titles selected with original terms only in the online environment

Initial search formulation	Title context	No. of titles examined	No. of titles selected
E	S	6	3
E	B	6	2
E	N	13	4
N - B	S	8	0
N - B	B	45	11
N - B	N	5	5
B - N	S	3	2
B - N	B	0	0
B - N	N	3	1
	Total	89	Total 28

E = Exact B = Broad N = Narrow S = Synonymous

4.3.3 Search formulation strategies and documents retrieved

The overall success of initial search strategies in terms of documents examined and selected is presented in Tables 18A and 18B.

TABLE 18A Initial search formulation and titles examined and selected at the shelves in the manual environment

Initial search formulation	Titles examined		Titles selected		Take up rate
E	89	(22%)	32	(25%)	36%
N - B	280	(71%)	92	(70%)	31%
B - N	28	(7%)	6	(5%)	21%
Total	397	(100%)	130	(100%)	33%

TABLE 18B Initial search formulation and titles examined and selected at the shelves in the online environment

Initial Search formulation	Titles examined		Titles selected		Take up rate
E	250	(58.4%)	102	(60%)	41%
N - B	142	(33.2%)	44	(26%)	31%
B - N	36	(8.4%)	24	(14%)	67%
Total	428	(100%)	170	(100%)	40%

In the manual environment the narrow to broad search formulation strategy led to the highest percentage of titles selected 70%, whilst 25% resulted from an exact approach, (Table 18A). A reverse order was produced in the online environment with 60% of titles selected resulting from an exact formulation and only 26% from a narrow to broad formulation, (Table 18B). The take up rate for the

broad to narrow search formulations was considerably higher in the online environment 67% as opposed to 21% in the manual setting.

A sub-set of subject searches representing only those initiated at the bibliographic tools was also analysed to assess any influence on retrieval at the shelves.

The data set includes the 24 cases who used the PRECIS index and then searched at the shelves (Categories D + C, 19 cases Table 1B and 5 other PRECIS cases not included in the pre-OPAC sample), and 48 cases who initiated subject searches at the online catalogue and continued their search at the shelves, (Categories, DD + C or B, 19 cases OPAC2 sample, Table 2B and 29 cases OPAC1 sample Table 2C).

Tables 19A and 19B reveal the same order of success for the different initial search formulations in selecting items at the shelves, i.e. exact, narrow to broad and broad to narrow approaches, (Tables 19A and 19B). Again the take up rate of the broad to narrow approach was higher for the online catalogue 89% as opposed to 25% for the PRECIS index.

TABLE 19A Initial search formulation for the PRECIS index and titles examined and selected

Initial search formulation	Titles examined	Titles selected	Take up rate
E	76 (59%)	34 (67%)	43%
N - B	48 (38%)	16 (31%)	33%
B - N	4 (3%)	1 (2%)	25%
Total	128 (100%)	51 (100%)	40%

TABLE 19B Initial search formulation for the online catalogue and titles examined and selected

Initial search formulation	Titles examined	Titles selected	Take up rate
E	138 (54%)	49 (52%)	26%
N - B	98 (38%)	28 (30%)	29%
B - N	19 (8%)	17 (18%)	89%
Total	255 (100%)	94 (100%)	37%

For the final search formulations shown in Tables 20A and 20B, the narrow to broad approach becomes the most successful for the PRECIS index (64%), whilst the broad to narrow approach comes first in the online catalogue (44%) closely followed by the narrow to broad approach (42%). The

order of success for each tool thus reflects the predominance of approach resulting from the use of the tool, Tables 12A and 12B discussed in the previous section 4.2.3.

TABLE 20A Final search formulation from the PRECIS index and titles examined and selected

Final search formulation	Titles examined	Titles selected	Take up rate
E	18 (14%)	8 (16%)	44%
N - B	79 (62%)	33 (64%)	41%
B - N	31 (24%)	10 (20%)	32%
Total	128 (100%)	51 (100%)	40%

TABLE 20B Final search formulation from the online catalogue and titles examined and selected

Final search formulation	Title examined	Titles selected	Take up rate
E	45 (18%)	13 (14%)	29%
N - B	124 (49%)	40 (42%)	32%
B - N	86 (33%)	41 (44%)	48%
Total	255 (100%)	94 (100%)	37%

4.3.4 Search outcomes

The average number of titles examined and selected for the 24 PRECIS cases who searched at the shelves was 5.3 examined and 2.1 selected. As for the 48 searches initiated at the online catalogue, on average 5.3 were examined 1.9 selected. The 44 cases who used a direct shelf approach, (Categories C and C + B, 18 cases, Table 1B, 26 cases, Table 2B), the average was 4.2 titles examined and 1.6 selected.

4.4 Success and failure and user perseverance at the bibliographic tools and at the shelves

The second aspect of the qualitative analysis was concerned with users' perseverance in the searching activity in the light of success or failure at different stages of the search. Success is defined here as finding a relevant reference or item. Were they more persistent at the bibliographic tool or at the shelves? How did success/failure rates compare between the different bibliographic tools and at the shelves?

In addition subject searches initiated at the online catalogue who then followed up specific references at the shelves were examined to ascertain the effectiveness of relevance judgements made at the catalogue and those at the shelves with actual documents.

Comparisons were drawn to find out:

a) Initial success/failure rates at the different bibliographic tools and subsequent searching

b) Subsequent and final success/failure rates at the bibliographic tools

c) Initial and subsequent success/failure rates of cases with references followed up from the online catalogue at the shelves

d) Success/failure rates at the bibliographic tool and at the shelves

e) Success/failure rates of cases using a bibliographic tool and those using a direct shelf approach

All subject searches which were undertaken both at a bibliographic tool and at the shelves in the two searching environments, i.e. PRECIS index followed by searching at the shelves, and the online catalogue followed by searching at the shelves, were examined.

They included the following cases:

- 27 cases who used the PRECIS index (22 cases, category D in the pre-OPAC sample Table 1B and 5 additional cases not included in the sample)

- 83 cases using the online catalogue

  Subject searches initiated at the online catalogue, (initial category DD OPAC2 sample Table 2B, 15 cases, and OPAC1 sample Table 2C, 29 cases)

  Subject searches initiated as specific item searches at the catalogue but developing into subject searches either at the catalogue or at the shelves, (initial category *AA OPAC2 sample Table 2B, 15 cases, and OPAC1 sample Table 2C, 20 cases)

  Subject searches which were initiated at the shelves but were continued at the online catalogue, (initial category C + DD, OPAC2 sample Table 2B, 4 cases)

4.4.1 Success/failure and searching at the bibliographic tool

The searching activity depends not only on searchers' abiblity to formulate and reformulate their search but also on the success or failure of the initial formulation and subsequent reformulations. Table 21 shows how initial results, i.e. outcome of the first access points, influenced searchers in furthering their searching activity at the bibliographic tool.

TABLE 21 Initial result and progress of subject searches at the bibliographic tools

Tool	Initial success	Cont'd	Dis-cont'd	Initial failure	Cont'd	Dis-cont'd
PRECIS index no. of cases	11	[5	+ 6]	16	[14	+ 2]
%	41%	[19%	+ 22%]	59%	[52%	+ 7%]
Online catalogue no. of cases	33	[7	+ 26]	50	[44	+ 6]
%	39%	[8%	+ 31%]	60%	[53%	+ 7%]

Those who failed initially in either tool, tended to continue searching whereas those who succeeded, particularly in the online catalogue, discontinued.

TABLE 22 Subsequent result of subject searches at the bibliographic tools

	Success after positive result	Success after negative result	Failure after positive result	Failure after negative result	Total no. of cases
PRECIS index no. of cases	5	14	0	0	19
%	26%	74%	-	-	100%
Online catalogue no. of cases	3	28	4	16	51
%	6%	55%	8%	31%	100%

Table 22 presents the subsequent result for those cases who continued to search the bibliographic tool, (Table 21, 14 + 5 cases for the PRECIS index and 44 + 7 cases for the online catalogue). The likelihood of success following a negative result appears higher than the likelihood of failure, particularly with the PRECIS index.

The subsequent results were usually obtained after more than one attempt. Users of the PRECIS index averaged 1.9 initial or new entry points and those of the online catalogue 2.8. A single point of entry could then lead to several other access points through browsing entries in the PRECIS index, browsing subject headings and iterating between bibliographic references and subject headings in the online catalogue.

TABLE 23 Final result of subject searches at the bibliographic tools

	Result	No. of cases	%
Online catalogue	Found reference(s)	58	70
	Found class number(s)	15	18
	Found reference(s) but not available for loan	6	7
	No references found	4	5
	Total	83	100%
PRECIS index	Found class number(s)	25	93
	No class number found	2	7
	Total	27	100%

The results of the consultations of the bibliographic tools are given in Table 23. Final success and failure is less clearly defined in the online catalogue, but if failure is taken to be no references found then the performance of both tools is comparable with 95%/5% success/failure rates for the online catalogue and 93%/7% success/failure rates for the PRECIS index. Cases with references found but not available for loan could also be considered as failed searches. Some however chose a class number as an alternative and were thus considered as successful searches.

4.4.2 Following up references from the online catalogue at the shelves

The development of searches at the shelves was further analysed for the 58 cases following up references found in the online catalogue (Table 24). Success and failure is defined here in terms of whether or not a title was selected at the shelves.

TABLE 24 Initial result and progress of subject searches following up references from the online catalogue at the shelves

	Initial success	Cont'd	Dis-cont'd	Initial failure	Cont'd	Dis-cont'd
No. of cases	39	[26 +	13]	19	[15 +	4]
%	67%	[45%	22%]	33%	[26%	7%]

Initial success (67%) promoted further searching (45%) as did initial failure (33%, 26%). Thus 41 cases (26 + 15) continued searching. As seen in Table 25, initial success also seemed more likely to produce a further positive result, (22 out of 26 cases, 85%). The chance of success after an initial failure, was also high, (11 out of 15 cases, 73%).

TABLE 25 Subsequent result of subject searches following up references from the online catalogue at the shelves

	Success after positive result	Success after negative result	Failure after positive result	Failure after positive result	Total no. of cases
No. of cases	22	11	4	4	41
%	53%	27%	10%	10%	100%

4.4.3 Success/failure and searching at the shelves

In Table 26 the final result at the shelves for subject searches initiated at a bibliographic tool are compared. Cases who followed up class number(s) from the online catalogue to the shelves, (15 cases), are also included. 10 cases however failed at the catalogue 6 of which found references not available for loan, and 2 cases failed at the PRECIS index.

TABLE 26 Final result at the shelves for subject searches initiated at the bibliographic tools

	Result	No. of cases	%
Online catalogue	Selected only title(s) found at the catalogue	17	23
	Selected title(s) found at the catalogue and others	22	30
	Did not select any title(s) found at the catalogue but selected others	11	15
	Did not select any title(s) at all	8	11
	Selected title(s) from a class number(s)	10	14
	Did not select any title(s) from a class number(s)	5	7
	Total	73	100%
PRECIS index	Selected title(s) from a class number(s)	18	72
	Did not select any title(s) from a class number(s)	7	28
	Total	25	100%

The final success/failure rate at the online catalogue is 82%/18% which is a 10% difference from the PRECIS index. A high proportion of searches were satisfied with the titles they followed up from the online catalogue and did not search any further, (23%). The selection of titles found in

the online catalogue also promoted the selection of other titles at the shelves, (30%).

The retrieval of titles from the shelves via class numbers extracted from the bibliographic tool appears less effective overall. The PRECIS index produced a success/ failure rate of 72%/28%. For class number searches from the online catalogue the rate is 66%/33% (10 and 5 cases respectively).

Table 27 compares success/failure rates of the different bibliographic tools both, at the tool and at the shelves.

TABLE 27 Success/failure rates at the bibliographic tools and at the shelves

Tool	Success no. of cases	%	Failure no. of cases	%	Total
Online catalogue	73	88%	10	12%	83
Online catalogue/ shelves	60	82%	13	18%	73
PRECIS index	25	93%	2	7%	27
PRECIS index/ shelves	18	72%	7	28%	25

Although more cases failed initially at the online catalogue than at the PRECIS index, the success rate was well maintained at the shelves dropping only by 6% as opposed to the PRECIS index whose success rate decreased by

21%.

Overall success/failure rates of subject searches initiated at a bibliographic tool and those initiated at the shelves are compared in Table 28.

TABLE 28 Overall success/failure rates of subject searches initiated at bibliographic tool and initiated directly at the shelves

Tool	Success no. of cases	%	Failure no. of cases	%	Total no.of cases
Online catalogue	60	72%	23	28%	83
PRECIS index	18	66.6%	9	33.3%	27
Shelves	39	89%	5	11%	44

If the online catalogue appears to be a more effective tool than the PRECIS index, the contribution of either tool for subject searching overall, would appear to be less effective than the direct shelf approach, (Category C only, 15 cases and categories *B + C, 3 cases, pre-OPAC sample, Table 1B: category C only, 19 cases and categories *B + C, 7 cases, OPAC2 sample, Table 2B i.e. total of 44 cases for both samples).

4.5 Classification and searching at the shelves

The third aspect of subject searching investigated was the role of classification in retrieving books at the shelves. The object was to determine: whether or not

searchers pursued their searches beyond initial single class numbers; under what circumstances they did so; and what was the subsequent outcome.

Having identified those cases who browsed more than one class number, the analysis considered two possible contributory factors: a) how the search originated and, b) the initial success/failure at the shelves. Subsequent success/failure was then examined as well as the search outcomes of multiple class number searches originating from the bibliographic tools.

4.5.1 Multiple class number searches

The majority of searchers came to the shelves with one classification number in mind and tended to browse only within a single class number regardless of whether they had consulted a bibliographic tool or took a direct shelf approach.

Table 29 seems to show that there is little difference in browsing behaviour at the shelves in the context of the manual or online environments overall.

TABLE 29 Browsing different classification numbers at the shelves

Search context	Cases browsing within a single class number	Cases browsing more than one class number
Manual	45 (65%)	24 (35%)
Online	59 (69%)	26 (31%)

Of the cases who browsed more than one class number at the shelves, the majority initiated the search at a bibliographic tool (71% and 85%), and the initial success/failure rates (i.e. item(s) selected or not selected at the first attempt) at the shelves was more or less equally divided (40% and 38%) (Table 30).

TABLE 30 Multiple class number shelf browsing and searches initiated at a bibliographic tool and at the shelves

Search context	Searches initiated at a bibliographic tool		Initial result at the shelves +	-	Searches initiated at the shelves		Initial result at the shelves +	-	Total
Manual	17	(71%)	[7	10]	7	(29%)	[3	4]	24
Online	22	(85%)	[13	9]	4	(15%)	[0	4]	26
			+	-			+	-	
	Total		20 (40%)	19 (38%)			3 (6%)	8 (16%)	50 (100%)

+ = positive result - = negative result

However initial failure at the shelves for those searches which were initiated at the shelves was higher, 16% as opposed to the 6% who succeeded on the first attempt. It would also appear that initial success at the shelves following the online catalogue consultation was higher, 59% (13 out of 22 searches) as opposed to 41% (7 out of 17 searches) following the use of a manual bibliographic tool.

Of the 35% and 31% of cases who browsed beyond a given class number (Table 29), 54% browsed following a negative initial result at the shelves and 46% browsed following an initial positive result (Table 31).

TABLE 31 Browsing more than one class number following a negative or positive initial result

Search context	Browsing following a negative result	Browsing following a positive result	Total no. of searches
Manual	14	10	24
Online	13	13	26
Total	27 (54%)	23 (46%)	50 (100%)

Although the sample is small there is some indication that searchers who searched further than a given class number only, were likely to succeed but also an initial success was more likely to be followed by a positive result (Table 32).

TABLE 32 Success in browsing beyond a given class number after an initial positive or negative result

Search context	Success after positive result	Success after negative result	Failure after positive result	Failure after negative result	Total no. of searches
Manual	10	8	0	6	24
Online	10	8	3	5	26
Total	20	16	3	11	50

If browsing beyond a given class number is beneficial in furthering a search, it must be noted that for the searcher the class numbers themselves seemed to have a negligible influence. The main criterion for furthering a search was the title terms on the spines of adjacent books and not the different number on the shelf mark labels.

4.5.2 Multiple class numbers originating from the bibliographic tools

A correlation was also made between the outcome of the consultation of bibliographic tools in terms of the number of class numbers extracted and search outcome at the shelves, i.e. the number of documents selected. Out of 27 cases who consulted the PRECIS index, 7 (26%) resulted in more than one class number being noted and followed up at the shelves by the searcher, (Table 33).

In the case of the online catalogue 18 (24%) out of 73

cases extracted two and more class numbers. The cases include all subject searches initiated at the online catalogue with the subject search element undertaken at the catalogue or at the shelves, (Categories DD, 19 cases, Table 2B, 29 cases, Table 2C and initial category *AA, 15 cases, Table 2B and 20 cases, Table 2C i.e. a total of 83 cases less the 10 cases who failed see Table 23, section 4.4.1). 58 out of 73 successful cases extracted class numbers with specific references whereas 15 cases extracted class numbers only, (Table 23, section 4.4.1).

