Mental models and user experience of a next-generation library catalogue

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2 Acknowledgements

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Andrew Preater

15th December 2010

3 Declarations

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4 Abstract

Title: Mental models and user experience of a next-generation library catalogue

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This dissertation investigates library users' experience and understanding of a library online public access catalogue (OPAC), Encore by Innovative Interfaces. This is done with particular reference to the mental models concept from cognitive science, underpinned by George Kelly's personal construct psychology.

Research techniques known to be useful in similar research on other information retrieval systems will be applied to a new area of next-generation catalogues. This further demonstrates that the application of repertory grid technique (RGT) to work on OPACs is viable. The application of this to the next-generation catalogues that have appeared in the last five years is novel, and provides a useful starting point for further research in this area

Repertory grid technique is combined with cognitive walkthrough techniques based on ideas from Web usability testing to provide several views of user experience of the catalogue. This is analysed qualitatively and sketches of several models of the Encore catalogue are developed.

It was found that library users' mental models of Encore tend to take cues from their experience of the Web, especially search engines, and concludes with guidelines for library staff expecting to train library users on a next-generation catalogue.

5 Conventions and abbreviations used

In this dissertation the following conventions will be used:

1) Names of personal constructs are shown in an italic typeface for clarity within the main body text, for example: *Layout of catalogue emphasises most useful features*

2) Search terms are always shown in a monospaced typeface, for example: `greek oracles`

Key to abbreviations not in general use:

IR	Information retrieval
OPAC	Online public access catalogue. Specifically, a catalogue accessible remotely by users over a computer network.
RGT	Repertory grid technique
SAS	School of Advanced Study, University of London
ULRLS	University of London Research Library Services

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7 Introduction

This investigation looked into users' experience and understanding of a next-generation library online public access catalogue (OPAC) by comparison with previous catalogue interfaces, and the broader Web.

Broad consensus across commentators is that a 'next-generation' catalogue is one that improves on the core functionality of library management systems while including additional Web 2.0 technologies (Merčun and Žumer, 2008).

They include features such as:

- Emphasis on a simple style of search interface that makes novice users comfortable
- Making better use of existing metadata to improve relevancy ranking of search results and offer 'Did you mean...?' suggestions
- Allowing for user interaction including tagging and reviews

(Andrews, 2007; Markey, 2007; Breeding, 2007).

Library catalogues are now under competitive pressure from Web search engines as a starting point when researching a subject (De Rosa *et al.*, 2006 p. 20), with search engines proving popular even if they are not considered as trustworthy as the OPAC (Fast and Campbell, 2005). This is therefore a good opportunity to deploy the same research methods to OPACs as have been used on search engines and compare the models formed.

The system to be studied is the next-generation library catalogue Encore (Innovative Interfaces, 2010a) which University of London Research Library Service (ULRLS) acquired in 2009 and is currently being readied for deployment as the default library catalogue in use at ULRLS. This was to be compared with Innovative's previous WebPAC catalogue (Innovative Interfaces, 2008a).

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7.2 Aims and objectives

The aim is to investigate library users' understanding and mental models of a next-generation catalogue and explore how this differs from previous catalogues.

The objectives are to:

- Carry out cognitive walkthroughs and semi-structured interviews on library users to probe their understanding of the catalogue. Methods from personal construct psychology – the repertory grid technique (RGT) – will be used to give interviews structure and provide scaffolding for describing mental models.
- Analyse results and compare with previous studies in this area which have mainly been on previous generation of library OPACs.
- Compare models with those for Web search engines and similar information retrieval systems to see if the model is a closer match to that for Web search engines than expected for a traditional OPAC.

7.3 Anticipated outcomes

The main benefit of this investigation is in helping librarians and other information professionals understand how users interact with next-generation OPACs compared with previous systems.

It is anticipated the conclusions drawn will be useful for information literacy training in the academic library context, and one outcome includes guidelines to help librarians understand students' mental models. These have already been put into use for staff training at ULRLS to help library staff better understand the new catalogue so they can become expert with it themselves, and more effectively explain it to library users.

These guidelines may also help inform libraries thinking of acquiring a next-generation catalogue; additionally, findings should be of interest to those creating next-generation catalogues be they proprietary software vendors or developers of Open Source / Free Software systems.

Research techniques known to be useful in similar research on other information retrieval systems will be applied to a new area of next-generation catalogues, it is hoped this will further demonstrate that the application of repertory grid technique (RGT) to work on library catalogues is viable and provide a useful starting point for further research in this area.

Finally, this project aims to demonstrate the benefits of combining research methods to produce visual representations of user mental models, which remain very difficult to describe in a way that can be easily understood and interpreted by others.

8 Literature review

8.1 Mental models theory

A mental model in cognitive science is a functional, incomplete internal representation of a system that we create to provide a means of understanding and predicting the systems we encounter (Norman, 1983; 1988). This idea was first expressed in terms of a 'model' by Kenneth Craik, who said, "[i]f the organism carries a 'small-scale model' of external reality and of its possible actions within its head", it would be possible to think through different solution to problems before they have arisen and apply knowledge of past events to new situations (Craik, 1943 pp. 60-61).

Mental models are simplified, non-fixed and contain concepts or ideas that often poorly imitate reality (Johnson-Laird, 1983 p. 10), acting as "cognitively acceptable versions of a too-complex reality" (Besnard, Greathead and Baxter, 2004). Although the idea of a model as a mental picture or image crops up often in the literature, Johnson-Laird argues this is insufficient and that the model is rather, "an internal representation of a possibility" created in the mind (2001 p. 86).

The first wide-ranging theory of mental models was produced by Johnson-Laird, who explained mental models were "intended to explain the higher processes of cognition and, in particular, comprehension and inference" (Johnson-Laird, 1983 p. 446). Around the same time, Norman (1983 p. 7-8) defined different types of mental models from the perspective of the designer, the user, and the scientist attempting to describe the user's model. This, and a further article by Young (1983 p. 35-52) laid down the basis for what has become one of the two key themes in mental models research: the practical **design** perspective of improving systems by understanding user mental models, as contrasted with the theoretical **cognitive** perspective described previously.

It remains unclear from the literature what a mental model actually is (Hemforth and Koniesczny, 2006 p. 190) and due to varying use of the term by different researchers across different disciplines, what is actually being represented in a model (Carroll and Olson, 1987 pp. 3-5; Turner and Belanger, 1996). Indeed, as late as 1987, Carroll and Olson stated as a research recommendation a need to "[i]nvestigate whether people have and use mental models of various kinds", (1987, p. 30) which spurred researchers such as Sasse (1997) to attempt to demonstrate that they do in fact exist. More recently, Thagard (2010) describes a unified account of mental models based on their being created and sustained by populations of neurons in the brain. One exciting aspect of this approach is that it is something that can be measured directly using modern neuroimaging techniques.

8.2 Definition

Doyle and Ford (1998) reviewed definitions of mental models from across the literature and criticised existing definitions for being too broad and at times contradictory. They synthesised a clear, focused definition for use in systems dynamics research which following Westbrook (2006) will be used here:

> "A mental model of a dynamic system is a relatively enduring and accessible, but limited, internal conceptual representation of an external system whose structure maintains the perceived structure of that system."
>
> (Doyle and Ford, 1998 p. 19-24)

8.3 Mental models research in libraries

Since the 1980s mental models theory has been applied to information retrieval (IR) and other library systems, including real-world reference interviews (Michell and Dewdney, 1998), email reference (Westbrook, 2008), behaviour during Web searching (Slone, 2002), and online information literacy tutorials (Veldof and Beavers, 2001). It has also been applied to broader themes such as students' understanding of their own information needs (Cole and Leide, 2003), understanding of information technology as a precursor to information literacy (Brandt, 2001),

the concepts underlying IR systems (Zhang and Chignell, 2001), differences between mental models of traditional and digital libraries (Blandford *et al.*, 2007), and models of the Web as an IR system (Zhang, 2008).

Studies on second-generation character-based catalogues demonstrated the application of mental models to library science research. Dimitroff (1992) showed quantitatively that searchers with more complete mental models carried out more successful searches with a lower rate of errors, while Borgman (1986) showed users given model-based training on a catalogue system demonstrated improved performance on complex tasks. Dimitroff identified eight components that were required for users to form a complete mental model of the system, these were knowledge of:

1) Contents of the database
2) Interactive nature of the system
3) Existence of multiple files
4) Multiple fields within each record
5) Multiple indexes and / or inverted indexes
6) Boolean search capability
7) Keyword search capability
8) Use of controlled vocabulary

(Dimitroff, 1992)

In many ways this list is still applicable to the previous, or third generation of Web-based catalogues still widely in use, although it is less applicable to next-generation catalogues.

Dimitroff (1992) argued that IR systems design should "shift the burden from the user to the machine", acting to fill the gap caused by users' basic search abilities and inaccurate or non-existent catalogue mental models. More recently, Markey commented on the relative simplicity of many current IR interfaces and identified a need for responsive systems, those that

would monitor the users' progress and intervene to help with complex or advanced features of systems (Markey, 2007). A similar idea is raised in Kuhlthau's suggestion that IR systems support and accommodate users beyond simply returning results (Kuhlthau, 1999).

A lack of progress seen following early studies lead Christine Borgman to complain that "[m]ost of the improvements are in surface features rather than core functionality" and that library catalogues still required users to have built up a richer conceptual model than is reasonable to expect from non-experts (Borgman, 1996). It is testimony to the slow pace of change in the library systems world that it was 14 years from the publication of her paper to the appearance of catalogues in the late 2000s that make a serious attempt at providing what Dimitroff argued for in 1993.

8.4 Mental models and the next-generation OPAC

Next-generation systems are presented by vendors as comprehensive 'discovery platforms' (Medialab Solutions, 2008) or 'discovery solutions' (Innovative Interfaces, 2008b) rather than simply a new catalogue with Web 2.0 features. The emphasis is on providing search across all information resources the library has available, as well as better discovery of the local print holdings. Due to this broader remit beyond searching local library holdings, Breeding (2010) has argued we should stop using the term 'next-generation catalogue' in favour of "discovery interfaces".