TABLE 33 Bibliographic tool consultations resulting in more than one class number and titles selected at the shelves

Bibliographic tool	No. of cases	No. of class numbers found	No. of items selected
PRECIS index	6	2	9
	1	3	1
	7		10
		Average	1.4
Online catalogue	11	2	35
	2	3	4
	3	4	18
	16		57
		Average	3.5

Those cases who extracted more than one class number at the online catalogue, ended up selecting 3.5 items at the shelves which is above the average of 1.7 for other subject searches initiated at the online environment, see Section 4.3.3 By contrast multiple class numbers extracted from the PRECIS index, did not lead to the selection of a greater number of items at the shelves, resulting in 1.4 items as opposed to 2 for other subject searches initiated at the PRECIS index.

4.6 Browsing at the shelves

The fourth aspect of subject searching was concerned with browsing behaviour. Browsing at the shelves was carefully observed and compared with browsing at the online catalogue to ascertain whether there is any similarity between the two activities.

Browsing at the shelves was found to be an unstructured activity for 82% of cases, 122 out of 148 for all the samples, (Category C, 63 cases Table 1B, 54 cases Table 2B, 31 cases Table 2C), whereby searchers:

a) did not start at the beginning of the sequence of a given class number,

b) did not for the most part cover the entire class number sequence,

c) always backtracked in the immediate course of the search, i.e. progressed in a zig-zagging irregular fashion, and repeatedly going back over ground already covered.

By contrast cases who browsed in a structured way, 18%, 26 out of 148, started at the beginning at the class sequence, progressed in a linear fashion to the end without backtracking. In 10 of these cases searchers were found to be looking for specific keywords which were included in their expressed topic but had also been encountered in titles on the microfiche or online catalogue although these titles had not been specifically noted at the end of the catalogue consultation. Cases who were following up specific references from the online catalogue account for another 6 out of the 26 cases.

4.6.1 Browsing on the online catalogue

Browsing in the context of the online catalogue seems to be quite a different activity. Although the searcher's purpose may bear some similarity with browsing on the shelves, the constraints of the screen displays make it appear more akin to the 'structured' type of browsing on the shelves, where backtracking does not occur. All of the 62 cases which included a subject searching element in both OPAC1 and OPAC2 samples were analysed, (Category DD, 36 cases, Table 2C and 26 cases, Table 2B). Only 5 out of the 62 cases went back to previous screens whilst browsing brief references. Furthermore 68% of cases, 42 out of 62 viewed all screens available for their search with 32%, 20 out of 62 viewing only some of them. Up to nine references could be displayed on a screen. Table 34 shows the number

of references 'browsed' by the searcher. Searchers tended to persevere until they got a positive result.

TABLE 34 'Browsing' Brief references in the online catalogue

No. of references viewed	No. of cases	%
Up to 9 refs. (1 screen)	36	58
10 to 45 refs. (2-5 screens)	15	24
46 to 90 refs. (6-10 screens)	6	10
91 to 291 refs. (11-31 screens)	5	8
Total	62	100%

4.7 Summary of results

The major findings of the study can be summarised as follows:

1. Subject searching was predominant both before and after the installation of the online catalogue but has not increased as a result of the new tool.

2. The majority of library searchers used the bibliographic tools but there is no evidence that the online catalogue led to an increase in use.

3. Subject searching directly at the shelves was still the dominant single approach favoured by users and subject searching occurred predominantly at the shelves for users of the online catalogue.

4. The occurrence of hybrid subject searches, i.e. specific item searches developing into subject searches, increased with the online catalogue.

5. Searchers accessed both bibliographic tools using the same terms as their expressed topics.

6. Both bibliographic tools enabled searchers to narrow their search. The online catalogue consultation led to more user generated reformulations and fewer searches being reformulated, whereas the PRECIS index produced more interactive reformulations and a greater number of reformulated searches.

7. Reformulations in the online catalogue resulted in more searches with broad to narrow final search formulations whereas the PRECIS index supported narrow to broad search formulations.

8. Broad search formulations led to more titles being examined on the shelves for both tools but more titles from the narrow formulations from the online catalogue were selected. For the PRECIS index more titles were selected from broad formulations.

9. At least three quarters of titles selected matched or partially matched users' search terms as in their expressed topics or encountered at the bibliographic tool, but the remainder contained original terms only and resulted mostly from broad search formulations.

10. Online catalogue users undertaking subject searches followed up specific references at the shelves, but users of the PRECIS index followed up class numbers. Both tended to search at a single class number only.

11. In terms of search outcome, searchers who took a direct shelf approach for subject searching were more successful than users of the online catalogue and PRECIS index users were the least successful.

12. In terms of the numbers of items selected at the shelves, results were between 1.6 for the direct shelf approach, 1.9 for the online catalogue, and 2.1 for the PRECIS index

CHAPTER 5

DISCUSSION OF RESULTS

5. Introduction

The results of the investigation are further discussed in this chapter. The different stages of analysis are drawn together to assess the subject searching process overall and in particular to evaluate the role and influence of the different bibliographic tools. Some of the findings and issues treated include: the extent and need for subject searching, query formulations and the function of the bibliographic tools in supporting different formulation strategies, the documents retrieved as a result of the bibliographic tool consultations, the role of the indexing language, titles and classification for subject access, the linear characteristic of subject searching and success/failure in searching at the bibliographic tool and at the shelves. Finally the research methods adopted in the study are reviewed in the light of the findings.

5.1 Subject searching: the basic information need of library users

The overall objective of this study was to determine the nature of searching for monographic materials in the library context as a whole and to ascertain the role of the different bibliographic tools in the searching process. In adopting a 'black box' approach, previous studies have

emphasized the distinction between known item or specific item searching and subject searching. Furthermore these usage studies have concluded that the predominance of known item searching at the library catalogue has reflected and supported users' basic requirement for this type of searching thus minimizing the need for subject searching. The findings reported here, resulting from a comparative macro and micro analysis of the entire searching process in the different searching environments, bring into question this dual assumption of information need and the use of the library catalogue in meeting that need.

5.1.1 Hybrid searches

In this study there are a number of contributory factors for the high occurrence of subject searching. Firstly, 'hybrid' searches, that is searches which developed into subject searches for whatever reason, have been identified as subject searches. One in three of searches initiated as specific item searches in both parts of the study, before and after the installation of the online catalogue, were in fact subject searches whether initially intended or not, (Section 4.1.1). The very fact that these specific item searches led to subject searches is indicative of the basic and underlying need for subject searching by library users.

The availability of the different bibliographic tools did not appear to affect the overall incidence of 'hybrid' searches but their occurrence is slightly higher in online

catalogue searching, (Section 4.4.1, Table 3). This may be because circulation data on the catalogue provides immediate information on the availability of items found and coupled with the ease by which different search commands can be selected, the searcher can change search tactic readily if an initial approach fails. The subject searching element of 'hybrid' searches however tends to be introduced at the shelves where relevance judgements are based on actual documents, (Section 4.4.1, Tables 4, 5).

5.1.2 Title searches as subject searches

A second factor in accounting for subject searching depends on being able to identify cases using titles for subject access. Title subject searches in past catalogue use studies could have been mistaken for specific item searches. Although a small number of cases did use the title search option in the online catalogue, 15 cases, (Categories *AA + B, 1 case and *AA + B + C, 4 cases, Table 2B; *AA, 3 cases, and *AA + B + C, 7 cases, Table 2C), and lead terms in the microfiche catalogue for subject searching, these were not prevalent approaches. In the case of the online catalogue the order in which title and other subject search options were presented in the opening menu could well have influenced users' choices. The online catalogue offered subject (i.e. subject headings) as a first choice, title as third choice and keyword as fifth choice. It is not apparent on what basis searchers made

their choice but it is unlikely that users here could differentiate between keyword in title searching and keyword searching across the different fields of the bibliographic record.

5.1.3 Subject index for subject access

Thirdly, subject searching in past studies such as the UK catalogue use survey (Maltby, 1973) had been equated to searching the classified catalogue only, and did not include the use of subject indexes. Subject indexes as the PRECIS index here, give access to the classified catalogue but may also be used without reference to the classified catalogue. Clearly the true extent of subject searching would have been underestimated. In the present study not a single search was initiated at the classified catalogue, (Category F, Table 1B) equally the 'shelf mark' search option in the online catalogue was not used.

5.1.4 Holistic approach

Finally the fourth and perhaps the most important factor to account for the predominance of subject searching is the fact that the information retrieval task here is defined as a whole taking into account the searching activity at the shelves for both catalogue users and non-users.

The occurrence of subject searching (72%) in the before study, (Section 4.1.2, Table 6) for reasons discussed above, appears to be higher than in previous traditional

catalogue use studies. Markey (1984) reported that in 21 out of 41 studies, subject searching accounted for between 40% and 60% with only two studies over that.

In the case of the online catalogue, its use in subject searching (60%), (Section 4.1.2, Table 6), seems to fall within the range of other results between 34% and 65% (Markey, 1984) even though the holistic approach may have been expected to reveal a higher occurrence more in line with the 'before' study.

The fact that the online catalogue does not appear to have promoted an increase in subject searching overall seems to indicate that the new technological environment may have had less of an impact on subject searching than the results of studies first reported led us to believe. The apparent increase in subject searching in online catalogues may not have been entirely attributable to the new technology but the new technology may have brought to light what was already inherent in searching behaviour. Larson (1986) in comparing subject searching over a period of time on the Melvyl system, reports an apparent drop. He suggests that users' inability to match LCSH subject headings and the consequent lowering of user expectations as a possible cause.

These discrepancies highlight the need:

a) to monitor the use of the online catalogue beyond its initial impact,

b) to evaluate performance in the context of the searching environment as a whole,

c) to assess system dependent as well as user dependent factors in subject searching.

5.2 Query formulation

At the very outset searchers expressed their information need in a formalised statement using a limited number of terms more akin to a controlled language than a natural language description, (Section 4.2.2). This was irrespective of whether they were taking a direct shelf approach or intending to use a bibliographic tool. Users of the online catalogue were even more curt, using on average only 2 terms as opposed to 2.4.

The expressed topics did not always reveal the searchers' ultimate requirements. In some cases the initial expressed topics were clearly formulated in terms of where the searchers thought it most likely that they would find the information wanted. Searchers said that they were looking for books on certain subjects when in fact they knowingly or even not knowingly wanted more specific topics or information which they considered to be or possibly be within those subjects. The tendency towards a broad search formulation strategy would seem to be evident in searching behaviour even before accessing any bibliographic tool or approaching the shelves. Manifestations of such 'anomalous state of knowledge' (Belkin, Oddy and Brooks, 1982) or 'visceral and conscious needs' (Taylor, 1968) if they did become evident, tended to emerge only when searchers examined actual documents at the shelves in the final

stages of their search. Even then it was not always possible to ascertain whether search refinements which were expressed, resulted from an interaction with the documents or were in fact 'a priori'.

5.3 Search formulation strategies at the bibliographic tool

Although the initial search formulation is taken here for our purposes and by the user, as an identifiable starting point, the initial formulation and the transitions that follow are relative to the searcher's need, conscious or not. In considering the different stages of the search formulations at the bibliographic tool, those approaches which were most susceptible to change as well as those which remained constant are taken into account.

5.3.1 Exact and broad search approaches for initial search formulations

In the initial access to the PRECIS index and the online catalogue, more than half of the searchers used the same terms as in their expressed topics with narrow to broad and broad to narrow approaches as second and third choices, (Section 4.2.2, Tables 8A, 8B). The exact initial formulations were the least stable when compared with the final search formulations, (Section 4.2.4, Tables 13A, 13B). This is either because they represent a compromise from the start and were in effect a 'conscious' broader or narrower need or, it could have been the influence of the

bibliographic tool which led to the reformulations. Regardless it does indicate that exact initial search formulations cannot be taken at face value.

There is no apparent difference in the way searchers initiated their search in either of the bibliographic tools. Both catered for all approaches at the point of entry. The variations seem more subtle. The greater number of broad to narrow formulations in the online catalogue may provide a clue in that the role of this approach became more significant as the searches progressed through the orientation stage to the resulting final formulations.

5.3.2 Orientation tactics in reformulating searches in the bibliographic tool

It may have been expected that the online catalogue could provide more opportunity for experimentation and orientation than the manual index because of the very nature of its 'dynamic' medium. This did not prove to be the case in the present study.

Dalrymple (1987) in comparing the extent of search reformulations in an online catalogue with a card catalogue, found that the former led to more reformulations yet fewer items were retrieved. She concludes that the nature of the reformulations in the two environments may differ in that in the online catalogue these are more 'process' based whereas in the traditional catalogue reformulations are 'content' based. The distinction is made between reformulations which result from feedback due to

system mechanisms and those resulting from the content of the bibliographic tool.

In the present study, a differentiation is made between system mechanisms which enable the user to adopt tactics for reformulating a query as opposed to the tactics themselves that is tactics as defined by Bates (1979). For example a reformulation by which a user generates a new term can be done on the online catalogue by searching subject headings or by using a keyword option to search keywords in titles. If the subject headings are accessed, the searcher may then be led to browse as a further tactic.

The online catalogue may offer more access points for searching but this in itself does not necessarily lead to more or better search reformulations. The online catalogue searcher used more access points than in the PRECIS index but fewer searches were in fact reformulated.

In comparing the orientation tactics in the two environments, this study has focused on identifying and distinguishing between those which depend on the user's initiative and those which have been stimulated by the tool. The PRECIS index through browsing and its cross-referencing provided for a more interactive orientation, i.e. 'content' based reformulations, whereas orientation in the online catalogue was more user generated, less interactive and led to fewer searches being reformulated.

5.3.3 Narrowing search formulations by orientation in the bibliographic tool

In the orientation stage, from the point of entry to the point of exit from the bibliographic tool, users had the opportunity to narrow or specify their search so that exact search formulations were narrowed and broad formulations shifted their context to being more exact or narrower. These reformulations resulted in the narrow approach becoming dominant in both tools. This was achieved by a greater number of searches being reformulated in the PRECIS index (89%) than in the online catalogue (69%), (Section 4.2.3 Tables 11A, 11B).

Success in matching exact terms in the online catalogue did not promote further reformulations. Furthermore reformulations in the online catalogue depended more on users' own initiative in generating new terms 'a priori'. Even in the browsing of subject headings, the entries were not related but consisted of a mixture of Library of Congress subject headings (LCSH) interfiled with brief versions of PRECIS strings (MARC 082 PRECIS verbal discription field). The full printed PRECIS index on the other hand in providing related entries, promoted more browsing as well as the possibility of following up cross-references. The PRECIS index by its contextual structure thus supported the contextual approach to search formulations and the online catalogue seemed to cater best for the exact matching initial approach through keyword

access or phrase access. However having found initial matches, access to actual bibliographic records of titles either through keyword access or via subject headings then also provided the added opportunity to specify and narrow search formulations.

5.3.4 Contribution of the bibliographic tool to the final search formulation

In the final search formulation, comparing the expressed topic and exit from the bibliographic tool, different contextual approaches dominated in both tools. In spite of the extensive orientation within the PRECIS index, users were still limited in specifying their requirements within the controlled language and were led to entries with class numbers broader than their expressed topics. The narrow to broad initial approach was thus the most stable and dominant, (Section 4.2.4, Table 13A).

These results compare with Bates'(1977) findings in the use of LCSH where users entering the dictionary card catalogue under broader terms were also more likely to succeed. The adoption of a broad search formulation strategy in the use of both of these different indexing systems would appear to depend on other factors in addition to those related to the structure of the indexing system itself.

With regard to the online catalogue the influence of specific titles in narrowing search formulations seems to have led to the broad to narrow approach being higher in

the final search formulations, (Section 4.2.4, Table 12B). The different approaches however appear to be more evenly distributed and as in the PRECIS index the narrow to broad initial approach remained the most stable. As such the online catalogue would seemingly have some potential of catering for the dual approach to subject searching.

5.4 Predominance of a broad search formulation at the shelves

Thirty seven out of fifty three cases, (Initial categories *B and C, 21 cases, Table 1B and 32 cases, Table 2B), who initiated subject searches at the shelves took a broad search strategy, i.e. they looked for books at a broader class number than their expressed topic. Searchers were self-directed to general locations on the shelves with which they were already more or less familiar. Searchers depended upon physical features, for example, on the left half way down the reading room, rather than citing class numbers. If class numbers were cited these were invariably broad and tentative. The hierarchical classified arrangement of the collection (Dewey Decimal Classification), encouraged a broad search strategy because general class numbers were signposted, they tended to have more books and were consequently easier to find.

5.5 Documents retrieved

The close correlation between the terms of the expressed topic and the titles examined and selected shows how

searchers succeeded in matching their queries with actual documents. Searchers tended to stick to their initial terms as contained in their expressed topics at the outset. The broad initial search formulation strategy adopted in the manual environment not only produced more matches or partial matches, but also produced more titles with original terms, (Section 4.3.1, Tables 15A, 15B). Hence the documents themselves would seem to justify the broad search strategy favoured. However because searchers tended to retrieve monographs more general in their coverage than their expressed topic, those books whose entire contents were more specifically on their topics were not retrieved.

If the manual setting with the PRECIS index supported a broader approach for retrieving a greater number but less specific documents, the online catalogue environment had the opposite effect. The dominance of the broad to narrow approach resulted in fewer items being selected but these were narrower in context than the expressed topics, (Section 4.3.2).

The bias towards specificity is manifested at different stages of the searching process:

a) initial broad to narrow search formulations were 11% higher in the online catalogue than in the PRECIS index, (Section 4.2.2, Tables 8A, 8B),

b) initial broad to narrow search formulations were slightly more stable in the orientation stage than other approaches, (Section 4.2.3, Table 11B),

c) the final search formulation resulted in a greater number of broad to narrow formulations, (Section 4.2.4, Table 12B),

d) the online catalogue consultations resulted in more specific items being followed up at the shelves than class numbers, (Section, 4.4.1, Table 23),

e) the take-up rate for the broad to narrow approach for items examined at the shelves was higher than for other approaches in the online catalogue as well as higher than any of those in the PRECIS index, (Section 4.3.3., Tables 20A, 20B),

f) although the narrow to broad approach produced more items with original terms as in the PRECIS index, the context of the titles were almost equally divided between those which were narrower and those which were broader than the expressed topic. In the PRECIS index they tended to be broader, (Section 4.3.2, Tables 16A, 16B, 17A, 17B).

5.6 Subject access elements: controlled vocabulary, titles, classification

As evidenced from the type of search formulations and documents selected, the different bibliographic tools available would appear to have affected searching behaviour not only at the bibliographic tool itself but also at the follow up consultation at the shelves. In addition there is some indication, in the increase of the direct shelf approach for specific item searching in the online setting,

that behaviour at the shelves was also being indirectly modified.

The major difference between the use of the two bibliographic tools lies in the bias created by each towards one type of approach for subject searching, with the PRECIS index supporting a broad more open approach and the online catalogue a narrow more closed approach. This could be the result of the structure of the tool itself and/or of the way the user exploits the features offered by that structure.

Subject access is provided through three interdependent elements: the controlled vocabulary of the subject index, the titles of the bibliographic record and the class numbers of the classification scheme. The subject searching process would in turn be dependent not only on the strengths of the individual elements but also on how each is related to the other.

5.6.1 Dominance of the contextual controlled vocabulary for subject access in the PRECIS index

The strength of the PRECIS index lies in its syntactic structure for subject indication allowing the user to browse within a subject context and providing new and preferred search terms through its cross-referencing. In this study although the index was available alongside and was meant to be used with the classified catalogue, consultations of the index did not lead to the classified catalogue. Users were either unaware of its existence, or

if they were, they did not see any advantage in using it before going to the shelves. As a result an important step of the subject access path was omitted minimizing not only the inherent advantages of the PRECIS index but also limiting the role of the classification. The searchers did not have the immediate opportunity to test the PRECIS entries with given class numbers against actual titles. At the same time the class numbers assigned to the index entries were often broader in context than the controlled language. Hence the effectiveness of subject searching, combining the elements of the controlled vocabulary of the subject index leading to a classified sequence of titles remains untested.

The apparent bias in supporting a broad search formulation strategy in the use of the PRECIS index for subject access could be attributed to a combination of factors:

a) The contextual structure of the indexing language may be predisposed to a broad approach

b) class numbers tended to be broader and did not match the specificity of the index entries

c) index entries were not followed up in the classified catalogue and verified with actual titles

5.6.2 Dominance of term matching for subject access in the online catalogue

In the online environment the nature and interplay of the three subject access elements differ from those of the manual system. The implementation of both LCSH and PRECIS

online alters their function from that of their manual application. Firstly, due to the lack of cross-references to 'preferred terms' the headings and PRECIS entries lose the characteristics of a 'controlled' language. In addition the PRECIS verbal description no longer allows for the syntactic relationships found in the full strings of the printed index. Thus both vocabularies are reduced to a verbal linguistic level providing only term enrichment for the matching of terms in the same way as in keyword matching in titles. Confusion is also created for the searcher in the way both vocabularies were displayed in one sequence, making success in browsing subject headings dependent on alphabetical accidents and not on any inherent structure.

Whereas titles had no contribution to subject access in the PRECIS environment, in the online environment it is the controlled language which plays a diminished role and titles, keyword in titles in particular, become the dominant subject access element.

5.6.3 Minimal role of classification for subject access

The role of classification as the third element in subject access in both of the bibliographic tools is limited. Searchers did not initiate any searches by class mark either at the classified catalogue or at the online catalogue. Although searching by class numbers was available on the online catalogue, unlike in the use of the

PRECIS index, there was no direct link to class numbers from the subject headings or keyword access options which initiated searches. Moreover users having found references did not use the given class numbers to further their search by browsing the classified sequence of the microfiche catalogue or the online catalogue.

In the majority of cases, searchers extracted a single class number which served merely as a location marker on the shelves. When the searcher was faced with actual books on the shelves, the classification played no part in narrowing or broadening a search, (Section 4.5.1). Furthermore the use of the classification for subject access relating different parts of the collection was not explored. In the cases who did follow up more than one class number, those from the online catalogue did result in more successful colocations for related subjects than those produced from the PRECIS index, although it would seem more by accident than by design, (Section 4.5.2).

5.6.4 Subject searching: a single linear dimensional process

It was found that users failed to explore the full potential of the manual system based on the PRECIS index. This may be partly due to the physical division between the different subject access elements but also partly because of a certain lack of inherent co-ordination between them. Consequently subject searching was essentially reduced to a linear single dimensional process in which the controlled

language of the index, the classification and the titles of the documents on the shelves, were only loosely connected, if at all, in the sequence of the search.

The online catalogue, on the other hand, provided access to all of the three elements in a single environment but it does not appear to have promoted a multidimensional integrated process. Even though the missing link between the indexing language and the record titles is established, the impoverished role of the mixed unrelated subject headings, minimizes the possibility of more effective interaction between the two. Titles may have been expected to serve as pivot between subject headings as well as the classified sequence. 26% of subject searches at the online catalogue did iterate between subject headings and titles and 13% browsed subject headings as well as used keyword searching for a single search. However users did not demonstrate a conscious systematic approach to searching. Due to the lack of inherent structure between the elements the title record themselves remained the dominant source for subject indication whether directly or indirectly. Hence the subject searching process in the online catalogue would appear to have maintained the linear single dimensional characteristics of the manual environment.

5.7 Measuring success at the bibliographic tools and at the shelves

Past catalogue use studies have been dependent on measuring success in terms of finding relevant items in the

catalogue without taking into consideration the availability of items found. The inclusion of circulation data on the online catalogue in this study made it possible to differentiate between the two categories and determine how a positive or negative result could influence subsequent searching behaviour either at the catalogue or at the shelves. In addition the holistic approach adopted made it possible to map out success/failure throughout the search process.

If only the result of the consultation of the bibliographic tool is taken into account, there appears to be little difference in the performance of either of the tools, i.e. searchers succeeded in locating an area in the library collection to continue their search.

The main difference however is that the PRECIS index led to class numbers being followed up at the shelves whereas the online catalogue led to specific references. Half of the cases (53%) who followed up specific references at the shelves from the online catalogue, found them to be relevant and selected them, (Section 4.4.3, Table 26). 30% of these also selected other items in the same area on the shelves. Thus the effectiveness of relevance judgements made at the online catalogue is significant in view of the fact that 23% of searchers were satisfied solely with the items found at the catalogue and didn't select any others at the shelves.

In correlating success and perseverance, it was found

that initial success at the online catalogue did not promote further searching, whereas initial success at the shelves did. It was also more fruitful to search further after a negative result at the online catalogue than after a positive result. It would appear that searchers did not expand on a successful search. At the shelves initial success was more likely to lead to further success than an initial failure. It is thus evident that the main subject searching activity is undertaken at the shelves and that the bibliographic tool serves to direct the searcher to the relevant areas of the collection. The higher rate of success at the shelves for those using the online catalogue seems to indicate that specific references are a more direct signpost than class numbers only.

However from the few items examined and selected at the shelves regardless of how the search was initiated, it is evident that searches are far from exhaustive. The uniformity of search outcomes from the different approaches, reveals that the direct shelf approach is seemingly just as effective.

5.8 Assessment of the combined methodology

The purpose of the investigation undertaken was twofold. On the one hand, the research questions sought to inform on the extent, characteristics and effectiveness of subject searching in the different manual and online environments. On the other hand, a combination of data gathering methods

were explored to see how these research questions could best be addressed. The extent by which the results obtained have provided answers to those questions has depended on the methodology adopted.

The contribution of the different components of the combined methodology namely, the holistic approach, the talk-aloud/observation technique and the screen logging facility, should thus be assessed in the light of the findings.

5.8.1 Findings from the holistic approach

Firstly the holistic approach, by directly relating searching activity at the bibliographic tools to that undertaken at the shelves, has made it possible to observe the following:

a) That subject searching occurs predominantly at the shelves. For users of the bibliographic tools, this is manifested by the number of searches developing into hybrid subject searches at the shelves and by the preference and perseverance demonstrated by users in pursuing a search at the shelves rather than at the catalogue. For the non-user, the direct shelf-approach represents the most prevalent single approach preferred by library users in both of the main samples.

b) The online catalogue user followed up specific references at the shelves and by selecting these, confirmed relevance judgements made at the catalogue.

These also served as a more direct path to further searching than class number alone, thus reinforcing the role of known citations in subject searching.

c) Subject searching at the shelves was limited in its scope in three ways: searchers carried out their search at single given class numbers only, they examined fewer than 6 items and selected 2 and less, 75% and more of titles selected 'matched' or partially 'matched' terms already expressed or encountered at the bibliographic tool thus revealing limited experimentation in expanding searches at the shelves.

d) The smaller proportion of titles selected which did not match users' search terms, between 16.5% and 25%, would not have been retrieved through the use of the bibliographic tool.

Some of these results seem to confirm some of the findings of previous studies which did not adopt a holistic approach. For example, the one in three occurrence of hybrid searches in both the manual and online environment here corresponds with the Yale study (Lipetz, 1970) on the traditional card catalogue where, through pre-search and post-search interviews, 17% of subject searches were discovered to be 'hybrid' searches, Borgman's (1983) study of transaction logs of the online catalogue at Ohio State University revealed that one in three search sessions contained a mixture of search commands which included at

least one subject search command. This combined approach to subject searching does not seem to be dependent on the searching environment but would appear to be a more fundamental characteristic of subject searches.

Indications of more extensive subject searching at the shelves than at the bibliographic tool is equally supported by other studies. Markey (1984) in her study of subject searching at the traditional library catalogue using protocol analysis, found a prevalence of 'shelf browse' searches whereby searchers extracted class numbers only from the catalogue consultation with the intention of pursuing their search at the shelves. Tagliacozzo et al (1970) interviewed searchers when they returned from the shelves and reports further more successful searching at the shelves following on from catalogue consultations.

Other studies who questioned users after the event, also confirm that the user handles a limited number of items in the shelf consultation and selects but a few as was observed here. Slater and Fisher (1969) found that 4.1 items were consulted and 2.4 were considered useful. Fussler and Simon (1961) estimated that three to nine books were consulted for every one selected.

The holistic approach was thus useful in confirming what users said they intended to do after the catalogue consultation in previous studies, as well as what they reported to have done at the shelves. It was most valuable however in showing that the user of the bibliographic tools

did not necessarily have an advantage over the non-user and that both followed a similar pattern of behaviour at the shelves particularly in sticking to initial query terms in the browsing activity regardless of the bibliographic tool used.

5.8.2 Supporting observation with a talk-aloud technique

The strength of the holistic approach has been to be able to record observable behaviour in a continuous fashion from the beginning to the end of a search. The talk-aloud technique was used to complement or confirm what was being observed without providing any explanations for the actions taken. Searchers were asked to talk-aloud but were left to choose their own level of verbal comment so that the amount of information volunteered varied with individuals and with different search situations.

Great care was taken by the experimenter not to interrupt but to leave the searcher in control. As such there appears to be no evidence of interferring with the continuity of the search process. Whether or not interference could be manifested in other ways has not been determined. For instance searchers could have been taking a shorter time to search or carried out simpler searches than normal. In leaving the level of interaction between experimenter and searcher at a minimal level, the method did not inform on searchers' full intentions, motivation or perception of the task or problems encountered. As such it

may have been possible to have gathered the same information by observation alone particularly at the shelves but being observed in silence may have been more intrusive. Equally it may have been more disruptive for the searcher if the experimenter had interrupted intermittently.

At the bibliographic tool, the verbal data provided by the user was essential to indicate choices and decisions made in the course of the consultation and particularly the information extracted for further searching at the shelves. Through the combined data gathering methods the object was to record the full progression of searches. Any attempt to seek further more indepth information relating for example to search formulations would certainly have interacted with the search process.

5.8.3 Logging searches at the online catalogue

The screen logging facility provided a comprehensive source of data of the searching activity at the terminal but did not include any data pertaining to relevance judgements made by the user. This was obtained through the talk-aloud technique and was recorded separately. The analysis of each search required both sources of data. Interpreting the logs independently from the recorded verbal data even with user sessions being clearly demarcated can still prove to be difficult and unsatisfactory particularly in deciphering individual searches. Combining these two sources of data into a

more automatic format would require an enhanced logging facility which at a minimum would ask the user to indicate what they indend to follow up at the shelves.

With regard to obtaining more information on users' intentions for search formulations, a replay facility of the screen logs combined with a confrontation technique where the user provides explanations after the event, may prove to be fruitful.

CONCLUSIONS

6.1 Subject searching and the impact of the online catalogue

To evaluate the impact of the online catalogue on subject searching behaviour the project addressed three research questions pertaining to:

1. the extent of subject searching at the library catalogue

2. the nature and effectiveness of subject searching at the library catalogue

3. the nature and effectiveness of subject search at the shelves

In seeking to compare and contrast searching behaviour through the different bibliographic tools and at the shelves, the results obtained provide us with some insight not only on the function of the individual tools but more importantly on the more fundamental underlying aspects of the retrieval task for monographic materials in the library context.

The following general conclusions are drawn from the results reported:

1. Library users have a basic primary need for subject searching and access.

2. In subject searching the bibliographic tool tailors the task.

3. The online catalogue in its present form has not improved retrieval effectiveness for subject searching.

4. Subject searching is mostly undertaken at the shelves where it is limited to the physical arrangement of the book collection.

6.2 The need for subject searching

The study establishes users' need for subject searching and having recognized it, the catalogue's function should then be evaluated in terms of meeting that need.

The distinction between known item searching and subject searching does not provide a sound basis for evaluation. This calls for a shift in paradigm from the catalogue perceived as a finding tool for known items to that of a retrieval tool for information access.

6.3 Subject searching behaviour: an adaptive process

The analysis and correlation of searchers' expressed information need, search formulation strategies and documents selected, reveal that subject searching in the library environment is a complex process whereby searchers adapt to three interdependent elements:

1. The structure of the bibliographic tool
2. The linear hierarchical arrangement of the collection
3. The type of documents being retrieved, i.e. monographs

6.3.1 The tool tailors the task

The bibliographic tools influenced searching behaviour in a number of ways in the course of the searching process. From the outset searchers formulated their search to suit the system. In adopting an exact or broad search

formulation strategy, searchers not only attempt to 'match' the system's language but also try to place their underlying or expressed need in a broader context. The extent by which they succeed would seem to depend on the structure of the tool in supporting the duality of the matching and contextual approaches.

Simply 'matching' the system's language in terms of words or access points is not an adequate measure of success. More than half of searchers who searched both tools, failed to reach a positive outcome from their initial access even if their search terms did 'match'. Those who did succeed initially, particularly in the online catalogue, did not build on their success or explore any other alternatives before going to the shelves. Those who continued to search at the catalogue, equally tended to search only until they obtained a positive result. It would thus seem that the tool was not conducive to further developing searches and searchers themselves were also limited in their ability to expand their requirements.

Parallels can be drawn between the matching and the contextual approaches adopted by catalogue users and the types of searches defined by Ingwersen (1982) in analysing search negotiations between librarians and users. He characterises three types of searches: the open search, the fixed search and the semi-fixed search. In the open search the librarian starts by drawing on knowledge concepts which extend beyond the query formulated by the user and are

'open to new information'. By contrast, in the fixed search the librarian searches for a direct solution to the query by trying to find 'the document that included the answer immediately'. The semi-fixed search starts as a fixed search but then progresses to a more open mode.

Similarly, the catalogue user who specifies his query to correspond with a document title, i.e. a known item search or a known named subject, could be adopting a fixed or matching search approach, whereas a less defined query could lead to an open or contextual search approach. The hybrid subject searches on the other hand could be defined as a semi-fixed search.