A typical goal is to provide what, in the case of British Library's next-generation catalogue, is described as "a new, simpler way of searching [...] with a 'Google-style' interface and new and improved user features" (British Library, 2010). Underpinning this is the assumption that libraries need to better matches users' expectations in a networked world of abundant information but scare user attention and an expectation of a richer user experience (Dempsey, 2006).

In the literature there is relatively little research on mental models, or even straightforward Web usability testing in next-generation catalogues possibly because they are so new.

One recent attempt to engage with this was a masters dissertation by Wilkinson (2009), who investigated usability and mental models of the next-generation catalogue Primo (Ex Libris, 2010a). Wilkinson's qualitative findings about mental models of Primo versus Google and Google Scholar search are very interesting: in Primo, users expected ordered presentation of materials suitable for university-level study, but beyond the initial single search box found obstacles to discovery – from library jargon terms to lack of information about locations of physical items; additionally she found that users brought with them ideas from their experience of their previous third-generation OPACs (Wilkinson, 2009). This latter point echoes Slone's (2002) comments that users may develop mental models on one system that are reworked on a second similar system.

8.5 Concluding remarks

The mental models theory devised in the discipline of cognitive science has been applied to help understand users interactions with library catalogues since the 1980s. Over time quantitative research based on measuring IR success have partly given way to qualitative methods including methods borrowed from Web usability testing.

There is so far little research into mental models in next-generation catalogues, but one masters dissertation suggests a possible user expectation of reusing Web mental models - based on the interface presented by a next-generation OPAC – followed by disappointment and misunderstandings based on previous experience of older library systems (Wilkinson, 2009).

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9 Methodology

9.1 Support for this project

The ULRLS, as the author's employer, committed to provide time and resources to support and sustain this research (McLaughlin, 2010), which the author very gratefully acknowledges.

9.2 Sample size and recruiting

Previous researchers on mental models have typically recruited undergraduate or postgraduate students. Due to this research being carried out around the 2010 exam period it was likely undergraduates would have been very difficult to recruit, so the user group investigated was postgraduate students of the School of Advanced Study (SAS) which is part of the central University of London, or members of these institutes who are postgraduate students at other UK universities.

Nine postgraduate students were recruited for this study during April 2010 as participants, henceforth they will be denoted P1 to P9. This sample size was expected to generate a sizeable but manageable quantity of qualitative data and reach a practical point of 'data saturation' for analysis rather than provide statistical generalisability across the wider student population (Pope, Ziebland, and Mays, 2000). This is similar to previous qualitative work on mental models in information retrieval (Wilkinson, 2009; Makri *et al.*, 2007).

Based on previous studies using RGT, nine participants were anticipated to be enough to determine most of the important constructs (Crudge and Johnson, 2004). Additionally, this study takes some cues from Web usability testing where typically small sample sizes are considered sufficient to throw light on the nature of a usability problem (Nielsen, 2000). Although Nielsen's specification of five users has been criticised it is widely followed by Web usability testers. Interestingly, one author who described problems with small sample sizes in Web usability was able to conclude that simply doubling the sample size to ten greatly increased the chance of finding a sample that identified most issues (Faulkner, 2003) so it was anticipated

nine would be a reasonable sample size as far as identifying problems with the catalogue was concerned.

This small sample size of 9 would make any quantitative statistical work essentially meaningless because at small sample sizes there is increasing uncertainty about whether the sample is representative of the population as a whole (Fowler and Cohen, 1990 p. 79; p. 110).

Students were recruited by an email invitation sent to those with a record on the Millennium library management system that was 'active' in the current academic year. A reader's record is marked active by various functions including using the library access control gates, renewing loaned items online, and authenticating to access online resources using the library catalogue. It was thought 'active' readers would be likely to have used the current library catalogue system and have at least some active engagement with the library even if they did not necessarily visit the physical library to use print materials.

The researcher used the Millennium system to search for active reader records belonging to postgraduate students either from SAS or elsewhere who held SAS institute library membership. Contact details were exported in the form of a flat text file, and this was used as a data source for a mail merge in Microsoft Outlook (Microsoft Corporation, 2010) that sent a personalised email to each member. Interested readers were given an information sheet with an explanation of the purpose of the study and made aware of the requirement for recording (Appendix A).

The sampling was therefore purposive in the sense that most members of the ULRLS libraries were excluded and only those matching specific criteria were included (Gorman and Clayton, 2005 pp.128-189). The sample may be unrepresentative of ULRLS members libraries as a whole as it is made of people who voluntarily self-selected to take part in research on library catalogues. Given the time and resources available it was not possible to do otherwise, and in any case it was considered desirable to pick from a limited sample population that would produce

useful data for inquiry (Morse, 2007). The important point about this, as Burns points out, is not to generalise beyond the sample population (Burns, 2000 p. 85; quoted by Pickard, 2004 pp. 66-67).

Participants were offered an Amazon gift voucher in return for participating, to thank them for volunteering their time. The reason for offering any reward is the author's previous experience running small qualitative usability tests in an academic library setting – a reward however small greatly reduces the number of 'no shows' for interviews. One participant offered to take part without accepting the gift voucher.

Individual interviews with participants took place at Senate House Library, University of London between April and June 2010.

9.3 Pilot study

Before embarking on the main investigation, a small pilot study was conducted in April with a postgraduate student from Queen Mary, University of London who was already known to the researcher.

Timing of the pilot study indicated that 20 minutes for initial cognitive walkthroughs and another 60 minutes for the structured interview were reasonable. Feedback from the pilot participant demonstrated it was possible to look at two search activities on Encore within a reasonable time-frame: one unfamiliar to them, and one already familiar to them from their own research. The pilot also provided an invaluable opportunity to practice grid elicitation in a realistic interview situation and confirm the coding techniques to be used were technically workable.

It became clear during the pilot that recording both the participant and the computer screen showing their actions on Encore would be necessary to gain a good record, and in agreement with Makri *et al.* (2007), written notes to provide observations and context as required.

9.4 Cognitive walkthroughs

A familiarisation session is needed because Encore is a new system not yet in use at ULRLS. Although similar systems are in use at other academic libraries in the UK, it was decided this study should not rely on participants' existing experience of next-generation catalogues.

The starting point is a qualitative approach modified from Web usability testing methods: cognitive walkthroughs, based on test subjects working through tasks (George, 2008 pp. 127-140) will be combined with close questioning to provide a starting point for generating 'constructs' (explained below) for the interview to follow. Cognitive walkthroughs have previously been used by Wilkinson (2009) and Veldof and Beavers (2001) to investigate mental models. During the cognitive walkthroughs, a method used by Makri *et al.* (2007) and Holman (2009) was employed to probe for additional information. This method involves probing the participants with questions of the types:

- How?
- Why?
- What?
- What if?

The purpose of this is to shed light on the models of the system they were generating during use, and to add some standardisation to the form of questioning used during the interviews to help limit interviewer bias. The techniques used by Makri *et al.* are based on Beyer and Holtzblatt's contextual inquiry approach (1998), which is an ethnographic method based on observation of use of a product or system in the user's normal work environment. It should be noted this investigation did not make use of a full contextual inquiry approach, the interview situation and methods used are mainly artificial in nature.

Interviews took place around the time of the televised party leaders' debates before the 2010 UK general election (The First Election Debate, 2010; The Sky News Debate, 2010; The Prime

Ministerial Debate, 2010) and the subject of the Liberal Democrats and their history was suggested during the pilot interview session as an alternative to searching for general themes around politics. ULRLS has a strong politics collection which the participants, as they were all studying unrelated subjects, were unlikely to be very familiar with.

The reason for choosing an unrelated subject was to encourage use of the exploratory search features in Encore. An exploratory search is one characterised by ambiguity and uncertainty, where the searcher may not know the subject at all well and will typically need to retrieve multiple items across an iterative search to complete a given task (Kules and Capra, 2008; Marchionini, 2006). Kules and Capra summarise a definition of exploratory search, which was used for this investigation:

- Answers not found on the first iteration
- Searchers interact with the results and / or reformulate their queries
- Searchers search for multiple items

  (Kules and Capra, 2008)

Intuitively we might expect topical knowledge to affect assessment of a library catalogue, but Ruthven *et al.* (2006) demonstrated that alongside the confidence and expectations of the searcher, their existing topical knowledge certainly is a factor in judging how information surrogates are assessed.

Participants were questioned about their knowledge of the topic to confirm they were all starting from a reasonable base line: generally participants knew a little about the party and their policies but had no special, in-depth knowledge and no experience using the Senate House Library politics collection. Based on Kules and Capra's (2008) approach, the participants were situated in an imaginary situation from which to start their search:

> Following the televised election debates you've become interested in the politics of the Liberal Democrats. As a Senate House Library user you realise the lib-

> rary has an extensive collection on British politics so you decide to find out more about the party, their politics, and their history. Use Encore to explore books and other resources available on this subject to a point where you are confident you have a good starting point for researching them.

The recent history of liberal politics in Britain means finding works about the Liberal Democrats and their history in the ULRLS holdings is fairly challenging, but not impossible. Aside from searching for the name Liberal Democrats, the searcher may find relevant items by looking for information about predecessor parties such as Liberal Party, Social Democratic Party (SDP), and previous names used following the SDP and Liberal Party merger including Social and Liberal Democrats and The Democrats. To add confusion some ULRLS catalogue records include subject headings with terms such as 'Liberal Democratic Party (Great Britain)' which is probably erroneous as the party have never used this name. Further, there are relevant works in the ULRLS catalogue including books by Charles Kennedy and Paddy Ashdown that do not mention 'Liberal Democrats' in the bibliographic record at all.

Following this, to generate further comparisons between Encore and the WebPAC, a second task was introduced where the reader was asked to:

> Use Encore to search for books and other resources related to a subject you have recently been working on or researching.