Neither of the tools examined supported both approaches to searching. The PRECIS index favoured a contextual approach and the online catalogue was more suited to matching. It is becoming more evident that to improve retrieval effectiveness, the online catalogue should cater for both.

A recent study on relating user context of questions in information retrieval for intermediaries (Saracevic and Kantor, 1988), reports that:

> "In general, searches based on problem and intent statements by users out-performed on the average all other types of searches...This suggests that the user context...is a most powerful element in the potential effect on retrival effectiveness...while doing the search on the basis of questions terms only (without elaboration) is the poorest way to go about it."

6.4 Improving retrieval effectiveness

Retrieval effectiveness in an information system should depend on the successful interaction between:

a) the user's search formulation

b) the knowledge base representation

In online catalogues, problems arise on both fronts. Searchers have difficulties in expressing their requirements and conversely, the system's knowledge base structure does not cater adequately for the three types of searches which may be formulated.

Most second generation online catalogues such as the CLSI system, provide for a combined phrase/keyword access with some automatic field specification together with implied Boolean ANDing. The state of the art focuses on the search mechanics between the two IR elements, i.e. user query/knowledge base and provides for a low level of interaction.

To improve retrieval effectiveness for third generation systems, three lines of enquiry are being followed for query expansion: the development of automatic matching aids, assistance in search formulation through user feedback and the provision of contextual structures.

With these developments it is becoming more apparent that online catalogues are more akin to other interactive information systems and that research in both fields will relate to and influence the other.

6.4.1 Matching aids

Improvements of matching aids build on existing search mechanics to overcome the more mechanical retrieval problems associated with matching. Thus the concern is not only in exploring new techniques but also in improving on how these are being provided to the user at the interface.

The techniques include, more sophisticated automatic search sequencing or search trees, implied Boolean operations, term weighting with reverse frequency ranking, and automatic stemming and spelling corrections. Combinations of these have been implemented in different versions of the Okapi prototype (Mitev, et al, 1985, Walker & Jones, 1987), as well as the operational system CITE, (Doszkocs, 1983). The improvements are for the most part transparent to the user in that the system does the various operations automatically.

6.4.2 Search formulation assistance

The second approach is to provide assistance with search formulations more directly through user feedback. This can be done in several ways at different stages. In the first instance the user can be prompted to enter search terms in groups of related concepts. The system can then take care of the Boolean manipulations of these groups. Examples of this can be found in an operational OPAC linked by a front-end to online databases at the University of Illinois, (Mischo, 1986) and the prototype IR system Plexus (Vickery

et al, 1986).

Alternatively user relevance feedback can also be used to reformulate search concepts on the basis of user relevance judgments. This has been introduced in one operational system in a research library, (Porter & Galpin, 1988) and is also found in the CITE system (Doszkocs, 1983). Relevance feedback has been combined with weighting and ranking processess in CITE and the latest version of Okapi as well as a front-end to Medline and Datastar developed at City University, (Robertson & Thompson, 1987).

Similarly users can also indicate relevant items which the system can then link to other references through different fields or elements of that record. Linkages from specific references to subject headings, class numbers, other authors are provided by some systems such as BLCMP and TINLib (Noerr, & Bivins Noerr, 1985).

These user feedback techniques for expanding search formulations circumvent the problems of using Boolean logic by the searcher and build on user entered terms. More importantly they open the way to 'negotiation' between the user and the system to overcome the conceptual language problems in retrieval. However even with this type of interactive dialogue at the interface, retrieval is still dependent on keyword searching and the 'matching principle'.

6.4.3 Contextual aids

The third approach in improving retrieval effectiveness through query expansion, explores the structure of the subject access elements of the database, i.e. the indexing language, and the classification.

On the basis of the implementation of the indexing languages and the minimal role of classification for subject searching revealed in our findings, it would seem worthwhile to re-examine how these could provide users with a more structured contextual approach to searching.

The Dewey Decimal Classification project (Markey and Demeyer, 1986), sought to integrate the classification schedules and relative indexes in an online catalogue not only to provide an enriched vocabulary, but also to relate user search terms to class numbers so that subject perspectives or context could be displayed. By revealing the hierarchical structure of the classification, users could then broaden or narrow their search. Other classification systems could certainly be explored in this way particularly those with faceted structures.

Although the online catalogue examined provided access to two controlled languages, LCSH and PRECIS, their implementation reduced their function to term and phrase matching. Two current projects are attempting to introduce subject authority control online to provide related terms. The first, (Markey, 1986), will integrate LCSH assigned headings in bibliographic records with LC machine readable

subject authority file. Cross-references will be introduced in the alphabetical list of assigned subject headings. For headings selected by the user, 'see also' as well as 'see also from' references will be displayed to lead to more specific or broader related headings

A similar project uses PRECIS as a basis for online thesaural control and a browsing facility (Congreve, 1986). User entered terms are matched with the PRECIS file which contains cross-reference information which can be used to amend a search and prompt for more specific terms. 'See references' can be used automatically leading the user to preferred terms.

It would be very useful ultimately to compare the effectiveness of both LCSH and PRECIS for online authority control to see whether the much discussed limitations of LCSH (Cochrane, 1986), can be overcomed and assess whether PRECIS' contextual structure is more advantageous.

Whilst classification and subject authority control explore existing structural subject access elements other elements are also being introduced. For example Lesk (1987) has experimented with the Eighteenth Century Short Title Catalogue and various dictionary files. The dictionary definitions provide related words for user's input and from user relevance feedback the system can then expand the query by using the dictionary definitions to suggest other records. Hence the vocabulary is expanded within the context of the dictionary definitions.

These semantic contextual aids offer interactive assistance by either providing an overview of a subject or placing the user's search in a context.

6.5 Towards more interactive online catalogues

More interaction at the user interface through matching, search formulation and contextual aids could offer the necessary support for the different searching approaches formulated by users and lead to improved retrieval effectiveness. The applications of these techniques for the design of more 'intelligent' interfaces however has been limited to systems with narrow well represented and structured knowledge areas unlike most OPACs. Nevertheless expert systems like Plexus (Vickery et al, 1986) and its commercial version Tome Searcher which applies a combination of all of the techniques described above could serve as a useful model.

There is more to subject searching than the user having 'a simple straightforward need requiring an equally straightforward match with documents in the system', (Bates, 1986). Online catalogues should stimulate a more dynamic, multidimensional, truly interactive approach to subject searching and promote a spirit of discovery.

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Appendix 1

Combined questionnaire and observation form for the pre-OPAC sample

LIBRARY USER SEARCH ACTIVITY FIELD STUDY

CASE RECORD

USER CHARACTERISTICS

1. No. 2. Date: 3. M / F

4. Status:

4.1 Ungd. 4.1.1 1st 4.1.2 2nd 4.1.2 3rd

Lib. no. 1st yr _____

4.2 Pgd 4.3 Res 4.4 Stf 4.5 Oth

5. Course / Dept:

6. Cat use: 6.1 never 6.2 occas 6.3 freq

7. Material: 7.1 course rel 7.2 other

8. Time factor: 9.1 immed 9.2 sht term 9.3 long term

9. Search states:

COMMENTS:

SPECIFIC ITEM SEARCH ACTIVITY AT THE CATALOGUE

10.1 INITIAL SEARCH

10.2 SUBSEQUENT SEARCH from:_____

11. Description of item(S): written / memory

	Author	Title	Pub	Date	Class
11.1					
11.2					
11.3					
11.4					
11.5					
11.6 Other					

12. Source of reference:

12.1 reading list 1 2 3 4 5

12.2 printed source 1 2 3 4 5

12.3 lecturer 1 2 3 4 5

12.4 colleague 1 2 3 4 5

13. Expect to find in cat?

13.1 yes 13.2 maybe 13.3 no

14. Expect to find on shelves?

14.1 yes 14.2 maybe 14.3 no

15. Searcher consults:

15.1 sht au/ti cat

GO TO 17

15.2 full au/ti cat

*16. Subsequent consultation of alternative au/ti cat:

* 16.1 sht au/ti cat

1 2 3 4 5

GO TO 18

* 16.2 full au/ti cat

1 2 3 4 5

---

17. Initial access points:

17.1 author

1 2 3 4 5

17.2 corpauth

1 2 3 4 5

17.3 title

1 2 3 4 5

17.4 keywords:

17.4.1_____ 17.4.2_____ 17.4.3_____

17.4.4_____ 17.4.5_____

---

*18. Subsequent access points:

* 18.1 author

1 2 3 4 5

* 18.2 corpauth

1 2 3 4 5

* 18.3 title

1 2 3 4 5

* 18.4 keywords:

18.4.1_____ 18.4.2_____ 18.4.3_____

18.4.4_____ 18.4.5_____

---

19. End result:

19.1 exact match GO TO 21

1 2 3 4 5

19.2 partial match GO TO 20

1 2 3 4 5

19.3 no match GO TO 22

1 2 3 4 5

20. Matching difficulties:

20.1 Author:

20.1.1 Mispelt	1 2 3 4 5	20.1.1 No initials in cat	1 2 3 4 5
20.1.3 Initials in cat	1 2 3 4 5	20.1.4 Wrong initials	1 2 3 4 5
20.1.5 Other	1 2 3 4 5		

20.2 Title:

20.2.1 Lead term diff order	1 2 3 4 5	20.2.2 Lead term mispelt	1 2 3 4 5
20.2.3 Title incomplete	1 2 3 4 5	20.2.4 Other terms mispelt	1 2 3 4 5
20.2.5 Includes other terms	1 2 3 4 5	20.2.6 Other	1 2 3 4 5

21. Information recorded from cat: Written / Memory

	Class	Locs	Author	Title	Pub	Date
21.1						
21.2						
21.3						
21.4						
21.5						

22. Further search activities:

	22.1	go to shelves to retrieve specific item(s)	GO TO 23
		1 2 3 4 5	
*	22.2	subs access point in same au/ti cat	GO TO 18
		1 2 3 4 5	
*	22.3	subs consultation of alternative au/ti cat	GO TO 16
		1 2 3 4 5	
	22.4	subj search in precis index	GO TO 32
		1 2 3 4 5	
	22.5	subj search in subj guide	GO TO 32
		1 2 3 4 5	
	22.6	subj search in class cat	GO TO 46
		1 2 3 4 5	
	22.7	subj search at the shelves	GO TO 52
		1 2 3 4 5	
	22.8	seek help	
		1 2 3 4 5	
	22.9	request ILL	
		1 2 3 4 5	
	22.10	place an order	
		1 2 3 4 5	
	22.11	abandon search	
		1 2 3 4 5	

SPECIFIC ITEM SEARCH ACTIVITY AT THE SHELVES

23.1 Initial search 23.2 Subsequent search GO TO 28
From:_____

---

24. Description of item(s): written / memory

Author Title Pub Date Class

24.1

24.2

24.3

24.4

24.5 Other

---

25. Source of reference:

25.1 reading list 25.3 lecturer
1 2 3 4 5 1 2 3 4 5

25.2 printed source 25.4 colleague
1 2 3 4 5 1 2 3 4 5

---

26. Searcher consulted catalogue on previous occasion? Yes / No

26.1 sht au/ti cat 26.3 precis index
1 2 3 4 5 1 2 3 4 5

26.2 full au/ti cat 26.4 subj guide
1 2 3 4 5 1 2 3 4 5

26.5 class cat
1 2 3 4 5

---

27. Expect to find on shelves?

27.1 yes 27.2 maybe 27.3 no
1 2 3 4 5 1 2 3 4 5 1 2 3 4 5

28. Locating shelf section:

	YES					NO				
28.1 Familiar section?	1	2	3	4	5	1	2	3	4	5
28.2 Use of descriptive guiding?	1	2	3	4	5	1	2	3	4	5
28.3 Browse in general section?	1	2	3	4	5	1	2	3	4	5

---

29. Locating item(s) on the shelf:

29.1 Follow class order?

YES					NO				
1	2	3	4	5	1	2	3	4	5

Specify class no(s):

	from	to
29.1.1	_____	_____
29.1.2	_____	_____
29.1.3	_____	_____
29.1.4	_____	_____
29.1.5	_____	_____

29.2 Backtracking?

YES					NO				
1	2	3	4	5	1	2	3	4	5

29.3 No. of shelves scanned:

1	2	3	4	5
____	____	____	____	____

29.4 Look for other information on the spine?

YES					NO				
1	2	3	4	5	1	2	3	4	5

Specify:

29.4.1	_____	_____
29.4.2	_____	_____
29.4.3	_____	_____
29.4.4	_____	_____
29.4.5	_____	_____

30. Result:
30.1 Item(s) not found: 1 2 3 4 5

30.2 Item(s) found:

	Class	Information on the spine
30.2.1		
30.2.2		
30.2.3		
30.2.4		
30.2.5		

31. Further search activity:

31.1 Reserve item(s) not found 1 2 3 4 5

31.2 Seek help 1 2 3 4 5

31.3 Abandon search 1 2 3 4 5

31.4 Go to the catalogue:

* 31.4.1 Subs consultation of alternative au/ti cat — GO TO 16
1 2 3 4 5

* 31.4.2 Subs access point in same au/ti cat — GO TO 18
1 2 3 4 5

31.4.3 Consult au/ti cat — GO TO 10
1 2 3 4 5

31.4.4 Subj search in precis index — GO TO 32

31.4.5 Subj search in subject guide — GO TO 32

31.4.6 Subj search in class cat — GO TO 46

31.5 Subj search at the shelves — GO TO 52

SUBJECT SEARCH ACTIVITY PRECIS INDEX / SUBJECT GUIDE

32.1 Initial Search 32.2 Subsequent search From:

33. Expressed subject:

34. Searcher consults:

34.1 precis index 34.2 subj guide

*35. Subsequent consultation of alternative subj source:

35.1 precis index 35.2 subj guide

GO TO 37

36. Initial access point:

36.1 precis index 36.2 subj guide

GO TO 38

*37. Subsequent access point:

* 37.1 precis index:

37.1.1 _____ 37.1.2 _____

37.1.3 _____ 37.1.4 _____

* 37.2 precis see / see also ref:

37.2.1 _____ 37.2.2 _____

37.2.3 _____ 37.2.4 _____

* 37.3 subject guide:

37.3.1 _____ 37.3.2 _____

38. Scanning precis index / subj guide

38.1 Headings / topics from 1 to ?

1 _____ 6 _____

2 _____ 7 _____

3 _____ 8 _____

4 _____ 9 _____

5 _____ 10 _____

38.2 Backtracking yes / no

38.3 Relevant headings / topics

1_____ 2_____

3_____ 4_____

38.4 Relevant keywords in full strings / topic description

1_____ 2_____ 3_____

4_____ 5_____ 6_____

38.5 Search refinements: A= A priori I= Interactive

---

*39. Subsequent scanning precis index / subj guide

39.1 Headings / topics from 1 to ?

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

39.3 Backtracking yes / no

39.4 Relevant headings / topics

1_____ 2_____

3_____ 4_____

39.5 Relevant keywords in full strings / topic description

1_____ 2_____ 3_____

4_____ 5_____ 6_____

39.6 Search refinements: A= A priori I= Interactive

*40. Subsequent scanning precis index / subj guide

40.1 Headings / topics from 1 to ?

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

40.3 Backtracking yes / no

40.4 Relevant headings / topics

1_____ 2_____

3_____ 4_____

40.5 Relevant keywords in full strings / topic description

1_____ 2_____ 3_____

4_____ 5_____ 6_____

40.6 Search refinements: A= A priori I= Interactive

---

*41. Subsequent scanning precis index / subj guide

41.1 Headings / topics from 1 to ?

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

41.3 Backtracking yes / no

41.4 Relevant headings / topics

1_____ 2_____

3_____ 4_____

41.5 Relevant keywords in full strings / topic description

1_____ 2_____ 3_____

4_____ 5_____ 6_____

41.6 Search refinements: A= A priori I= Interactive

---

42. Result:

42.1 relevant string / topic _____

42.2 possible relevant stg/topic _____

42.2 no relevant string/topic

---

43. Difficulties:

43.1 Keywords taken out of context of string

43.2 Class no misaligned incorrect no. noted

43.3 Other:

---

44. Further search activity:

	44.1	Seek help	
*	44.2	Subs consultation of other index / guide	GO TO 35
*	44.3	Subs access point of same index / guide	GO TO 37
	44.4	Proceed to class cat	GO TO 46
	44.5	Proceed to the shelves	GO TO 52
	42.6	Abandon search	

---

45. Information recorded from precis index/ subj guide:

memory / written

45.1 Class no(s) full/partial

45.2 Index terms_____

SUBJECT SEARCH ACTIVITY CLASSIFIED CATALOGUE

46.1 Initial search

46.2 Subsequent search From:

46.1.1 Expressed topic:

46.1.2 Source of class no(s):

---

47. Scanning class cat: scan all backtrack

47.1.1 class no _____ y / n y / n

47.1.2 class no _____ y / n y / n

47.1.3 class no _____ y / n y / n

47.1.4 class no _____ y / n y / n

47.2 No frames scanned:

47.2.1_____ 47.2.2_____ 47.2.3_____ 47.2.4____

47.4 Search refinements: A= A priori I= Interactive

47.4.1_____

47.4.2_____

47.4.3

47.4.4_____

---

*48. Subs scanning class cat: scan all backtrack

48.1.1 class no _____ y / n y / n

48.1.2 class no _____ y / n y / n

48.1.3 class no _____ y / n y / n

48.1.4 class no _____ y / n y / n

48.2 No frames scanned:

48.2.1_____ 48.2.2_____ 48.2.3_____ 48.2.4____

48.4 Search refinements: A= Apriori I= Interactive

48.4.1_____

48.4.2_____

48.4.3_____

48.4.4_____

49. Result:

49.1 relevant class nos _____

49.2 possible relevant class nos _____

49.3 not relevant class nos _____

50. Further search activity:

50.1 Seek help

50.2 Consultation of other subj source

precis index / subj guide GO TO 32

50.3 Proceed to shelves to find items GO TO 23

50.4 Proceed to shelves to continue subj search GO TO 52

50.5 Abandon search

51. Information recorded from class cat: memory / written

	Class	Loc	Author	Title	Pub	Date
51.1						
51.2						
51.3						
51.4						
51.5						

SUBJECT SEARCH ACTIVITY AT THE SHELVES

52.1 Initial search

52.2 Subsequent search From:

53. Expressed topic:

54. Locating relevant section:

54.1 Section familiar? yes / no

54.2 Use of descriptive guiding? yes / no

54.3 Look for specific class no(s)? yes / no

54.4 Searcher consulted cat on previous occasion? yes / no / not applic

55. Browsing on the shelves:

55.1 Structured browsing? yes / no

55.2 Backtracking? yes / no

55.3 Class nos covered:

from _____ to _____

_____ _____

55.4 No of shelves scanned: _____

55.5 Search refinements: A= A priori I= Interactive

55.6 Items taken from shelf and contents / index examined
Information on spine:

1 _____ 6 _____

2 _____ 7 _____

3 _____ 8 _____

4 _____ 9 _____

5 _____ 10 _____

*56. Subsequent browsing at another section on the shelves:

56.1 Structured browsing? yes / no

56.2 Backtracking? yes / no

56.3 Class nos covered:

from_____ to_____

_____ _____

56.4 No of shelves scanned: _____

56.5 Search refinements: A= A priori I= Interactive

56.6 Items taken from shelf and contents / index examined
Information on spine:

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

*57. Subsequent browsing at another section on the shelves:

57.1 Structured browsing? yes / no

57.2 Backtracking? yes / no

57.3 Class nos covered:

from_____ to_____

_____ _____

57.4 No of shelves scanned: _____

57.5 Search refinements: A= A priori I= Interactive

57.7 Items taken from shelf and contents / index examined
Keywords on spine

1_____ 2_____

3_____ 4_____

5_____ 6_____

7_____ 8_____

9_____ 10_____

58. Result:

58.1 Relevant class section _____

58.2 Not relevant class section_____

59. Further search activity:

59.1 Seek help

* 59.2 Subs subj search on another shelf section GO TO 56/57

59.3 Subj search in precis ind/subj guide GO TO 32

59.4 Subj search in class cat GO TO 46

59.5 Search in au/ti cat GO TO 10

59.6 Abandon search

60. Items retrieved:

	Class	Title
60.1		
60.2		
60.3		
60.4		
60.5		

Appendix 2

Combined questionnaire and observation form for the OPAC1 and OPAC2 samples

LIBRARY USER SEARCH ACTIVITY FIELD STUDY

CASE RECORD

USER CHARACTERISTICS

1. No. 2. Date: 3. M / F

4. Status:

4.1 Ungd. 4.1.1 1st 4.1.2 2nd 4.1.2 3rd

Lib. no. 1st yr _____

4.2 Pgd 4.3 Res 4.4 Stf 4.5 Oth

5. Course / Dept:

6. Cat use: 6.1 never 6.2 occas 6.3 freq

7. Material: 7.1 course rel 7.2 other

8. Time factor: 9.1 immed 9.2 sht term 9.3 long term

9. Search states:

COMMENTS:

SPECIFIC ITEM SEARCH AT THE CATALOGUE

1.1 Initial search 1.2 Subsequent search from

---

2. Description of item: 2.1 written 2.2 memor

Author Title Date Pub

2.3_____

2.4_____

2.5_____

2.6_____

2.7_____

---

3. Source of Reference

3.1 Reading list 3.2 Lecturer 3.3 Colleague

3.4 Printed source 3.5 Other

---

4. Initial Access

4.1 Author 4.2 Title 4.3 Author/title 4.4 Other

1 2 3 4 5 1 2 3 4 5 1 2 3 4 5 1 2 3 4 5

4.5 HELP? 1 2 3 4 5

AUTHOR SEARCH

5.1 Initial access 5.2 Subsequent access from:

Input 5.3_____

5.4_____

5.5_____

5.6 HELP 5.7 RESTART 5.8 END

---

6. Heading Browse 6.1 No match

Author selected 6.2_____

6.3_____

6.4_____

6.5_____

6.6_____

6.7 COPY AVAIL 6.8 BRIEF REFS 6.9 SEARCH HIST

6.10 HELP 6.11 RESTART 6.12 END

---

7. Brief References selected ____out of____ 7.1 None

7.2 Written 7.3 Memory 7.4 Marked

Author Title Date Class no.

7.5_____

7.6_____

7.7_____

7.8_____

7.9_____

7.10 HEADING BROWSE 7.11 COPY AVAIL 7.12 SEARCH HIST

7.13 HELP 7.14 RESTART 7.15 END

8. Copy availability references selected____out of____ 8.1 None

8.2 Written 8.3 Memory

Author Title Class no. Other

8.4_____

8.5_____

8.6_____

8.7_____

8.8_____

8.9 BRIEF REFS 8.10 FULL RECORD 8.11 SEARCH HIST

8.12 HELP 8.13 RESTART 8.14 END

---

9. Full Record Display____out of____ 9.1 Written 9.2 Memory

Author Title Class no. Other

9.3_____

9.4_____

9.5_____

9.6_____

9.7_____

9.8 COPY AVAIL 9.9 BRIEF REFS 9.10 SEARCH HIST

9.11 HELP 9.12 RESTART 9.13 END

TITLE SEARCH

10.1 Initial access 10.2 Subsequent access from:

Input 10.3_____

10.4_____

10.5_____

10.6 BROWSE 10.7 KEYWORD

10.8 HELP 10.9 RESTART 10.10 END

---

11. Heading Browse 11.1 No match

Titles Selected 11.2_____

11.3_____

11.4_____

11.5_____

11.6_____

11.7 COPY AVAIL 11.8 BRIEF REFS 11.9 SEARCH HIST

11.10 HELP 11.11 RESTART 11.12 END

---

12. Search History - postings No. of refs.

12.1 _____

12.2 _____

12.3 COPY AVAIL 12.4 BRIEF REFS 12.5 NEW SEARCH

12.6 HELP 12.7 RESTART 12.8 END

13. Brief References selected____ out of____ 13.1 None

13.2 Written 13.3 Memory 13.4 Marked

Author Title Date Class no.

13.5_____

13.6_____

13.7_____

13.8_____

13.9_____

13.10 HEADING BROWSE 13.11 COPY AVAIL 13.12 SEARCH HIST

13.13 HELP 13.14 RESTART 13.15 END

---

14. Copy availability references selected____out of____ 14.1 None

14.2 Written 14.3 Memory

Author Title Class no. Other

14.4_____

14.5_____

14.6_____

14.7_____

14.8_____

14.9 BRIEF REFS 14.10 FULL RECORD 14.11 SEARCH HIST

14.12 HELP 14.13 RESTART 14.14 END

AUTHOR/TITLE SEARCH

16.1 Initial access 16.2 Subsequent access from:

Input 16.3 Au_____

Ti_____

16.4 Au_____

Ti_____

16.5 Au_____

Ti_____

16.6 COPY AVAIL 16.7 SEARCH HIST

16.8 HELP 16.9 RESTART 16.10 END

---

17. Copy availability references selected___out of___ 17.1 None

17.2 Written 17.3 Memory

Author Title Class no. Other

17.4_____

17.5 FULL RECORD 17.6 SEARCH HIST

17.7 HELP 17.8 RESTART 17.9 END

---

18. Full Record Display 18.1 Written 18.2 Memory

Author Title Class no. Other

18.3_____

18.4 COPY AVAIL 18.5 SEARCH HIST

18.6 HELP 18.7 RESTART 18.8 END

19. Search History - Postings

No. of refs.

19.1 _____

19.2 _____

19.3 COPY AVAIL 19.4 BRIEF REFS 19.5 NEW SEARCH

19.6 HELP 19.7 RESTART 19.8 END

---

20. Brief References selected____ out of____ 20.1 None

20.2 Written 20.3 Memory 20.4 Marked

Author Title Date Class no.

20.5_____

20.6_____

20.7_____

20.8_____

20.9_____

20.10 COPY AVAIL 20.11 SEARCH HIST

20.12 HELP 20.13 RESTART 20.14 END

21. Copy availability references selected____out of____ 21.1 None

21.2 Written 21.3 Memory

Author Title Class no. Other

21.4_____

21.5_____

21.6_____

21.7_____

21.8_____

21.9 BRIEF REFS 21.10 FULL RECORD 21.11 SEARCH HIST

21.12 HELP 21.13 RESTART 21.14 END

---

22. Full Record Display____out of____ 22.1 Written 22.2 Memory

Author Title Class no. Other

22.3_____

22.4_____

22.5_____

22.6_____

22.7_____

22.8 COPY AVAIL. 22.9 BRIEF REFS. 22.10 SEARCH HIST

22.11 HELP 22.12 RESTART 22.13 END

SUBJECT SEARCH

23. Expressed topic:_____

23.1 Initial search/access 23.2 Subsequent search/access from:

Input 23.3_____

23.4_____

23.5_____

23.6 HELP 23.7 RESTART 23.8 END

---

24. Heading Browse 24.1 No match

Selected 24.2_____

24.3_____

24.4_____

24.5_____

24.6_____

24.7 COPY AVAIL 24.8 BRIEF REFS 24.9 SEARCH HIST

24.10 HELP 24.11 RESTART 24.12 END

---

25. Brief References selected___out of___ 25.1 None

25.2 Written 25.3 Memory 25.4 Marked

Author Title Date Class no.

25.5_____

25.6_____

25.7_____

25.8_____

25.9_____

25.10 HEADING BROWSE 25.11 COPY AVAIL 25.12 SEARCH HIST

25.13 HELP 25.14 RESTART 25.15 END

26. Copy availability references selected___out of___ 26.1 None

26.2 Written 26.3 Memory

Author Title Class no. Other

26.4_____

26.5_____

26.6_____

26.7_____

26.8_____

26.9 HEADING BROWSE 26.10 BRIEF REFS

26.11 FULL RECORD 26.12 SEARCH HIST

26.13 HELP 26.14 RESTART 26.15 END

---

27. Full Record Display___out of___ 27.1 Written 27.2 Memory

Author Title Class no. Other

27.3_____

27.4_____

27.5_____

27.6_____

27.7_____

27.8 COPY AVAIL. 27.9 BRIEF REFS. 27.10 SEARCH HIST

27.11 HELP 27.12 RESTART 27.13 END

KEYWORD SEARCH

28. Expressed topic:_____

28.1 Initial search/access 28.2 Subsequent search/access from:

Input 28.3_____

28.4_____

28.5_____

28.6 HELP 28.7 RESTART 28.8 END

---

29. Search History-keyword postings

No. of refs.

29.1 _____

29.2 _____

29.3 COPY AVAIL 29.4 BRIEF REFS 29.5 SEARCH HIST

29.6 HELP 29.7 RESTART 29.8 END

---

30. Brief References selected___out of___ 30.1 None

30.2 Written 30.3 Memory 30.4 Marked

Author Title Date Class no.

30.5_____

30.6_____

30.7_____

30.8

30.9_____

30.10 COPY AVAIL 30.11 SEARCH HIST

30.12 HELP 30.13 RESTART 30.14 END

31. Copy availability references selected___out of___ 31.1 None

31.2 Written 31.3 Memory

Author Title Class no. Other

31.4 _____

31.5 _____

31.6 _____

31.7 _____

31.8 _____

31.9 BRIEF REFS 31.10 FULL RECORD 31.11 SEARCH HIST

31.12 HELP 31.13 RESTART 31.14 END

---

32. Full Record Display___out of___ 32.1 Written 32.2 Memory

Author Title Class no. Other

32.3 _____

32.4 _____

32.5 _____

32.6 _____

32.7 _____

32.8 COPY AVAIL 32.9 BRIEF REFS 32.10 SEARCH HIST

32.11 HELP 32.12 RESTART 32.13 END

SHELF-MARK SEARCH

33.1 Initial search

33.2 Subsequent search from:

Input: 33.3 _____

33.4 _____

33.5 HELP

33.6 RESTART

33.7 END

---

34. Shelf-mark browse

34.1 No match

Shelf-mark selected

34.2 _____

34.3 _____

34.4 _____

34.5 _____

34.6 _____

34.7 COPY AVAIL

34.8 BRIEF REFS

34.9 SEARCH HIST

34.10 HELP

34.11 RESTART

34.12 END

---

35. Brief References selected___out of___

35.1 None

35.2 Written Author

35.3 Memory Title

35.4 Marked Date Class no.

35.5 _____

35.6 _____

35.7 _____

35.8 _____

35.9 _____

35.10 COPY AVAIL

35.11 SEARCH HIST

35.12 HELP

35.13 RESTART

35.14 END

36. Copy availability references selected___out of___ 36.1 None

36.2 Written 36.3 Memory

Author Title Class no. Other

36.4_____

36.5_____

36.6_____

36.7_____

36.8_____

36.9 BRIEF REFS 36.10 FULL RECORD 36.11 SEARCH HIST

36.12 HELP 36.13 RESTART 36.14 END

---

37. Full Record Display___out of___ 37.1 Written 37.2 Memory

Author Title Class no. Other

37.3_____

37.4_____

37.5_____

37.6_____

37.7_____

37.8 COPY AVAIL. 37.9 BRIEF REFS. 37.10 SEARCH HIST

37.11 HELP 37.12 RESTART 37.13 END

SEARCH HISTORY

Search reformulation from:

38.1 Author 38.2 Title 38.3 Author/title

38.4 Subject 38.5 Keyword 38.6 Shelf-mark

38.7 Search History

---

39. New search input: No. Refs. Browse / Keyword

39.1_____

39.2_____

39.3 TRUNCATED TERMS: ALL

SELECTION:_____ _____

_____ _____ _____

39.4 COPY AVAIL 39.5 HEADING BROWSE 39.6 BRIEF REFS

39.7 HELP 39.8 RESTART 39.9 END

---

40. Search History - Postings

No. of Refs

40.1_____

40.2_____

40.3 COPY AVAIL 40.4 BRIEF REFS 40.5 NEW SEARCH

40.6 HELP 40.7 RESTART 40.8 END

41. Heading Browse 41.1 No match

Selected 41.2_____

41.3_____

41.4_____

41.5_____

41.6_____

41.7 COPY AVAIL 41.8 BRIEF REFS 41.9 SEARCH HIST

41.10 HELP 41.11 RESTART 41.12 END

---

42. Brief References selected___out of___ 42.1 None

42.2 Written 42.3 Memory 42.4 Marked

Author Title Date Class no.