In this case it is reasonable to expect participants will have specific ideas about what they will find at the end of their exploration of Encore. This task is much more open-ended and was included to encourage participants to think about how Encore could be applied to their own area of study and encourage direct comparisons between the Encore and the WebPAC interface.

In our context, the bibliographic and item records shown in the catalogue are surrogates. However, in addition to simply displaying records Encore also includes features that are supposed to support exploratory search. These include:

- Novel presentation of metadata from bibliographic record subject headings used to show additional suggestions for searches based on records retrieved.
- Reusing metadata including geographical terms from subject headings, dates of publication, language, and material types (meaning the format of an item) to create a 'faceted' view of the catalogue.
- 'Did you mean...?' suggestions for misspellings, typos, and so on, based on indexing of the catalogue so that suggestions bring up further results if used.

Examples are given below in Figures 1 and 2. Figure 1 shows the facets Encore displays for a search for `social anarchism` (this has been manipulated to fit the page, in Encore the facets appears as a single column on the left hand side of the screen). The facets serve two purposes: to limit and refine the search results, and to give an indication of how many items there are related to each facet. Interestingly, this faceted display of holdings is a reasonably close match to S.R. Ranganathan's imagined library stock-room that could physically rearrange itself, "as in a kaleidoscope" to suit the requirements of different users entering the room (Ranganathan, 1950 pp. 42-43).

Figure 2 shows a cloud generated by Encore following a search for `industrial workers of the world`. As is usual in a word cloud, the larger type reflects increasing number of items with these subject headings. Clicking items in the cloud allows the reader to limit search results to those that match this subject. One major benefit of this cloud is that it presents library-created terms from Library of Congress Subject Headings directly in the reader's eye view on the search results page, arguably a useful way of making suggestions for related terms to continue the search. Innovative Interfaces notes evidence from academic development partner libraries that this leads to a ten-fold increase in use of subject heading searches compared with their previous OPAC interface, from around 1% of searches to around 10% of searches (Majors, 2009).

Figure 1: Facets displayed for Encore search of `social anarchism`

Figure 2: Subject headings cloud for Encore search of `industrial workers of the world`

9.5 Repertory grid technique

RGT represents the practical application of George Kelly's personal construct theory (Kelly, 1955). Kelly argued that we understand the world through our own **personal construct systems** which are formed of a "personal, internal set of theories, which in turn become hypotheses, governing our expectations of the world" (Crudge and Johnson, 2004). This theory is cognitive constructivist in nature (Gergen, 1999 p. 20), constructivism being the idea that the mind creates an understanding of reality, "within a systematic relationship to the external world" (Talja, Tuominen, and Savolainen, 2004). Kelly's theory was influential on Kuhlthau's information search model (1993). It was Kuhlthau's work along with an early version of Dervin's sense-making theory (1983) that have been particularly influential in driving the adoption of constructivism in information science (Talja, Tuominen, and Savolainen, 2004) and have informed the author's own view of information seeking.

RGT in the context of mental models of information retrieval is suited to the inductive, flexible qualitative approach advocated by Fidel (1993), because we expect that a picture of parti-

cipants' individual mental models will only be elicited during testing. RGT uses a semi-structured interview including a 'grid construction' phase that will compare catalogue interfaces by rating each construct on a scale (Fransella, Bell, and Bannister, 2004). Also, it was anticipated that much qualitative data would be generated at this stage. This combination of methods will provide a measure of methodological triangulation (Fidel, 1993). Because the RGT interview provides a structured framework which allows the participant to describe their understanding of the subject in their own terms rather than using the interviewer's, it is seen as a particularly good way of avoiding bias introduced by the interviewer's own understanding of the topic at hand (Pervin, 1973).

9.5.1 Repertory grid technique methods

The topic under discussion was library catalogues, with the more specific intention of looking at user experience of a next-generation library catalogue. This was pre-determined by the author as the area of research of interest. Within this topic, **elements** were chosen for investigation that represent the sample in some way. It was expected that at least Encore and the previous WebPAC Pro OPAC interface would serve as elements. In addition, the concept of the participant's 'ideal' library catalogue was introduced. This follows Crudge and Johnson's (2007) approach of using an ideal search engine introduced due to the low number of elements involved, which gives a useful "comparison anchor" (Hunter, 1997) to relate the real elements to the participant's conception of the ideal catalogue. It was expected that the concept of an ideal library catalogue would vary widely between participants and there is no suggestion of considering the ideal catalogue to be the same across grids; the ideal is used within the individual participant's grid only.

Although a baseline of elements was provided, some participants wanted to include their own elements – search engines or library catalogues they had used elsewhere including the Copac union catalogue of UK national, academic, and specialist libraries (Mimas, 2010), the WebVoyage OPAC from the Voyager library system (Ex Libris, 2010b), and the Web OPAC from the

Aleph library system (Ex Libris, 2010c). Including elements generated by the participant was very welcome as this improves the extent to which the topic under discussion is seen from their point of view (Jankowicz, 2004 p. 29-30).

The basic method of the repertory grid technique used was to create a grid where the participant will rate elicited 'constructs' on a five-point bipolar scale. This scale is similar to the rating scales used when constructing questionnaires (Pickard, 2007 pp. 188-190). A construct, or personal construct, is in Kelly's terms "a way in which some things are construed as being alike and yet different from others" (Kelly, 1955 p. 105). Constructs can be thought of as representing contrasts between different things - perhaps opposites (Jankowicz, 2004 p. 11), as they are bipolar. Kelly theorised that constructs actually exist within an individual's complete personal construct system which is evolved out of hierarchical relationships between different constructs (Bannister and Fransella, 1980 pp. 11-12).

Constructs elicited during an interview can only really be considered as giving an insight into the way the individual perceives and construes the world (Fransella, Bell, and Bannister, 2004 pp. 17-18), not a full picture of the individual's understanding of the topic.

In the context of a library catalogue, the following are some example constructs:

Simple, clear interface	versus	*Unclear, cluttered and busy interface*
A specialist tool	versus	*A general search tool*
Terms in catalogue are easy to understand	versus	*Stuffy or outdated jargon*

To take the example of a *A specialist tool*, this was elicited by asking P6 to describe a way in which the WebPAC and Copac were similar, but different from Encore. The contrasting idea of *A general search tool* was elicited by asking what the difference was with Encore, and at that point a comparison was also made with Google. The term that describes the ways in which two elements are similar is called the **emergent** pole, while the one that describes the element

that is different is called the **implicit** pole; by convention the emergent pole is put on the left hand side (Jankowicz, 2004 p.48).

This basic method is Kelly's original "triadic difference" approach (1955, p. 223). Other approaches have been devised since, for example a "triadic opposite" where the participant is asked for a way in which two elements are alike, but different from a third element, then asked what the opposite of that difference is (paraphrased from Fransella, Bell, and Bannister, 2004 p. 29). It was decided to concentrate on the triadic difference method to elicit constructs as this remains the most widely-used approach in RGT work and it was expected any future studies on RGT in library catalogues would likely use this same approach, additionally there is some evidence the "difference" approach produces a better-differentiated picture of the relationships between the elements investigated than do the more extreme contrasts invited by the "opposite" approach (Neimeyer and Hagans, 2002).

It was found in a few cases the participant had trouble comparing Encore and the WebPAC with a hypothetical ideal catalogue, so to keep the interview moving a "dyadic difference" approach was also employed. This is based on asking for a difference or similarity between two elements which is used to find the two poles of the construct (Fransella, Bell, and Bannister, 2004 p. 29-30).

The model for this study is Crudge and Johnson's (2004; 2007) use of RGT to determine user mental models of search engines, a novel use of this methodology. Their earlier study demonstrated that RGT is, "a suitable method for elicitation of a finite set of constructs from an ordinary information seeker", and furthermore that a relatively small sample size produced a set of constructs that was considered a good representation of the complete set of constructs that would be elicited from the population the sample was drawn from (Crudge and Johnson, 2004).

Their later study built upon this and used the RGT technique of **laddering**. This technique is used to elicit constructs of a higher and lower order of abstraction than those elicited from the

original elements. Laddering upwards is done by probing the interviewee about which side of the elicited construct is preferred, and why that is. Laddering downwards is based on asking 'how' questions about the emergent pole of the construct to find more detail out about it, for example for the above, "How can I tell a catalogue is a specialist tool?", might be used. (Fransella, Bell, and Bannister, 2004 pp. 39-43; Jankowicz, 2004 pp. 64-67).

Using data gathered using laddering techniques, Crudge and Johnson were able to describe a composite mental model from their interviewees based on three layers:

- The evaluation layer, which represents the user's assessment of the search engine. The authors describe this is a pyramid of increasingly complex evaluations of the catalogue. Examples of evaluative constructs are: *Finds relevant results* and *Offers additional information to judge item*.

- The affective layer, representing the user's emotional response. An example of an affective construct is *Pleasant look and feel*.

- The procedural layer, representing the user's actions or processes while using the search engines to carry out queries. Examples of procedural constructs are: *Ability to pre-limit search* and *Has working save / export features*.

  (Paraphrased from Crudge and Johnson, 2007 with own examples added)

A graphical representation of this model is shown below.