42.5_____

42.6_____

42.7_____

42.8_____

42.9_____

42.10 HEADING BROWSE 42.11 COPY AVAIL 42.12 SEARCH HIST

42.13 HELP 42.14 RESTART 42.15 END

43. Copy availability references selected___out of___ 43.1 None

43.2 Written 43.3 Memory

Author Title Class no. Other

43.4_____

43.5_____

43.6_____

43.7_____

43.8_____

43.9 HEADING BROWSE 43.10 BRIEF REFS

43.11 FULL RECORD 43.12 SEARCH HIST

43.13 HELP 43.14 RESTART 43.15 END

---

44. Full Record Display___out of___ 44.1 Written 44.2 Memory

Author Title Class no. Other

44.3_____

44.4_____

44.5_____

44.6_____

44.7_____

44.8 COPY AVAIL 44.9 BRIEF REFS 44.10 SEARCH HIST

44.11 HELP 44.12 RESTART 44.13 END

SPECIFIC ITEM SEARCH AT THE SHELVES

45.1 Initial search 45.2 Subsequent search from:

46. Description of item(s): written / memory

	Author	Title	Date	Pub	Class no.
46.1					
46.2					
46.3					
46.4					
46.5 other					

47. Source of reference:

47.1 Reading list 1 2 3 4 5

47.2 Lecturer 1 2 3 4 5

47.3 Printed source 1 2 3 4 5

47.4 Colleague 1 2 3 4 5

47.5 Other 1 2 3 4 5

48. Searcher consulted catalogue on previous occassion

48.1 yes 48.2 no

49. Expect to find item on the shelves?

49.1 yes 49.2 maybe 49.3 no

50. Locating shelf section	YES	NO
50.1 Familiar section?	1 2 3 4 5	1 2 3 4 5
50.2 Use of guiding?	1 2 3 4 5	1 2 3 4 5
50.3 Browse in section?	1 2 3 4 5	1 2 3 4 5

51. Locating item(s) on the shelf:

51.1 Follow class order? YES 1 2 3 4 5 NO 1 2 3 4 5

Specify class no(s): from to

51.1.1 _____ _____

51.1.2 _____ _____

51.1.3 _____ _____

51.1.4 _____ _____

51.1.5 _____ _____

51.2 Backtracking? YES 1 2 3 4 5 NO 1 2 3 4 5

51.3 No. of shelves scanned: 1 2 3 4 5

_____ _____ _____ _____ _____

52. Result:

52.1 Item(s) not found: 1 2 3 4 5

52.2 Item(s) found:

	class no.	information on spine
52.2.1		
52.2.2		
52.2.3		
52.2.4		
52.2.5		

53. Further search activity:

53.1 Reserve item(s) not found 1 2 3 4 5

53.2 Seek help 1 2 3 4 5

53.3 Abandon search 1 2 3 4 5

53.4 Go to the catalogue 1 2 3 4 5

53.5 Subj search at the shelves GO TO 54

SUBJECT SEARCH AT THE SHELVES

54.1 Initial search 54.2 Subsequent search from:

---

55. Expressed topic:

---

56. Locating relevant section:

56.1 Section familiar? yes / no

56.2 Use of guiding? yes / no

56.3 Look for specific class no(s)? yes / no

56.4 Consulted cat on previous occasion? yes / no
not applic

---

57. Browsing at the shelves:

57.1 Structured browsing? yes / no

57.2 Backtracking? yes / no

57.3 Class no(s) covered

from_____ to_____

_____ _____

57.4 No. of shelves scanned:_____

57.5 Search refinements: A= A priori I= Interactive

57.6 Items taken from shelf: examined contents / index
Information on the spine:

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

*58. Subsequent browsing at another section of the shelves:

58.1 Structured browsing? yes / no

58.2 Backtracking? yes / no

58.3 Class no(s) covered

from_____ to_____

_____ _____

58.4 No. of shelves scanned:_____

58.5 Search refinements: A= A priori I= Interactive

58.6 Items taken from shelf: examined contents / index
Information on the spine:

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

---

*59. Subsequent browsing at another section of the shelves:

59.1 Structured browsing? yes / no

59.2 Backtracking? yes / no

59.3 Class no(s) covered

from_____ to_____

_____ _____

59.4 No. of shelves scanned:_____

59.5 Search refinements: A= A priori I= Interactive

59.6 Items taken from shelf: examined contents / index
Information on the spine:

1_____ 6_____

2_____ 7_____

3_____ 8_____

4_____ 9_____

5_____ 10_____

60. Result:

60.1 Relevant class section_____

60.2 not relevant class section_____

61. Items retrieved:

	Class no.	Title
61.1		
61.2		
61.3		
61.4		
61.5		

62. Further search activity:

62.1 Seek help

* 62.2 Subs subj search on another shelf section GO TO 58/59

62.3 Subs search at the catalogue

62.4 Abandon search

Appendix 3

Example of PRECIS index and entries selected by searcher

Alloys
See also
Aluminium alloys
Bimetallic catalysts
Binary alloys
Copper alloys
High temperature alloys
Multicomponent alloys
Nickel alloys
Steel
Almanacs
English astrological almanacs, 1500-1800 133.505
Almost sure behaviour. Partial sums. Random variables 519.24
Alphanumeric display systems
Electronic alphanumeric display systems 621.380414
Altaic languages
See also
Turkish language
Alternating current circuits. Electric equipment 621.3192
Coaxial alternating current bridge circuits 621.31913
Alternating current control devices. Electric equipment
Thyristor circuits 621.317
Alternating current electric locomotives. British Rail
to 1978. Engineering aspects 625.263
Alternating current electric motors
See also
Frequency changer fed electric motors
Alternating current equipment 621.3133
Alternating current machines 621.3133
Alternative energy resources 333.79
Alternative energy sources 333.79
Implications for design & construction of buildings - Conference proceedings 624.1977
Alternative energy sources. Great Britain
Development - Inquiry reports 333.79
Alternative logics See Nonclassical mathematical logic
Alternative medicine 615.5
to 1978 615.5
Alternative press See Underground press
Alternative science
- Sociological perspectives 303.483
Alternative technology
See also
Appropriate technology
Alternative technology 303.483
Information sources - Lists 016.301243
Alternative technology. Machynlleth. Powys
Organisations: National Centre for Alternative Technology - Guidebooks 604.5
Althusser, Louis
Theories of Marxism 335.4 ALT
Altitude. Aeroplanes
Measurement 629.1352
Altitudes
High altitudes. Effects on physiology of man 612.014415
Altruism
- Philosophical perspectives 171.8
Implications of environmental factors in survival of man 304.2
Altruism - cont.
Role in economics 330.1
Role in friendship - Philosophical perspectives 177.6
Alumina cement See High alumina cement
Aluminium
Anodising 673.722732
Aluminium alloys
Anodising 673.722732
Aluminium silicate
See also
Zeolites
Aluminium smelting industries. Great Britain
Expenditure by government 338.47669722
Aluminosilicates
See also
Feldspars
Alumni See Ex-students
Amalgamated Engineering Union (Australia)
to 1972 331.881 AMA
Amalgamated Union of Engineering Workers
Decision making. Role of district committees 331.881162
Amalgamations See Mergers
Amateur radio equipment 621.3841
Amateur theatre
- Manuals 792.0222
Ambiguity. Language
Ambiguity, metaphor & vagueness - Philosophical perspectives 401
Ambiguous colloquialisms. English language
- Dictionaries 427
Ambulatory patients
Medical records. Records management. Applications of digital computer systems 001.6402461
Amenity. Urban regions. Great Britain
Role in environment planning 309.262
America
See also
Caribbean region
Central America
Central American countries
Latin America
Latin American
North America
United States
America
Archaeology, to 1973 930.0973
Slavery, to 1865 326
American arts
American experimental visual arts. Kelly, Mary, 1941- - Illustrations 306.8743
Warhol, Andy - Autobiographies 700.924
American business firms. Manufacturing industries. Great Britain
Organisation structure compared with organisation structure of British manufacturing firms 338.7
American businessmen
Japan. Marketing - For American businessmen 658.800952

Encultiration See Socialisation 303.44
Encyclopaedias
  See also
    Miscellaneous facts
Encyclopaedias
  American encyclopaedias. Books of miscellaneous facts - Texts 000
  English encyclopaedias - Texts 032
  English encyclopaedias. Books of miscellaneous facts - Texts 000
Encyclopaedias in English
  - Texts 032
Endangered species See Organisms in danger of extinction
Endocrine system
  See also
    Neuroendocrine system
Endocrine system. Mammals
  Effects on behaviour 599.051
Endocrine system. Man 612.4
Endocrinology. Medicine 616.4
Endogenous periodic phenomena See Biological rhythms
Enduring powers of attorney. England
  Law - Proposals 344.044
Energy
  See also
    Bioenergetics
    Bond energies
    Electricity
    Heat
    Ionisation potential
    Potential energy
    Power. Energy
    Radiation
    Solar energy
    Sound
Energy 530
  Conservation. Theories, to ca 1880 531.62
  Consumption by agricultural industries 338.16
  Consumption by food production industries 338.19
  Demand - Conference proceedings 333.79
  Demand. Mathematical models 333.79
  Grading & degrading 621.4021
  Storage 621.4
  Storage - Conference proceedings 621.4
  Supply & demand 333.79
  Supply & demand. Role of Organization of the Petroleum Exporting Countries - Forecasts - Conference proceedings 338.27282 OPEC
Energy. Air transport. Great Britain
  Conservation - Proposals 629.134351
Energy. Ancient world
  Theories 531.6093
Energy. Buildings 621.042
  Conservation 333.7916
  Conservation. Management - Conference proceedings 658.2
Energy. Buildings. Great Britain
  Conservation - Reports, surveys 621.4
Energy. Chemical industries. Europe
  Supply & demand - Forecasts 333.79
Energy. Chemical industries. Great Britain
  Conservation - Proposals 658.26
Energy. Companies. Great Britain
  Conservation 621.4
Energy. Compressed air equipment
  Conservation - Manuals 621.51
Energy. Electric industrial processing equipment
  Conservation - Conference proceedings 621.31042
Energy. Freight transport. Great Britain
  Conservation - Proposals 380.522
Energy. Great Britain
  Conservation - Proposals 333.79
  Supply & demand - Forecasts 333.7912
  Supply & demand. Elasticity - Reports, surveys 338.436214
  Supply & demand. Forecasting. Methods 333.79018
Energy. Hot water heating systems. Residences. Great Britain
  Conservation 624.1966
Energy. Industrialised countries
  Consumption - Comparative studies 333.79
Energy. Industries
  Conservation 621.4
  Conservation. Management. Applications of computer systems 658.26
  Planning. Methodology 658.26
Energy. Industries. European Community countries
  Conservation - Conference proceedings 621.4
Energy. Industries. Great Britain
  Conservation 620.11
  Conservation - Proposals 333.79
  Conservation. Management - Manuals 658.26
Energy. Non-residential buildings. Great Britain
  Conservation. Law - Statutory instruments - Texts with commentaries 624.197
Energy. Passenger transport. Great Britain
  Conservation - Proposals 380.5
Energy. Residences. United States
  Conservation. Management - Amateurs' manuals 624.197
Energy. United States
  Consumption by agricultural industries - Conference proceedings 338.16
Energy bands
  See also
    Fermi surfaces
Energy bands. Semiconductors
  related to chemical bonding 541.28
Energy compression
  - Conference proceedings 621.4
Energy conversion
  See also
    Photovoltaic conversion
    Sensor systems
    Transducers
Energy conversion 621.4
Energy conversion. Machinery
  - Study examples: Diesel engines 621.43

Appendix 4

Classification of search formulations for subject searches at the PRECIS index

APPENDIX 4

Classification of Search Formulations in the Use of the PRECIS Index

4.1

Stage	Search Terms	Classification
Expressed topic	Mentally handicapped children	E
Initial access	Mentally handicapped children **See also** Parents of mentally handicapped children	E
Subsequent access	1. Mental disorders **See also** Mental retardation	N
	2. Mental retardation. Children, social aspects	N
	3. Parents of mentally handicapped children - Transcripts of interviews	N
Exit	1. Mental retardation. Children, social aspects	N
	2. Parents of mentally handicapped children - Transcripts of interviews	N

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

4.2

Stage	Search Terms	Classification
Expressed topic	Photogrammetry	E
Initial access	Photogrammetry	E
Exit	Photogrammetry	E

Initial search formulation: E
Orientation: E
Final search formulation: E

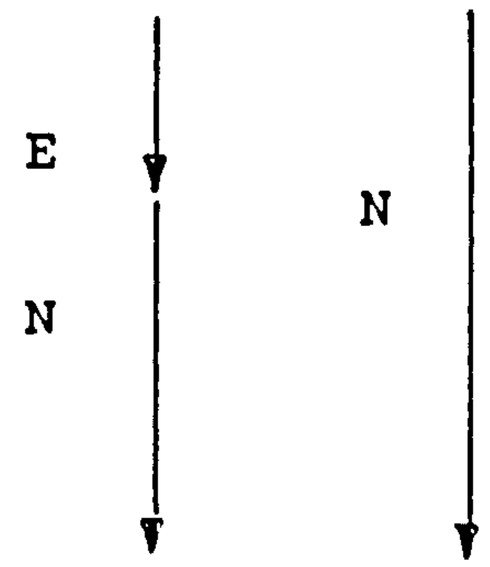
4.3

Stage	Search Terms	Classification
Expressed topic	Dependency theory in international relations	E
Initial access	Dependency. Developing countries	
Subsequent access	1. Dependency. Developing countries - implications for economic development - related to capital accumulation by capitalist countries to 1930	N
	2. Dependency **See also** Interdependence	
	3. Interdependence Economic relations - effects on international reinsurance	
	4. Interdependence. Foreign relations	N
	5. International relations	
Exit	1. Dependency. Developing countries - implications for economic development - related to capital accumulation by capitalist countries to 1930	
	2. Interdependence Economic relations - effects on international reinsurance	
	3. Interdependence. Foreign relations	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

4.4

Stage	Search Terms	Classification
Expressed topic	Ultrasonics	
Initial access	Ultrasonics*	E
Subsequent	Ultrasonic waves	N
Exit	Ultrasonic waves	

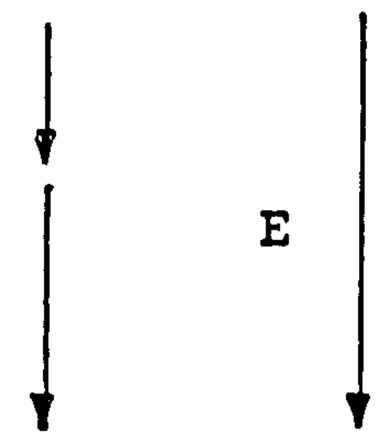


* not found

Initial search formulation: E
Orientation: N - B
Final search formulation: B - N

4.5

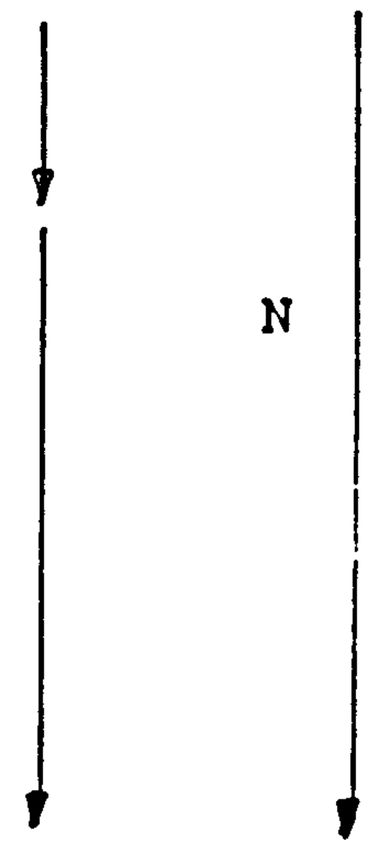
Stage	Search Terms	Classification
Expressed topic	X-ray diffraction	E
Initial access	X-ray diffraction	E
Exit	X-ray diffraction	



Initial search formulation: E
Orientation: E
Final search formulation: E

4.6

Stage	Search Terms	Classification
Expressed topic	Fortran programming	
Initial access	Fortran language	E
Subsequent access	1. Fortran 1V language 2. Fortran 1V language - for engineering 3. Fortran 77 language	N
Exit	1. Fortran 1V language - for engineering 2. Fortran 77 language	



Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

4.7

Stage	Search Terms	Classification
Expressed topic	Economics	E
Initial access	Economics	N
Subsequent access	Keynes, John Maynard: General theory of employment, interest and money - Critical studies	N
Exit	Keynes, John Maynard: General theory of employment, interest and money - Critical studies	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

4.8

Stage	Search Terms	Classification
Expressed topic	Carbanions	E
Initial access	Carbanions	E
Exit	Carbanions	E

Initial search formulation: E
Orientation: E
Final search formulation: E

4.9

Stage	Search Terms	Classification
Expressed topic	Geology	E
Initial access	Geology **See also** Petrology	N
Subsequent access	1. Geology Environmental geology 2. Petrology. Sedimentary rocks	N
Exit	Petrology. Sedimentary rocks	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

4.10

Stage	Search Terms	Classification
Expressed topic	Eurolex and Lexis	E
Initial access	Eurolex* Lexis*	B
Subsequen access	1. European Economic Community Information sources 2. Law. European Economic Community Information sources - Lists	B
Exit	Law. European Economic Community Information sources - Lists	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

* not found

4.11

Stage	Search Terms	Classification
Expressed topic	Auditory discrimination	E
Initial access	Auditory perception **See also** Hearing	
Subsequent access	1. Auditory perception. Man	B
	2. Speech Perception by man	B
	3. Hearing. Man Physiology & psycho-physiology	
Exit	1. Auditory perception. Man 2. Speech Perception by man 3. Hearing. Man Physiology & psychophysiology	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

4.12

Stage	Search Terms	Classification
Expressed topic	Computer simulation	E
Initial access	Computer simulation*	B
Subsequent access	Simulations	B
Exit	Simulations	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

* not found

4.13

Stage	Search Terms	Classification
Expressed topic	Energy conservation	E
Initial access	Energy conservation	
Subsequent access	1. Energy. Air Transport. Great Britain	B
	2. Energy. Buildings Conservation	
	3. Energy. Freight transport. Great Britain	B
	Conservation - proposals	
	Supply & demand - Forecasts	
	4. Alternative energy resources	
	5. Alternative energy sources. Great Britain	
	6. Energy resources	
Exit	1. Energy conservation	
	2. Alternative energy resources	
	3. Energy resources	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

4.14

Stage	Search Terms	Classification
Expressed topic	Token economy in psychology	E
Initial access	Token economy*	
Subsequent access	1. Psychological aspects. Physically handicapped children	B
	2. Psychological aspects. Physically handicapped persons	
	3. Psychological perspectives **See also** Behaviourist perspectives	
	4. Psychology **See also** Behaviour Behaviourism	N
	5. Behaviour. Man - Behaviourist perspectives	
	6. Behaviour modification **See also** Behaviour therapy	
	7. Behaviour modification. Education	
	8. Behaviour modification. Man	
	9. Behaviour therapy. Children	
	10. Behaviour therapy. Cognitive behaviour therapy. techniques	
	11. Behaviourist perspectives Man. behaviour	
Exit	1. Pshychological aspects. Physically handicapped children	
	2. Behaviour modification. Education	
	3. Behaviour modification. Man	
	4. Behaviour therapy	
	5. Behaviour therapy. Children	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

* not found

4.15

Stage	Search Terms	Classification
Expressed topic	German composer, Furtwangler	
Initial access	Music	B
Subsequent access	1. Music - Criticism 2. Composers - Biographical dictionaries 3. German music 4. Music. Austria 5. Musicians	N
Exit	Music - Composers - Biographical dictionaries	B

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

4.16

Stage	Search Terms	Classification
Expressed topic	Short term, long term memory	
Initial access	Memory. man	B
Subsequent access	1. Memory. man Long term memory - conference proceedings 2. Short term memory	N
Exit	1. Long term memory 2. Short term memory	E

Initial search formulation: N - B
Orientation: B - N
Final search formulation: E

4.17

Stage	Search Terms	Classification
Expressed topic	Neutron bomb	B
Initial access	Defence policies **see** Military policies	
Subsequent access	1. Military equipment **see also** Weapon systems 2. Military policies, United States 3. Weapon systems **see also** Nuclear weapon systems 4. Nuclear weapon systems, Europe 5. Nuclear weapons, Great Britain - policies of government	B N
Exit	1. Military policies, United States 2. Nuclear weapons, Great Britain - policies of government	

Initial search formulation: N - B
Oritentation: B - N
Final search formulation: N - B

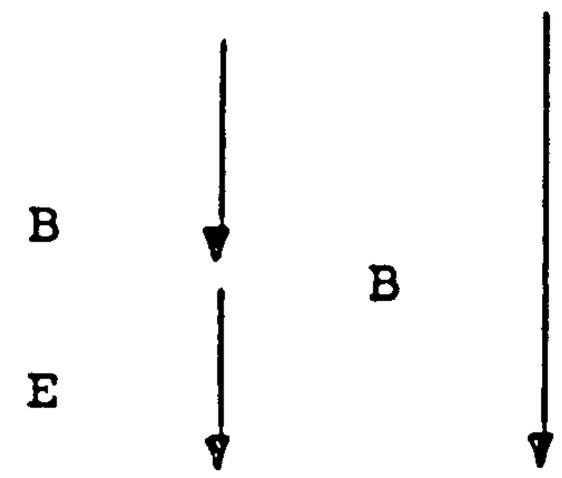
4.18

Stage	Search Terms	Classification
Expressed topic	Take over code for the Stock Exchange	B
Initial access	Stock Exchange. London	E B
Exit	Stock Exchange. London	

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

4.19

Stage	Search Terms	Classification
Expressed topic	Sociological aspects of media	
Initial access	Social psychology	B
Exit	*Failed to find any relevant entries	E

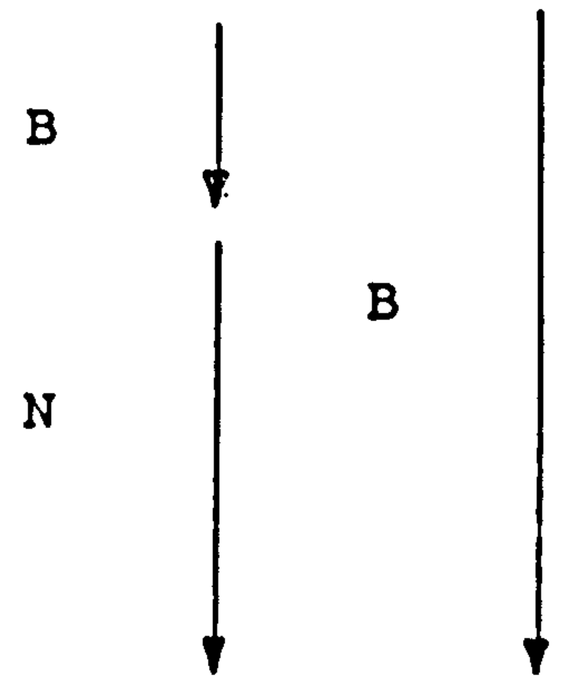


* was looking for social psychology and media

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

4.20

Stage	Search Terms	Classification
Expressed topic	Monet	B
Initial access	Art collections	
Subsequent access	1. Monet* 2. Impressionism. French paintings	N
Exit	Impressionism. French paintings	



Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

* not found

4.21

Stage	Search Terms	Classification
Expressed topic	Fortran	B
Initial access	Computer	N
Subsequent access	Fortran 77 language	B
Exit	Fortran 77 language	

Initial search formulation: N - B
Orientation: N - B
Final search formulation: B - N

4.22

Stage	Search Terms	Classification
Expressed topic	Industrial incentives	B
Initial access	Incentives	N
Subsequent access	Incentives. Motivation. Managers	N
Exit	Incentives. Motivation. Managers	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: B - N

4.23

Stage	Search Terms	Classification
Expressed topic	B-trees	B
Initial access	Computer	B
Exit	*Failed to find any relevant entries	E

* Was looking for computer files

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

4.24

Stage	Search Terms	Classification
Expressed topic	Report writing	B
Initial access	Literature	B
Exit	Literature	E

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

4.25

Stage	Search Terms	Classification
Expressed topic	Tee-line shorthand	B
Initial access	Shorthand	B
Exit	Shorthand	E

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

4.26

Stage	Search Terms	Classification
Expressed topic	Chemical safety of violegen, paraquat	B
Initial access	Organic compounds **See also -** Heterocyclic compounds	B
Subsequent access	1. Heterocyclic compounds 2. Pyrimidines	N
Exit	1. Heterocyclic compounds 2. Pyrimidines	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

4.27

Stage	Search Terms	Classification
Expressed topic	Surveying	N
Initial access	Levelling*	E
		B
Subsequent access	Surveying	
Exit	Surveying	

Initial search formulation: B - N
Orientation: N - B
Final search formulation: E

* not found

Appendix 5

Classification of search formulations for subject searches on the online catalogue

APPENDIX 5

Classification of Search Formulations at the Online Catalogue

5.1

Stage	Search Terms & Titles	Classification
Expressed topic	Cyclodextrin	
Initial access	Cyclodextrin*	E
Subsequent access	1. Starch 2. Fwa* 3. Florescent whitening agent* 4. Stilbene* 5. Photolysis*	B
Exit	- Failed to find any relevant entries	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

* not found

5.2

Stage	Search Terms & Titles	Classification
Expressed topic	Operations management	
Initial access	Operations management*	E
Subsequent access	1. Operations management - Production & operations management. 2. Queuing - Fundamentals of queuing. - Queuing. - Lecture notes on queuing systems. - Applied queuing theory. - Basic queuing theory.	N
Exit	1. Lecture notes on queuing systems. 2. Applied queuing systems. 3. Basic queuing systems.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

* not found

5.3

Stage	Search Terms & Titles	Classification
Expressed topic	Solar energy	
		E
Initial access	Solar energy - Solar energy and building. - Solar heating design. - Solar energy in building. - Solar homes and sun heating. - Solar energy today. - Solar heating systems for the U.K.	N
Exit	1. Solar energy and building. 2. Solar heating design. 3. Solar energy today. 4. Solar heating systems for the U.K.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

5.4

Stage	Search Terms & Titles	Classification
Expressed topic	Music	
		E
Initial access	Music	
Subsequent access	++1. Music, 1900 - 1979 - Music of the twentieth century. ++2. Music, 1937 - 1976 ++3. Music, 1918 - 1976 - Music since the First World War.	N
Exit	1. Music of the twentieth century. 2. Music since the First World War.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

++ also found

5.5

Stage	Search Terms & Titles	Classification
Expressed topic	Graphic tablets	E
Initial access	Graphic tablets*	
Subsequent access	1. Computer graphics	
	++2. Computer graphics-- Equipment and supplies-- Catalogs - The international computer graphics directory.	B
Exit	The international computer graphics directory.	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

* not found
++ also found

5.6

Stage	Search Terms & Titles	Classification
Expressed topic	Maths and psychology	E
Initial access	Maths in psychology*	
Subsequent access	+1. Mathematics--Tables - Tables, data and formulae for mathematicians. - Four figure tables and constants. - Mathematical handbook of formulas & tables.	N
	2. Psychology tables*	
	3. Maths in psychology*	N
	4. Mathematics in psychology - Elements of statistical reasoning. - Mathematics and psychology.	
	5. Statistics	
	++6. Statistics--charts, tables, - World facts and figures.	
Exit	1. Elements of statistical reasoning. 2. Mathematics and psychology.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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5.7

Stage	Search Terms & Titles	Classification
Expressed topic	Language acquisition	E
Initial access	Language acquisition - Language acquisition and communicative choice. - Studies of child language development.	E E
Exit	Language acquisition and communicative choice.	

Initial search formulation: E
Orientation: E
Final search formulation: E

5.8

Stage	Search Terms & Titles	Classification
Expressed topic	Information organisation	E
Initial access	Information organisation*	N
Subsequent access	+1. Information retrieval systems. Evaluation - Information retrieval experiments. ++2. Information processing. Economic aspects. - Economics of informatics.	N
Exit	Information retrieval experiments.	

Initial search Formulation: E
Orientation: B - N
Final search formulation: B - N

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++ also found

5.9

Stage	Search Terms & Titles	Classification
Expressed topic	Audiology	E
Initial access	Audiology	
Subsequent access	1. Fry - Physics of speech.	B
Exit	1. Audiology 2. Physics of speech.	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

5.10

Stage	Search Terms & Titles	Classification
Expressed topic	Organisation and Management	E
Initial access	Organisation and management*	
Subsequent access	+1. Organisation & methods ++2. Organisation development. Applications of systems theory - Systems theory for organization development. ++3. Organisation development ++4. Organisation development. Role of careers planning of personnel ++5. Organisation and methods ++6. Organisational change	N
Exit	1. Organisation development. Applications of systems theory 2. Organisation development	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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++ also found

5.11

Stage	Search Terms & Title	Classification
Expressed topic	Building administration	E
Initial access	Building administration*	
Subsequent access	+1. Building - Architectural practice and procedures. - The architect in practice.	N
	2. Architect promoter*	
	+3. Architect - The architect's guide to running a job. - The architect in practice.	
	4. Joint contracts tribunal - Contractors' guide to the Joint Contracts.	
	5. Building construction	N
	++6. Building construction. Contracts - Conditions of contract and forms of tender.	
	++7. Building construction. Contracts. Forms	
	++8. Building construction. Contracts. Law	
Exit	1. Architectural practice and procedures. 2. The architect in practice.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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5.12

Stage	Search Terms & Titles	Classification
Expressed topic	Transmission lines	E
Initial access	Transmission lines*	N
Subsequent access	1. Power transmission 2. Overcurrent protection relay* 3. Overcurrent protection* 4. Power generation* 5. Transmission lines - Modern transmission line theory and applications. - Electric transmission lines. - Electronic transmission technology.	N
Exit	1. Electric transmission lines. 2. Electronic transmission technology.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

* not found

5.13

Stage	Search Terms & Titles	Classification
Expressed topic	Microeconomics	E
Initial access	Microeconomics	E
Exit	Microeconomics	E

Initial search formulation: E
Orientation: E
Final search formulation: E

5.14

Stage	Search Terms & Titles	Classification
Expressed topic	Music programming	E
Initial access	Music computer programming*	
Subsequent access	1. Computing* 2. Computer programming 3. Computer programming BBC Basic* 4. BBC Basic - Good BASIC programming with the BBC. - Introducing BBC BASIC.	B
Exit	1. Good Basic programming with the BBC. 2. Introducing BBC BASIC.	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

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5.15

Stage	Search Terms & Titles	Classification
Expressed topic	Content analysis	E
Initial access	Content analysis	
Subsequent access	++1. Content analysis (Communication) - The message measurement inventory. - Television network news. - Advances in content analysis. ++2. Content analysis. Methodology - Content analysis:an introduction to its methodology.	N
Exit	1. Television network news. 2. Content analysis:an introduction to its methodology.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

++ also found

5.16

Stage	Search Terms & Titles	Classification
Expressed topic	Media history	E
Initial access	Media history*	
Subsequent access	+1. Media studies ++2. Media 3. Media history - Big story:how the American press and television reported and interpreted the crisis of Tet 1968 in Vietnam and Washington.	N N
	- The communications revolution:a history of mass media in the United States. - The powers that be. - Mass media in America. - America's mass media merchants. - The mass media: Aspen Institute guide to communication industry trends.	
Exit	1. Big story. 2. The communications revolution. 3. Mass media in America. 4. America's mass media merchants.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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++ also found

5.17

Stage	Search Terms & Titles	Classification
Expressed topic	6809 computer chip	E
Initial access	6809 Programming the 6809. 6809 machine code. 6809 programming.	E E E
Exit	6809	

Initial search formulation: E
Orientation: E
Final search formulation: E

5.18

Stage	Search Terms & Titles	Classification	
Expressed topic	Engineering mathematics	E	E
Initial access	Engineering mathematics - Engineering mathematics.	E	
Exit	Engineering mathematics.		

Initial search formulation: E
Orientation: E
Final search formulation: E

5.19

Stage	Search Terms & Titles	Classification	
Expressed topic	Optics	E	N
Initial access	Optics		
Subsequent access	1. Geometrical ++2. Geometrical and physical optics - Geometrical and physical optics.	N	
Exit	Geometrical and physical optics.		

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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5.20

Stage	Search Terms & Titles	Classification	
Expressed topic	Kruschev	E	E
Initial access	Kruschev - Khruschev: a biography.	E	
Exit	Khruschev: a biography.		

Initial search formulation: E
Orientation: E
Final search formulation: E

5.21

Stage	Search Terms & Titles	Classification
Expressed topic	Newspaper design	E
Initial access	Newspaper design*	N
Subsequent access	+Newspaper layout and typography - Modern newspaper editing and production. - Online editing.	N
Exit	Online editing.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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5.22

Stage	Search Terms & Titles	Classification
Expressed topic	Transformers	E
Initial access	Transformer - Electrical transformer theory. - Transformer and inductor bibliography.	B
Subsequent access	1. Circuit analysis 2. Transformers - Transformers for single and multiphase. - An introduction to electrical machines and transformers. - The performance and design of alternating current machines: transformers, three phase induction motors and synchronous machines.	B
Exit	The performance and design of alternating current machines: transformers, three phase induction motors and snychronous machines.	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

5.23

Stage	Search Terms & Title	Classification
Expressed topic	Attribution theory	E
Initial access	Attribution theory*	
Subsequent access	+1. Attribution (Social psychology) - Attribution theory and research.	
	++2. Attribution (Social psychology) --Addresses, essays, lectures - New directions in attribution research.	B
	3. Kelley - Social psychology of groups. - Attribution in social interaction.	B
	4. Attitude	
	5. Cognitive dissonance - An investigation into the effects of cognitive dissonance.	
	6. How opinions and attitudes are changed.	
Exit	1. New directions in attribution research. 2. How opinions and social attitudes are changed. 3. Attribution (Social psychology)	

Initial search formulation: E
Orientation: N - B
Final search formulation: N - B

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5.24

Stage	Search Terms & Titles	Classification
Expressed topic	Sex and violence in the media	
Initial access	Sex and violence in the media*	E
Subsequent access	+1. Sex in mass media - Sex, violence and the media.	E
Exit	Sex, violence and the media.	

Initial search formulation: E
Orientation: E
Final search formulation: E

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5.25

Stage	Search Terms & Titles	Classification
Expressed topic	Surveying	E
Initial access	Surveying	N
Subsequent access	++1. Surveying. Use of electronic equipment - Electronic surveying and navigation. 2. Control surveying*	N
Exit	Electronic surveying and navigation.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

* not found
++ also found

5.26

Stage	Search Terms & Titles	Classification
Expressed topic	Omnireader	E
Initial access	Omnireader*	N
Subsequent access	Oberon	N
Exit	- Failed to find any relevant entries	

Initial search formulation: E
Orientation: B - N
Exit B - N

* not found

5.27

Stage	Search Terms & Titles	Classification
Expressed topic	Strength of materials	E
Initial access	Strength of materials - Schaum's outline of theory and problems of strength of materials.	E
Exit	Schaum's outline of theory and problems of strength of materials.	