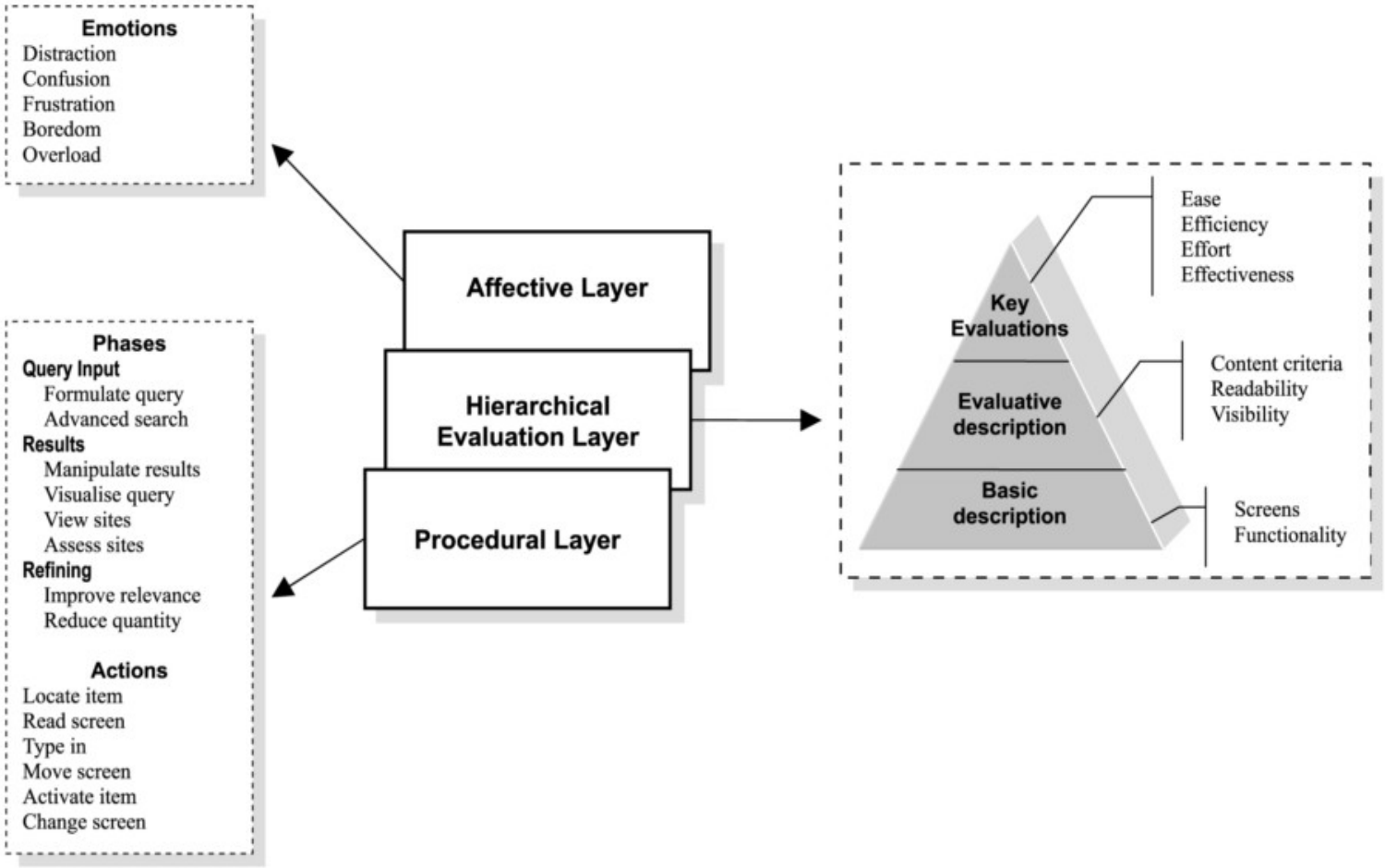

Figure 3: Representation of users' "evaluative mental model" of search engines, showing hierarchy of affective, evaluative and procedural layers (from Crudge and Johnson, 2007).

Laddering was not used in this investigation due to the wish to keep the interview sessions reasonably short. A normal RGT interview can be expected to last up to an hour (Jankowicz, 2004 pp.15-16), but laddering is more difficult, described by Fransella, Bell, and Bannister as "an art not a science" and one that should be considered a skilled rather than a standard procedure in RGT interviews (2004, p. 42). However, Crudge and Johnson's coding approach that allowed for describing a model including layers or emergent themed groupings from the RGT interview was key to analysing the data gathered during this investigation.

9.6 Data recording techniques

An initial questionnaire was used to gather information about existing familiarity with IR systems and information about the subject's background (for example, their area of study), this is shown in Appendix B. This also acted as a final filter check to confirm they did actually make use of the current library catalogue at ULRLS.

The questionnaire included some demographic data and questions about use of the Web as a possible aid to understanding and analysing replies given during the interview. There was no plan to carry out data analysis on the basis of this information, but it was thought this might assist with the understanding of replies given during the interviews and was therefore worth collecting. A summary of the participants questionnaire answers is shown in Appendix C.

Although most repertory grid software includes functions to assist in eliciting a grid, the researcher felt it would be quicker and less intimidating to record the grid on a paper template, allowing the participant to see what was recorded and show how the grid developed over the course of the interview. The template was based on that shown in Jankowicz (2004 p. 25) and shown in Appendix D.

Additionally, sessions were recorded on tape to provide a high fidelity record (Lincoln and Guba, 1984 p. 240-241) of what subjects said during walkthroughs and interviews, plus their non-verbal communication including any gestures at the computer screen. A small MiniDV

video camera was mounted on a tripod and placed in a corner of the room, this provided an adequate field of view while minimising the intrusion of the camera into the interview session (following comments by Ratcliff, 2003). Camstudio software (Smith, 2010) was used to record Web browsing activity in more detail than was possible using a camcorder. For coding and analysing data, recorded sessions were transferred to a PC from the camcorder which allowed them to be viewed side-by-side. At the start of the searching part of the session, the participant's Web browser was maximised on the screen which allowed the video recording and the screen capture to be synchronised. Written notes made during the session were later scanned and transferred to a PC so they could be easily linked to the video and screen captures. These effectively formed field notes including both observation and more subjective analytical notes, and were intended to bring an additional element of trustworthiness to the interview process (Gorman and Clayton, 2005 pp. 186-192).

In line with requirements of Northumbria University's Ethics Policy (Northumbria University, 2009a), subject data was anonymised. Further, participant data was kept confidential, stored securely and in the case of electronic documents on a password-protected computer, and will be disposed of in accordance with the guidelines in the Northumbria University Research and Ethics handbook (Northumbria University, 2009b).

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10 Discussion

10.1 Analysis of qualitative data

Following data transfer to a desktop PC, data were coded using ATLAS.ti software (ATLAS.ti GmbH, 2010). ATLAS.ti is flexible enough to deal with video files as well as text and PDFs, so it was possible to directly code snippets of recorded video according to their content as well as the screen captures and the observational parts of the field notes where this was appropriate. Although this was very time-consuming, being able to work directly with video files was much faster than having to transcribe them and code those transcriptions.

The purpose of the coding of these pieces of data – phrases, expressions or actions made by participants – was to allow categorisation and simplification of the data to make it possible to analyse further. This is the "data reduction" process described by Miles and Huberman, a dialectic and iterative process that transforms the data to make it intelligible (1994, p. 10) and allow theory to develop.

1023 individual codes were created across the video recordings, screen captures and notes. Although this seems like a large number of codes, and it would certainly be unmanageable in a paper-based system, ATLAS.ti made dealing with and assigning a large volume of codes straightforward. Following coding, a picture began to emerge from the codes assigned based on themes in the participants information behaviour. In effect the coding was a form of sampling from the data collected that allowed an analysis to be crafted (based on a grounded theory approach from Morse, 2007).

The following is a summary of frequency counts of the most commonly-assigned codes:

Code	Frequency
Encore - rewriting of search	20
Comparison of Encore to Amazon	12
Encore – use book jackets	10
Use of classification to find similar items	8
Familiarity of Encore user interface	6
Encore tag cloud for refining search	6
Wish for more metadata in record	6
Catalogue is for finding print books	6
Use of bibliographic record metadata	5
Comparison of Encore with Google Scholar	4
Use of Encore location facet	4
Dated appearance of WebPAC	4
Encore – more attractive	4
Encore – clearer interface	4
Encore - weblike scanning behaviour	4

Table 1: summary of frequencies of 15 most commonly used codes

A second iteration of coding was carried out to assign codes to a 'family'. A family is a way of grouping codes to classify them at a higher level of abstraction and make it easier to concentrate on a particular sub-group of codes for analysis (Muhr, 2004 p. 191). Codes were grouped according to the following aspects of information behaviour:

Family	Frequency
Statement about Encore	639
Encore: Web-like behaviour or statement	225
Statement of problems or issues	173
Statement about current IR behaviour	153
Wishes and expectations for IR	147
Encore: comparisons with WebPAC	125
Encore: OPAC-like behaviour or statement	68
Statement about print collections	44
Statement about use of electronic resources	29
Statement about Web search engines	26

Table 2: summary of frequencies of family codes

Of particularly interest during coding was to compare any 'Web-like' behaviour with 'library catalogue-like' behaviour to see what was emphasises in Encore. By 'Web-like', we mean behaviours associated with using Web search engines and browsing Web sites, such as:

- Scanning Web pages, concentrating on titles and skim-reading
- Iterative searching based on skim reading over multiple reworked search queries
- Short queries, characterised by use of a few keywords
- A tendency not to look beyond the first page of search results
- Trust in search relevancy ranking
- A query is seen as part of an ongoing process
- Expectation of tolerance to small errors or typos based on 'Did you mean...?' suggestions
- 'Satisficing' behaviour, a tendency to make do with results or information that seems good enough rather than search exhaustively

By 'library catalogue-like', we mean behaviours associated with traditional information retrieval systems including:

- More complex search queries including use of boolean operators
- Formulation of queries to meet an 'approved' format of the library bibliographic record, such as searching by author's last name first.
- A query is seen as a form that should be submitted to get a desired correct result, rather than a process
- Use of pre-limits, such as an index or limit to part of the library collection to control what is searched
- Browsing of the catalogue using linking generated in catalogue records such as subject headings
- Requirement to avoid or correct typos or other errors due to inherent intolerance of the system

(Summarised from Nielsen, 1997; Zhang and Chignell, 2001; Novotny, 2004; Jansen and Spink, 2006; Lau and Goh, 2006; Ahmed, McKnight and Oppenheim,

2008; Lauridsen and Law, 2009; Tunkelang, 2009; Craven, Johnson and Butters, 2010.)