Initial search formulation: E
Orientation: E
Final search formulation: E

5.28

Stage	Search Terms & Titles	Classification
Expressed topic	Computer language Prolog	E
Initial access	Prolog	E
Subsequent access	++Prolog (Computer program language) - Beginning micro-PROLOG.	E
Exit	Beginning micro-PROLOG.	

Initial search formulation: E
Orientation: E
Final search formulation: E

++ also found

5.29

Stage	Search Terms & Titles	Classification
Expressed topic	Thermodynamics	E
Initial access	Thermodynamic - Thermodynamic principles for chemical... - Thermodynamic properties of steam. - Thermodynamic principles of energy degrading.	N
Subsequent access	1. Problem solver on thermodynamic* +2. Problem solvers no. 14, 15, 16, 3, 6.	
Exit	- Failed to find any relevant entries	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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\+ found

5.30

Stage	Search Terms & Titles	Classification
Expressed topic	Structured systems analysis	E
Initial access	Downs Structured systems analysis.*	N
Subsequent access	+1. Downs Basic systems design. 2. SSADM*	N
	3. Structured systems - Structured systems analysis and design method.	
Exit	Structured systems analysis and design method.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

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5.31

Stage	Search Terms & Titles	Classification
Expressed topic	Mechanics	E
Initial access	Schaum Mechanics.*	
Subsequent access	1. Nash Mechanics.*	
	2. Mechanics	
	3. Mechanics	
	4. Schaum outline	
	5. Schaum'm outline mechanics - Schaum's outline of theory and problems of fluid mechanics and hydraulics. - Schaum's outline of theory and problems of continuum mechanics. - Schaum's outline of theory and problems of engineering mechanics. - Schaum's outline of theory and problems of theoretical mechanics.	N
	6. Engineering mechanics - Research and facilities of Engineering Mechanics Section, National Bureau of Standards. - Statistical mechanics, fluctuations and noise. - Engineering mechanics. - Elementary engineering mechanics. - Principles of engineering mechanics. - Engineering mechanics.	
Exit	1. Schaum's outline of theory and problems of fluid mechanics and hydraulics.	
	2. Schaum's outline of theory and problems of engineering mechanics.	
	3. Schaum's outline of theory and problems of theoretical mechanics.	
	4. Elementary engineering mechanics.	
	5. Principles of engineering mechanics.	
	6. Engineering mechanics.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

* not found

5.32

Stage	Search Terms & Titles	Classification
Expressed topic	Cost accounting	E
Initial access	Brown & Owler Costing simplified	E
Subsequent access	Cost accounting - Principles of cost accounting. - Cost and management accounting.	E
Exit	1. Principles of cost accounting. 2. Cost and management accounting.	

Initial search formulation: E
Orientation: E
Final search formulation: E

5.33

Stage	Search Terms & Titles	Classification
Expressed topic	Statistics in psychology	E
Initial access	Miller Experimental design* and statistics	E
Subsequent access	1. Statistics ++2. Statistics and dynamics (Social Sciences) 3. Miller Experimental design and statistics.	E
Exit	Experimental design and statistics.	

Initial search formulation: E
Orientation: E
Final search formulation: E

* not found
++ also found

5.34

Stage	Search Terms & Titles	Classification
Expressed topic	Fluid mechanics	E
Initial access	White Fluid mechanics.	
Subsequent access	1. Fluid mechanics 2. Flow meters - Symposium on flow measurement. - A guide to methods and standards for the measurement of water flow. - Flow measurement and meters. - Flowmeters.	N
Exit	Symposium on flow measurement.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

5.35

Stage	Search Terms & Titles	Classification
Expressed topic	BASIC programming	E
Initial access	30 hour BASIC.*	
Subsequent access	1. Thirty hour BASIC.* 2. BBC BASIC BBC Basic. Introducing BBC BASIC. BASIC programming on the Acorn/BBC.	N
Exit	1. Introducing BBC BASIC. 2. Basic programming on the Acorn/BBC.	

Initial search formulation: E
Orientation: B - N
Final search formulation: B - N

* not found

Stage	Search Terms & Titles	Classification
Expressed topic	Social Psychology	E
Initial access	Murphy Dialogue and debate in social psychology.	E
Subsequent access	++1. Murphy - Social psychology. 2. Brown 3. Social psychology - Social psychology.	E
Exit	Social psychology.	

Initial search formulation: E
Orientation: E
Final search formulation: E

++ also found

5.37

Stage	Search Terms & Titles	Classification
Expressed topic	Ocular anatomy of sheep	
		B
Initial access	Ocular anatomy domestic* animals	
		B
Subsequent access	1. Sheep anatomy of eye and orbit*	
	2. Domestic animals - The anatomy of domestic animals.	B
Exit	The anatomy of domestic animals	

Initial search formulation: N - B
Orientation: N - B
Final search formulation: N - B

* not found

5.38

Stage	Search Terms & Titles	Classification
Expressed topic	Blackboard model of voice operation	
		B
Initial access	Voice recognition*	
		B
Subsequent access	1. Human factors in organisational design.*	
	2. Ergonomics	
	++3. Ergonomics. Psychological factors	B
	++4. Ergonomics. Systems analysis	
	5. Minsky The society of mind.	
Exit	1. Ergonomics. Systems analysis 2. The society of mind.	

Initial search formulation: N - B
Orientation: N - B
Final search formulation: N - B

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++ also found

5.39

Stage	Search Terms & Titles	Classification
Expressed topic	Changes in the British legal system	B
Initial access	Legal system	B
Subsequent access	1. British legal system - Hamyln revisited. 2. Legal system - The English legal system.	N
Exit	The English legal system.	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

5.40

Stage	Search Terms & Titles	Classification
Expressed topic	Programming MSDOS	B
Initial access	MSDOS	B
Subsequent access	1. DOS 2. Msdos* 3. DOS - MSDos developers' guide. - Advanced MSDos. - MSDOS bible. - Advanced C program display, window and keyboard. - Dos Unix systems. - Dos complete reference desktop resource.	E
Exit	DOS	

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

* not found

5.41

Stage	Search Terms & Titles	Classification
Expressed topic	Moral conflict and decision making	B
Initial access	Morals - Promises, morals and law. - Morals without mystery. - Values and morals. - Morals in evolution. - A preface to morals. - Morals and ethics.	B E
Exit	Morals	

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

5.42

Stage	Search Terms & Titles	Classification
Expressed topic	Soil mechanics axial compression test	B
Initial access	Soil mechanics - The mechanics of soils. - An introduction to soil mechanics. - Soil mechanics, SI version.	B E
Exit	Soil mechanics, SI version.	

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

5.43

Stage	Search Terms & Titles	Classification
Expressed topic	Pop art	B
Initial access	art	
Subsequent access	++1. Art, Modern--United States - Art for the millions.	B
	++2. Art-modern - The shock of the new. Movements in art since 1945.	N
Exit	1. Art, Modern--United States 2. Movements in art since 1945.	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

++ also found

5.44

Stage	Search Terms & Titles	Classification
Expressed topic	Atlas of Great Britain	B
Initial access	Atlas*	
Subsequent access	+1. Atlases -The Heinemann world Atlas. - The Times atlas of the world.	E
	2. Map*	
	+3. Map collections	
Exit	- Failed to find any relevant entries	

Initial search formulation: N - B
Orientation: E
Final search formulation: N - B

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+ found

5.45

Stage	Search Terms & Titles	Classification
Expressed topic	Mercedes Benz	B
Initial access	Promotion*	B
Subsequent access	+1. Promotions 2. Mercedes Benz* 3. Japanese work practices* +4. Japanese multinational companies - The threat of Japanese multinationals.	B
	5. Business ++6. Business enterprises--Japan --History - The development of Japanese business. ++7. Business and politics--Japan - Mitsui empire.	
Exit	1. The development of Japanese business. 2. Mitsui empire.	

Initial search formulation: N - B
Orientation: N - B
Final search formulation: N - B

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\+ found
++ also found

5.46

Stage	Search Terms & Titles	Classification
Expressed topic	Laibtiz roots	B
Initial access	Partial differentiation*	B
Subsequent access	1. Differentiation*	B
	+2. Differentiation (Mathematics) - Differentiation	
Exit	Differentiation.	

Initial search formulation: N - B
Orientation: N - B
Final search formulation: N - B

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\+ found

5.47

Stage	Search Terms & Titles	Classification
Expressed topic	IBM-PC interface	
		B
Initial access	IBM	
		B
Subsequent access	++1. IBM computers - Essential concepts of operating systems: using IBM mainframe examples.	
	++2. IBM Personal Computer	N
	++3. IBM Personal Computer microcomputer systems. Graphic displays. Programs	
Exit	- Failed to find any relevant entries	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

* also found

5.48

Stage	Search Terms & Titles	Classification
Expressed topic	Psychology and Milgram's experiments	
		B
Initial access	Psycho$	
		B
Subsequent access	++1. Psychological tests - Measuring human behaviour.	
	2. Milgram	N
	- Obedience to authority.	
Exit	1. Measuring human behaviour. 2. Obedience to authority.	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

++ also found

Stage	Search Terms & Titles	Classification
Expressed topic	Descartes	B
Initial access	Philosophy	
Subsequent access	++1. Philosophy--Addresses, essays, lectures - The problems of philosophy. - Essays on philosophical method.	B
	+2. Philosophy - The central questions of philosophy. - Philosophical problems. - Fundamental questions of philosophy. - Philosophy of science.	N
	3. Bacon - Francis Bacon's essays. - The works of Francis Bacon.	
	4. Descartes - The essential Descartes. - Philosophical essays. - Descartes.	
Exit	1. Problems of philosophy. 2. Central questions of philosophy. 3. Philosophical problems. 4. Fundamental questions of philosophy. 5. Francis Bacon's essays. 6. The essential Descartes 7. Philosophical essays.	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

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++ also found

5.50

Stage	Search Terms & Titles	Classification
Expressed topic	Management development	B
Initial access	Rose Classical theory of management.*	
Subsequent access	1. Management development* +2. Management--Japan - The Japanese management development system. - Management and industrial structure in Japan. +3. Management. Decision making. Applications of organisation development - Organisation development. 4. Taylor Theoretical development.* 5. Render Management analysis* + Quantitative analysis for management.	N
Exit	1. Organisation development.	E

Initial search formulation: N - B
Orientation: B - N
Final search formulation: E

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\+ found

5.51

Stage	Search Terms & Titles	Classification
Expressed topic	Mail surveys	B
Initial access	Dillman Mail and telephone surveys.	
Subsequent access	1. Mail* 2. Mail - Direct mail testing and measurement. - Professional mail surveys. - Planning and creating better direct mail.	N
Exit	1. Mail and telephone surveys. 2. Direct mail testing and measurement. 3. Professional mail surveys.	B

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

* not found

5.52

Stage	Search Terms & Titles	Classification
Expressed topic	Alternative fuels	B
Initial access	Fuel science	
Subsequent access	1. Harker Fuel and energy.	B
	2. Backhunt	
	3. Benet	
	4. Fuel - Fuels and fuel technology. - Alternative fuel technology.	
	5. Transport fuel	
	6. Energy for transport	
	7. Fuel cells - Fuel cells.	
	8. Alternative fuels	N
	9. Automobile fuels	
	10. Methanol	
	11. Ethanol	
	12. Methane	
	13. Butane	
	14. Propane	
	15. Ethylene	
	16. Propylene	
	17. Automobiles	
	18. Fuels automobile	
Exit	1. Fuels and fuel technology. 2. Alternative fuel technology.	

Initial search formulation: N - B
Orientation: B - N
Final search formulation: N - B

5.53

Stage	Search Terms & Titles	Classification
Expressed topic	American and British television	B
Initial access	Curran Power without responsibility.	B
Subsequent access	1. Peacock Report on the financing of the BBC. 2. Cornstock Television in America. 3. Barnoun Communication de-regulation. 4. Tunstall - The media are American. 5. Television ++6. Television. Economic aspects. Great Britain ++7. Television. Broadcasting policy. U.S. ++8. Television. Broadcasting. Social aspects. Great Britain ++9. Television. United States. Management ++10. Television. Law and legislation	N
Exit	1. Power without responsibility. 2. Report on the financing of the BBC. 3. The media are American. 4. Broadcast management.	

Initial search formulation: N - B ++ also found
Orientation: B - N
Final search formulation: N - B

5.54

Stage	Search Terms & Titles	Classification
Expressed topic	International relations in the Middle East	N
Initial access	Palestine	N
Subsequent access	Mandate - Palestine, retreat from the mandate - Origins of the Israeli polity.	N
Exit	Origins of the Israeli polity.	

Initial search formulation: B - N
Orientation: B - N
Final search formulation: B - N

5.55

Stage	Search Terms & Titles	Classification
Expressed topic	Organic chemistry	N
Initial access	Protecting groups*	N
Subsequent access	+Protective groups (Chemistry) - Protective groups in organic synthesis.	E
Exit	Protective groups in organic synthesis.	

Initial search formulation: B - N
Orientation: E
Final search formulation: B - N

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5.56

Stage	Search Terms & Titles	Classification
Expressed topic	Borane chemistry	
Initial access	Boranes in organic chemistry*	N
Subsequent access	+Borane - Boranes in organic chemistry.	E
Exit	Boranes in organic chemistry.	

Initial search formulation: B - N
Orientation: E
Final search formulation: B - N

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5.57

Stage	Search Terms & Titles	Classification
Expressed topic	Use of computers in community information	N
Initial access	Acompline and urbaline*	
Subsequent access	1. Urbaline* 2. Community information and* computer applications 3. Computer application in* community +4. Computer applications/ community services - Making modern technology work. - Prestel for people.	B
Exit	1. Making modern technology work. 2. Prestel for people	

Initial search formulation: B - N
Orientation: N - B
Final search formulation: N - B

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\+ found

5.58

Stage	Search Terms & Titles	Classification
Expressed topic	Expert systems	N
Initial access	Expert systems and production rules*	E
Subsequent access	+Expert systems. Applications - Expert systems. - Competent expert systems. - Expert systems in the micro-electronic age.	B
Exit	Expert systems in the micro-electronic age.	

Initial search formulation: B - N
Orientation: N - B
Final search formulation: E

* not found
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5.59

Stage	Search Terms & Titles	Classification
Expressed topic	Databases	N
Initial access	Distributed databases - Distributed databases. - Distributed database management systems. - Distributed database technology.	N E
Exit	Distributed databases.	

Initial search formulation: B - N
Orientation: E
Final search formulation: B - N

5.60

Stage	Search Terms & Titles	Classification
Expressed topic	Systems analysis	N
Initial access	Methodologies - A survey of methodologies for the evaluation of online computer information systems. - Information system methodologies. - Project evaluation methodologies and techniques. - Systems: concepts, methodologies.	N N
Exit	Project evaluation methodologies and techniques.	

Initial search formulation: B - N
Orientation: B - N
Final search formulation: B - N

5.61

Stage	Search Terms & Titles	Classification
Expressed topic	Defence in Europe	N
Initial access	Rowen	
Subsequent access	1. Miller	
	2. Soviet strategic thinking*	
	+3. Soviet military forces - The threat.	N
	4. Can Europe be defended by conventional forces*	
	5. Defence of W.Europe*	
	+6. Defence policies. Political aspects - The politics of defence.	
	7. Martin - Conference diplomacy: a case study. - The changing face of nuclear warfare.	B
	8. Defending the West	
	9. Contemporary strategy vol 1.*	
	++10. Contemporary strategy theories and policies.	
	11. Nato, the next thirty years.	
	++12. Nato's nuclear dilemmas.	
	++13. Nato.	
Exit	1. The threat 2. The politics of defence. 3. The changing face of nuclear warfare. 4. Defending the West. 5. Nato, the next thirty years.	

Initial search formulation: B - N
Orientation: N - B
Final search formulation: B - N

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++ also found

5.62

Stage	Search Terms & Titles	Classification
Expressed topic	Neuropsychology	N
Initial access	Springer Left brain, right hand.	
Subsequent access	1. Caplan Neurolinguistics and linguistics. 2. Bradshaw Human cerebral asymmetry. 3. Beaumont Introduction to neuro-psychology.* 4. Hardyck Left handedness.* 5. Hecaen Cerebral organisation in left-handedness.* 6. Searlman Language capabilities* 7. Neuropsychology - Cognitive neuropsychology. - Introduction to neuro-psychology. - Neuropsychology of left-handedness. - Neuropsychology of language and reading. - Understanding neuro-psychology.	B
Exit	1. Neuropsychology of left-handedness. 2. Neuropsychology of language and reading. 3. Understanding neuropsychology.	

Initial search formulation: B - N
Orientation: N - B
Final search formulation: B - N

* not found