As well as the families that emerged from this iterative second round of coding, codes were also specifically assigned a family based on Crudge and Johnson's (2007) affective, procedural, and evaluative model to allow these aspects to be inspected at a higher level of abstraction:

Family	Frequency
Procedural codes	470
Evaluative codes	328
Affective codes	132
Miscellaneous	93

Table 3: summary of frequencies of procedural, evaluative, and affective codes

10.2 Comments on cognitive walkthroughs

As the cognitive walkthrough section of the investigation was only meant to generate ideas for the second step of the structured interview, each participant's walkthrough will not be detailed rather general themes that emerged will be discussed and one participant, P9 will be discussed in more detail as an illustrative example.

Most of the participants started off their search for the first task with a short search string of a few keywords, usually `liberal democrats`. This is not a bad starting point, although taking a more traditional library catalogue approach and truncating the search as `liberal democrat*` does better as it picks up records with erroneous subject headings added (discussed above).

P9 first searched for **"`liberal democrats`"** after explaining that as there are no pre-limits or search options on the Encore front page it suggested to her, "I should try to do something quite general". Innovative's Encore front page, shown below as Figure 4, seems to clearly invitation to the user to think along the lines of a keyword search similar to a Web search engine.

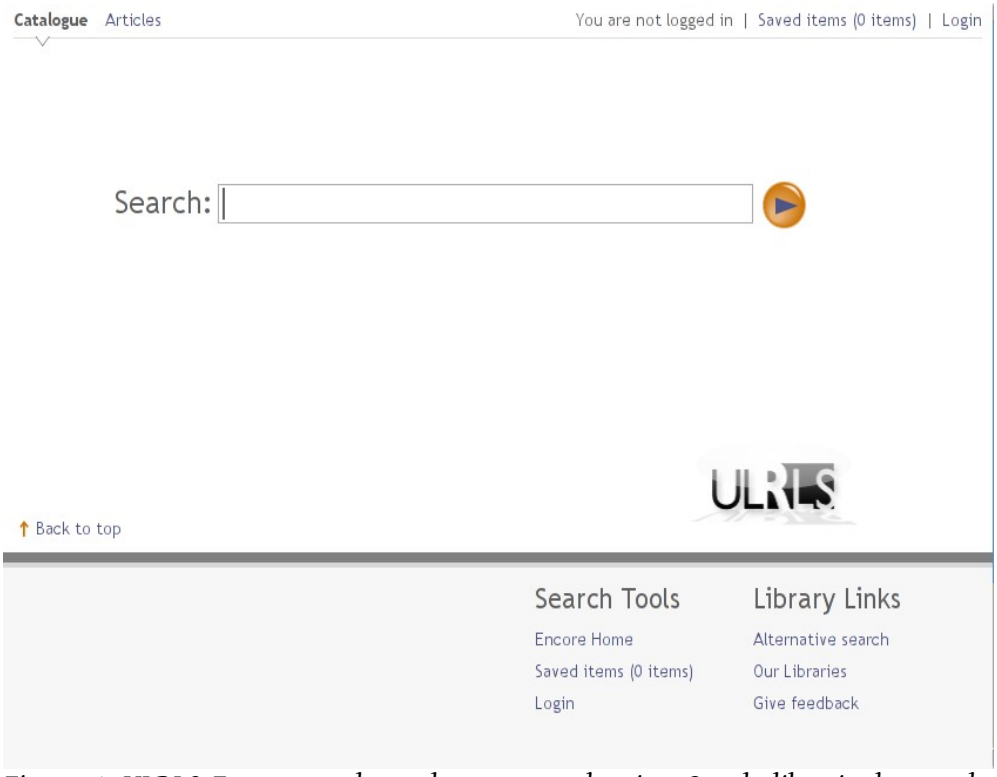

Figure 4: ULRLS Encore catalogue home page showing Google-like single search, minimal additional links

After scanning the search results page P9 immediately noticed results included items that were obviously false positives for this particular task, including works on the history of the German Democratic Party – she did not page through the rest of the search results or assess them in any way, but reasoned it was time for another iteration, "I might try to refine that... I'll put in 'UK'". This was done by reworking the search term itself rather than trying to use the tag cloud on the right-hand side (shown below as Figure 5).

By itself, this action of rewriting the search was the single most common step taken by the participants to alter their searches and it was considered a serious problem by several participants that Encore does not store a history of searches as the WebPAC does. The tag cloud of subject headings was understood by participants as being generated in some way from records in the catalogue, and was sometimes taken as hints for things to search for - but none understood it was being built from controlled terms that suggested a specific library view of what the results were about.

This approach led to a single hit for a book about Tony Blair. `UK` is not the right term to use for this, as suggested by the tag cloud `Great Britain` would be much better. P9 grasped the idea that there must be more in the ULRLS collection and said, "I would automatically go back to the last search", to try something else.

Figure 5: Encore subject tag cloud for search `Liberal democrats`

P9 then scanned the page looking for specific keywords of interest – she explained she was looking for something about history of liberal politics in Britain, allowing her eyes to roam the page until, "a name would pop out".

P9 then explained that faced with uncertainty about how to proceed she would look at the first relevancy-ranked result - because this would be "the best one" and assessed that it "should be fairly comprehensive" based on the title. She was also able to rule out several other items on the page on this basis. At this point she had not examined the full catalogue records for any items. She also discounted a PhD thesis as unsuitable, and explained the goal in this situation – the point of being satisfied with the results – would be a short list of five or six books.

This idea of a short list cropped up repeatedly with the participants, particularly the masters students, and was usually based around a desire to go to the shelves and start working with the actual items. There were two wishes expressed: to look at books and see what they referenced in their bibliographies for further ideas about where to go from there (chaining behaviour, first identified by Ellis, 1993); and to use the library classification itself to browse similar books nearby.

There was a universal expectation that the classification scheme used in the physical library would be useful for, and support doing, this style of browsing. This represents what Apted

termed "general purposive browsing" as it is done with some intent (Apted, 1973). This is a reasonable model for the print collection. However, it did not occur to any participant to see if this could be replicated on Encore, although it is possible to do something like this on the WebPAC interface already.

P9 was then asked about this historical treatment of the subject that she mentioned and asked about how she would go about applying this in Encore. She wanted to look for items about liberal politics since 1945 and performed another search iteration, adding `post war politics` which found no results. These two search failures led her to conclude that a better approach would be to limit the search terms to just a few as Encore seemed not to perform as well when more concepts are added in this way.

In a very speculative way she then followed the Encore 'Did you mean...?' suggestion for `liberal democratic association`. Coincidentally, this new search did find a work by Roy Jenkins on the Liberal-SDP alliance based on matching terms from the subject headings – P9 thought this looked like a good choice based on assessing the mention of the two parties given in the bibliographic record.

She then returned to her previous search and went through several quick searches that did not retrieve very many results: `post war politics uk, "post war politics"` and `"uk politics"`. Her explanation was that she was going for a more general set of results than could be browsed for works about the Liberal Party. Her view was this must be either: "I am not searching in the best way – or a flaw in the system". Her expectation was for hundreds of search results. She then tried removing the quote marks and searched for `uk politics`. This retrieved 445 results which P9 thought was now "a little bit too general", but a search for the term actually used in the records of `politics "great britain"` would have retrieved over 12,000 records.

P9 then tried an alternative strategy of `liberal party` which was inspired by seeing the term in a previous bibliographic record and was much happier with the results. Finding a great number of results including several good results on 20th century history of the Liberal Party at the top of the relevancy-ranking intuitively felt right. She found items by scanning the search results page that seemed relevant – in fact of the 1076 results returns, half were about the Australian Liberal Party.

P9 then identified the next steps to take as going to the shelves and identified the shelfmark on the record. She would write down five or six items and look for them, then browse in a purposive way nearby on the shelves. She expected to then assess each book and study a subset of those in more detail, perhaps taking them with her.

Interestingly, P9 also noted that she would make sure to browse the shelving area and trolleys for returned items, on the basis that popular books are those that circulate often and tend to spend a lot of time in the process of being re-shelved. Several other participants mentioned similar ideas, for example the fact something is out on loan shown in the catalogue is a suggestion that it's good, because someone thought it was worth borrowing!

P9 was happy with these results so the walkthrough was moved on to a subject she had recently studied. This was US foreign policy towards Haiti. She searched for `haiti` with the sure knowledge that this would be too broad – but still, did not attempt to search for anything narrower.

Although the 900-plus results were too many, P9 explained "I might have a quick flick through at this stage", picking about the first 25 results to browse with the expectation of some recognisable author names popping out. She further explained that at the early stages of the search process she was expecting to look for print books on open access shelving, anything else that might need requesting from a closed store was going to be too much effort when it might not prove useful.

Because P9 had an idea about this subject area already, her next strategy was quite different from the Liberal Democrats example. She added `aristide` to look for primary texts, scanned the search results and picked out a few items. P9 explained her expectation of this search was not met, she only expected a few items with Jean-Bertrand Aristide as an author, so she added Aristide's first name Jean-Bertrand in an attempt to narrow this down. She was happy with the results, although only 4 of the 17 results brought back actually had Aristide as the author. She summarised the set of results as a good one: "At this stage, this is where I'd be looking for my five or six [books]".

10.3 Analysis of repertory grid data

It was found during interviews that participants often wanted to rate constructs as if a scale were being used where '1' represents the pole of the 'bad' side of the construct, and '5' the 'good' side of the construct. An ideal catalogue was therefore usually to be found at one extreme or the other of the construct, although in some constructs such as this from P4 things were different:

	Encore	WebPAC	Ideal	
Search based on prelimiting / scoped search	5	1	3	Search based on post-limiting / refining a general search

Table 4: summary of one construct from P4's grid

Here the ideal was identified as a happy medium between the two approaches, both well-supported by the catalogue. This was probably because this construct was elicited using the 'dyadic difference' probe, asking for a way in which Encore and the WebPAC are different from each other.

The desire for 'good' versus 'bad' ratings might be due to participants' previous experience with questionnaires and surveys of various types. One participant had experience of carrying out market research, and immediately related to the idea of 'rating' each catalogue at points

along the bipolar construct. For this reason the researcher did not stick to the usual practise of putting the emergent pole on the left hand side, but rather wrote them down in a way that made sense to the participant, putting a note to show which was the emergent pole of the construct. The poles were then rearranged afterwards in the standard way to allow for analysis of grids and comparisons between grids.

Grids were subjected to cluster analysis using Webgrid software (Gaines, no date) which is able to analyse grids based on the FOCUS method devised by Shaw and Thomas (1978). In the FOCUS method, the grid is reordered so that constructs and elements that are most similarly rated are shown nearest to each other, thus 'focusing' the grid on relationships between similar constructs and elements. Having done this, a dendrogram or tree diagram can be constructed for these relationships showing how related the clusters of constructs and elements are to each other. This allows patterns to emerge that may have been missed simply by eyeballing the completed grids. This follows the method outlined by Crudge and Johnson (2004) to provide a way of visually representing differences between the catalogues investigated.

The sorting is accomplished by a simple analysis based on looking at the differences in ratings between constructs and elements. Briefly, this is based on calculating the differences between each pair of construct ratings, worked out for each possible combination of pairs of elements. If this is done for every combination it becomes possible to see which elements are construed in the most similar way as they will have the smallest difference between them (Jankowicz, 2004 pp. 96-99).

The overall purpose of this is explained by one RGT manual in this way: by analysing the clustering of elements, we are able to find out similarities in *what* the participant says about the elements. By analysing the clustering of constructs, we are able to find out similarities in *how* the participant describes the elements (paraphrased from Jankowicz, 2004 pp. 103-104).

Completed repertory grids for each participant are shown as Figures 6-14 overleaf. These show the elicited grids themselves after having been keyed, in addition to the dendrograms created by analysis using Webgrid. Note that participants did not always want to express a rating for a particular construct for every element, this is not a mistake. When this happens it is shown as a question mark.

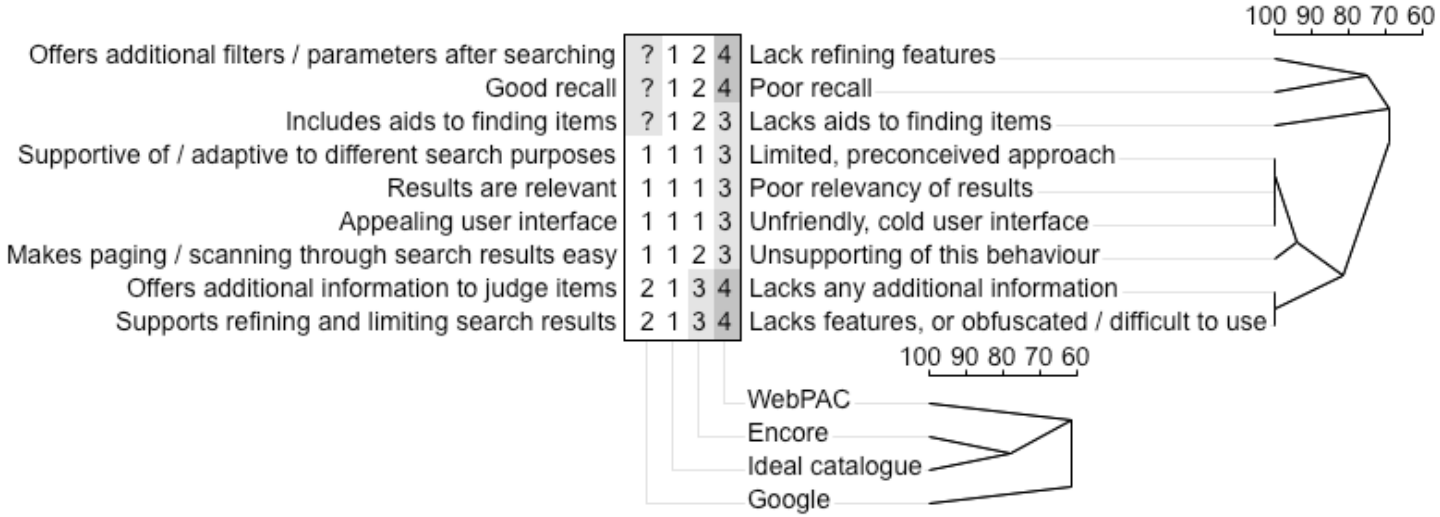

Figure 6: grid for P1 after FOCUS cluster analysis

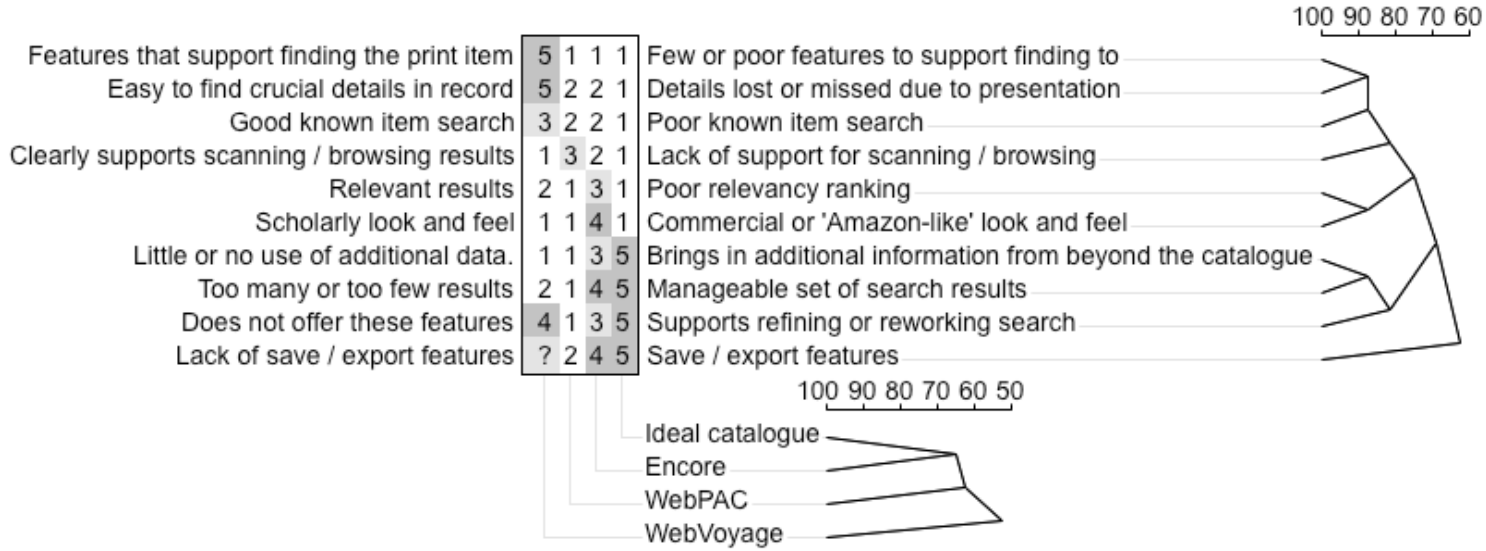

Figure 7: grid for P2 after FOCUS cluster analysis

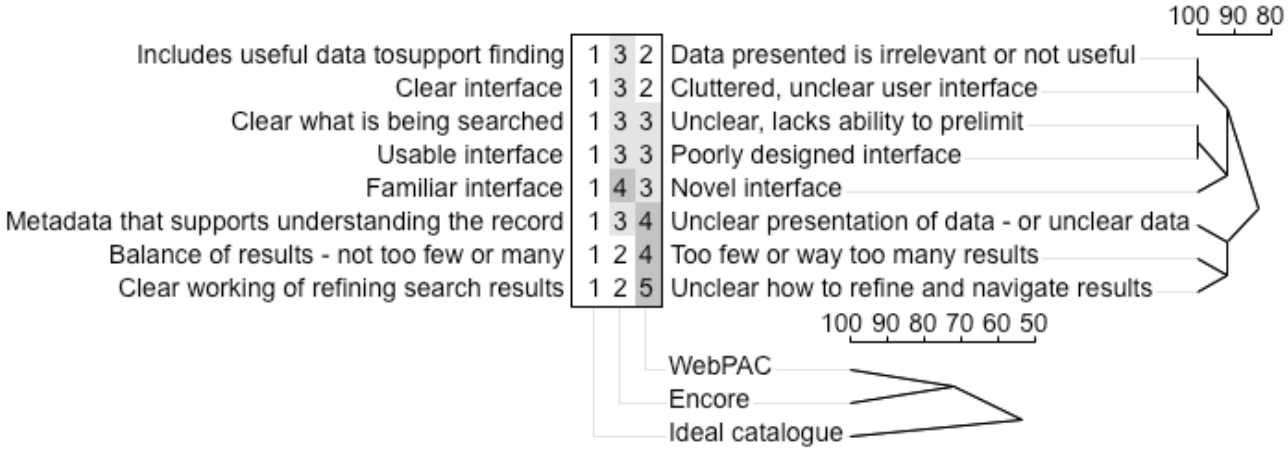

Figure 8: grid for P3 after FOCUS cluster analysis

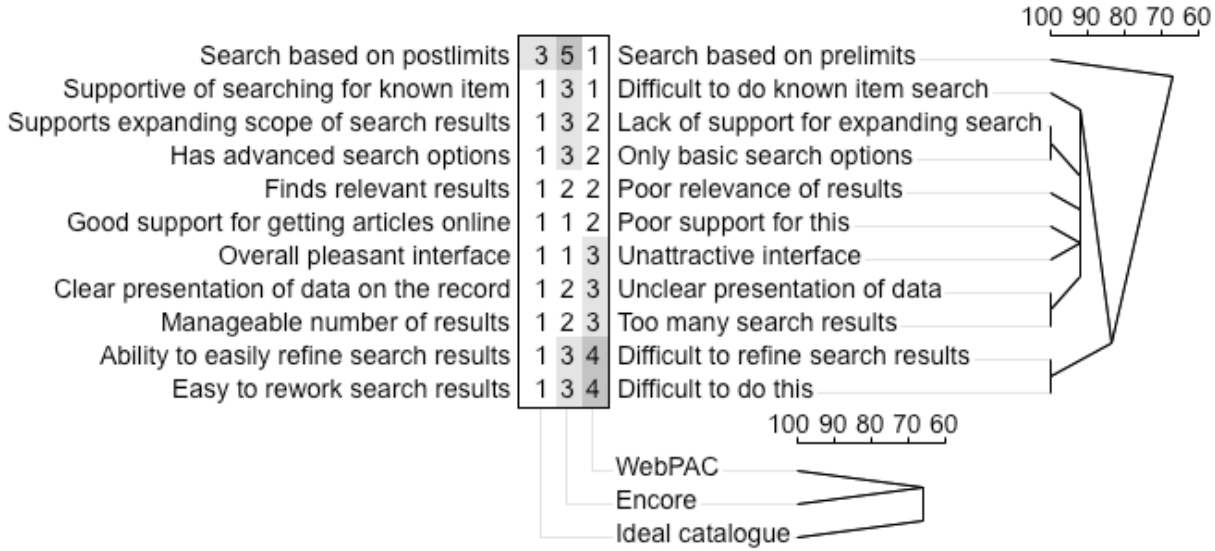

Figure 9: grid for P4 after FOCUS cluster analysis

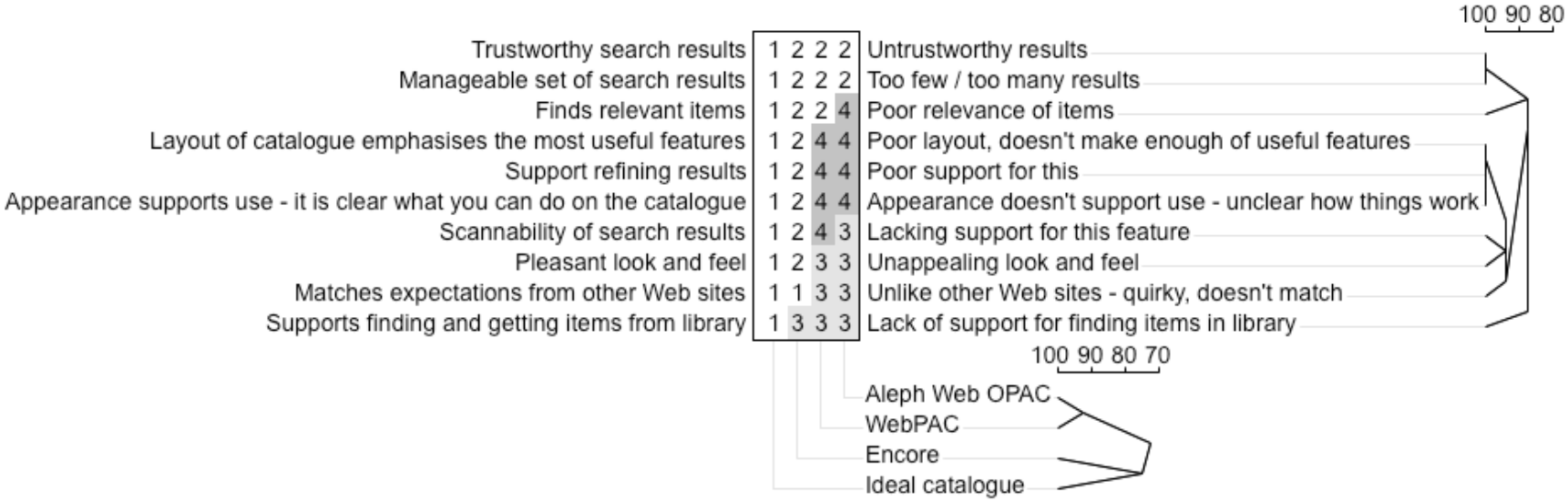

Figure 10: grid for P5 after FOCUS cluster analysis

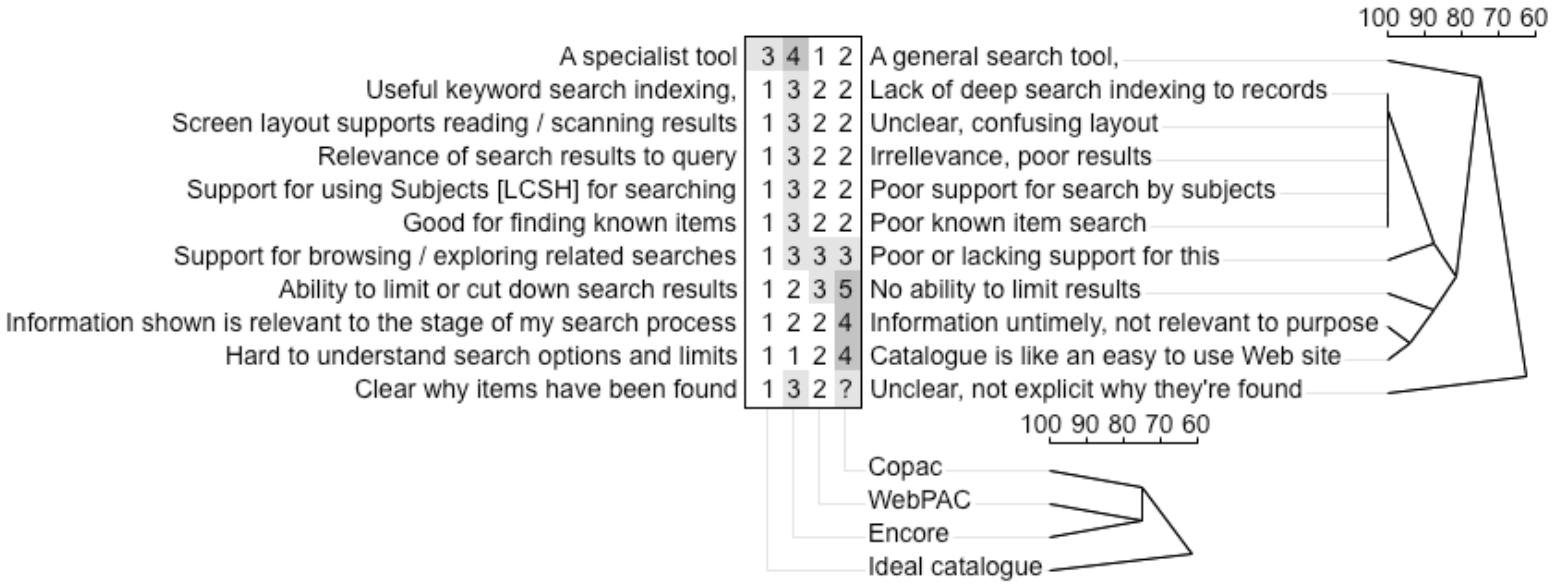

Figure 11: grid for P6 after FOCUS cluster analysis

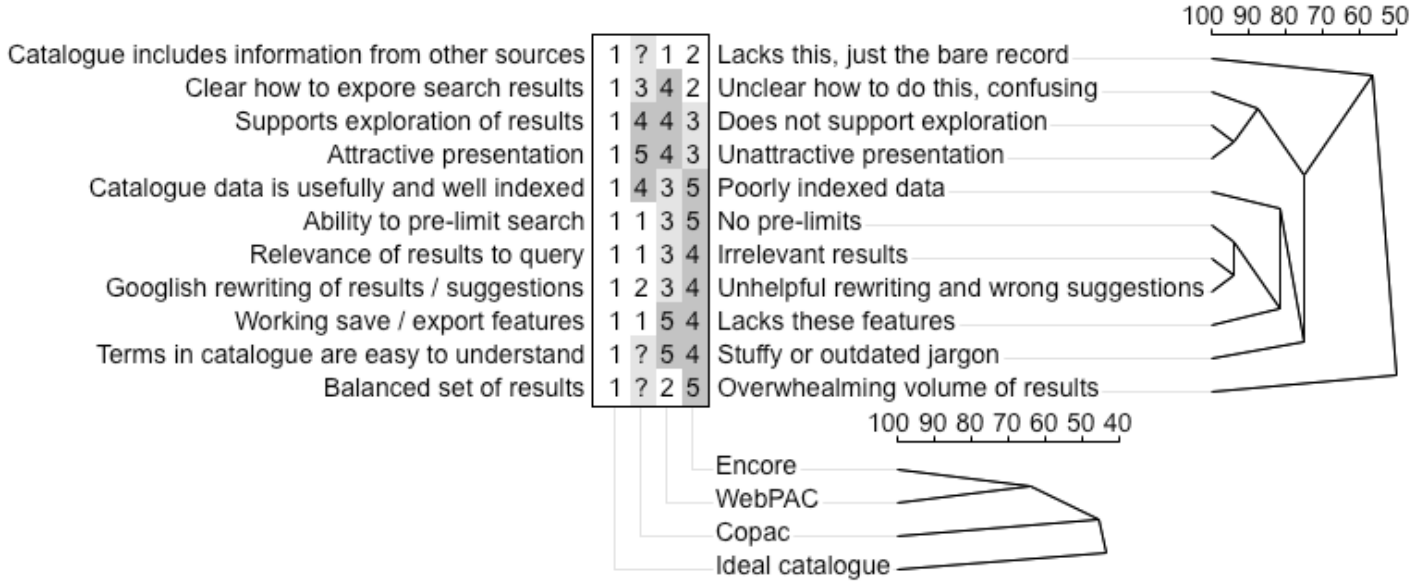

Figure 12: grid for P7 after FOCUS cluster analysis

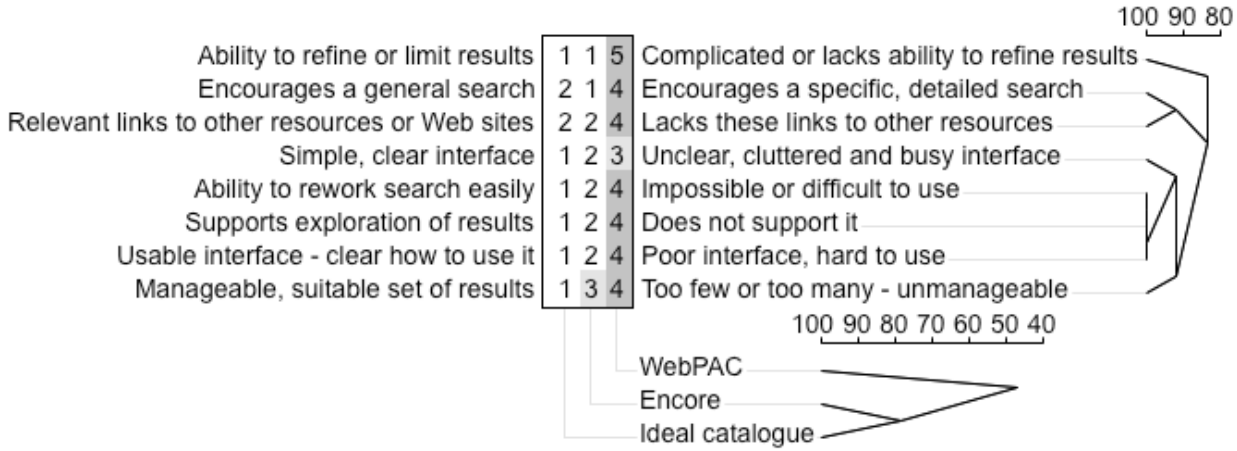

Figure 13: grid for P8 after FOCUS cluster analysis

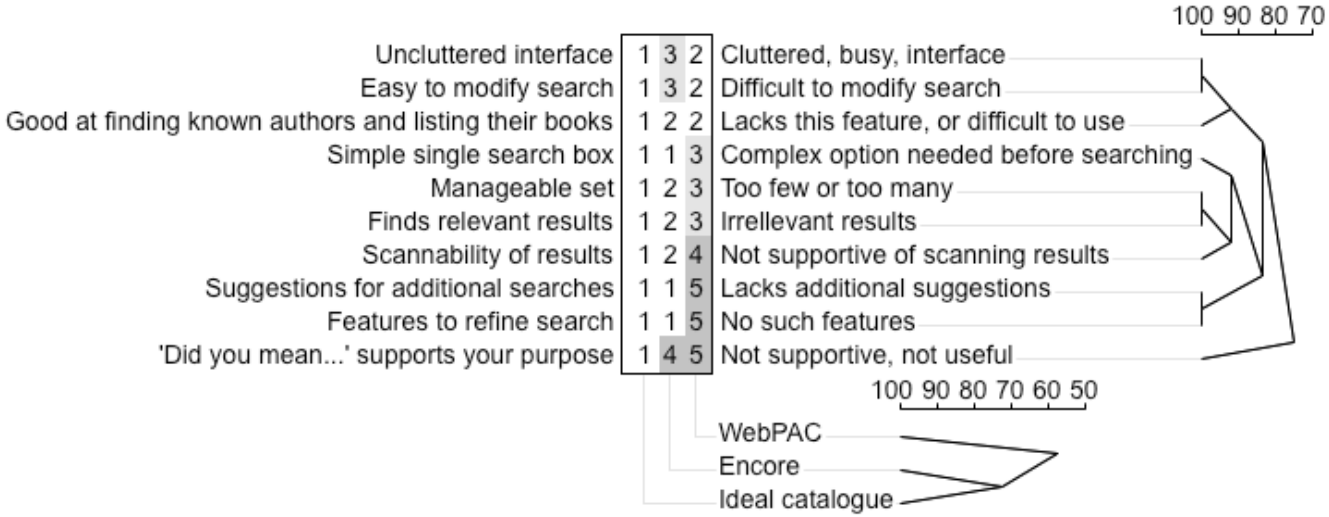

Figure 14: grid for P9 after FOCUS cluster analysis

10.4 Summary of repertory grid findings

For almost all participants, the Encore element was more closely related to the ideal catalogue element than it was to the WebPAC element. P1, P4, and P8 were highest with 78% agreement between Encore and Ideal catalogue elements, and P7 was by far the lowest with only 32% agreement between them. Based on the dendrograms in Figures 6-14, several types of catalogue user emerge from the data.

The first type is one who is dissatisfied with the WebPAC interface, and sees Encore as a closer match to the ideal catalogue than WebPAC. Encore may not be extremely highly matched to the ideal, for example for P2 there is only 65% agreement between them, but this is still higher than the match with the WebPAC (52%) or the additional element she introduced, the Web-Voyage OPAC (42%). For P8 and P1, the similarity between Encore and the ideal compared with the similarity between the WebPAC and the other two elements was marked. Of this group, P8 and P1 are closest to the 'millennial' type of younger library user that Holman identified in her research (2009). P1 also discussed using Google search as "a less restrictive interface" than an OPAC and even wanted to include Google as an element in her grid – the rationale for this was that although Google is not an OPAC, it can be used to discover relevant books that can later be looked up in the library.

A second type of user was one who was dissatisfied with all of the catalogues compared. This applies certainly to P5, who introduced his own element of the Aleph Web OPAC. P5 considered the Aleph OPAC and the WebPAC to be very similar and they form a tight cluster by themselves at 92% similarity. However, for P5 Encore doesn't represent a huge improvement, as it is no more closely related to the ideal catalogue than is the Aleph OPAC or the WebPAC (at 48%, 45%, and 48% respectively).

P6 was similar as he clustered the WebPAC, Encore, and his own element of Copac together, but the ideal catalogue on a separate branch, not closely related to any of the others. As he

preferred the WebPAC very slightly to the others he has been split into a third group by himself. A final type of user identified in one case was P4, who rated the WebPAC and Encore as similarly related to the ideal catalogue at 66% and 59% respectively.

10.4.1 First user type – Encore preferred

P1's grid (Figure 6) shows several tight clusters related to procedure, evaluation, and affectiveness: *Offers additional information to judge items* and *Supports refining and limiting search results* are related, as are *Results are relevant*, *Appealing user interface*, and *Makes paging and scanning through search results easy*. At first glance it may seem odd that pleasantness of the user interface and these other evaluative and procedural elements would cluster in this way. However this may well be a reasonable association because of our tendency to believe that, "Attractive things work better", or are more usable, because we find them easier and more enjoyable to use (Norman, 2004).

P2's grid (Figure 7) shows another example of a user who relates Encore more closely to the ideal, but in this case not very strongly than the WebPAC with only 65% agreement. P2 placed a strong emphasis on procedural constructs with a cluster including *Features that supporting finding the print item*, *Clearly supports scanning*, and *Easy to find crucial details in record* grouped together at the top of the grid. She also clustered *Scholarly look and feel* with *Relevant results*, reflecting her view expressed in the interview that a "less serious" or Amazon-like appearance was related to how good the relevancy ranking was. It should be noted the relevancy ranking in both catalogues, bar a few small changes to emphasise search matches for print and electronic journal titles, is exactly the same (the vendor calls the ranking algorithm 'RightResult', a summary of how it works originally written by the author while working at the University of Leeds is available at Leeds University Library, 2010). In some ways this is the negative to Donald Norman's design philosophy mentioned above (2004). P2's view was that the function of a library catalogue is for finding the most important information on known items or works by known authors, to allow for a judgement to be made about whether to pick the item from the

shelf. This is a rather traditional view – although no less valid than any other - of a catalogue as 'inventory plus metadata' which the author has often found reflected by library staff when running Encore training sessions at ULRLS.

P8's grid (Figure 13) shows strong agreement between Encore and the ideal catalogue compared with the WebPAC (78% versus 31% respectively). Her grid is characterised almost exclusively by constructs that rate the WebPAC in procedural terms as difficult to use and Encore as easier to use and as such the dendrogram is quite 'flat' with all of the constructs related above 80% agreement. The tightest cluster is procedural, with *Ability to rework search easily*, *Supports exploration of results* and *Usable interface – clear how to use it* related at the 100% level. P8 might fairly be described as a millennial as her view of what makes a good catalogue was influenced by experience from other "modern Web sites" and she admitted during the interview that she had only registered to use the ULRLS libraries when absolutely necessary for her degree due to being put off by the WebPAC interface.

P9's grid (Figure 14) is another where Encore is closer to the ideal than the WebPAC is (72% versus 40% agreement). P9 clustered procedural and evaluative aspects of the catalogue, with *Scannability of results*, *Finds relevant results*, and *Manageable set [of results]* clustered, followed by *Suggestions for additional searches* and *Features to refine search* slightly further across the dendrogram. On these points she is particularly critical of the WebPAC, and took the view that her approach to search matched what Encore could do – started with a very general search without specifying a search index, and then used the Encore faceting and limiting features to prune the results down.

10.4.2 Second user type – WebPAC preferred

P6 introduced the Copac union catalogue as an additional element. His grid and dendrogram (Figure 11) are interesting for the way the WebPAC and Encore have clustered. There is a very strong clustering between the procedural and evaluative constructs *Useful keyword search indexing*, *Screen layout supports reading /scanning*, *Relevance of search results*, *Good for finding known*

items and *Support for using subjects for searching*. If we look down the grid it may appear that Copac and the WebPAC are closer to the ideal than Encore in this, but in fact the WebPAC is very slightly preferred to Encore and Copac with 68% agreement versus 61% and 50% agreement respectively. P6 explained his assessment of the catalogue as based on a need for a very clear and simple way of looking up references in other books and journal articles as part of resource 'chaining' behaviour (Ellis, 1993), and he really preferred Copac for these lookups as he had access to several different libraries across London.

10.4.3 Third user type – none of the above preferred

P3's grid (Figure 8) is fairly short as his very specialist use of the catalogues at ULRLS meant the interview relatively quickly reached a point where no more constructs could be expressed. P3 very slightly prefers Encore to the WebPAC, with agreement between these and the ideal at 53% and 44%. However these are both low numbers and should not be taken as a strong preference, really neither of the catalogues is preferred. There are clusters of procedural constructs: *Clear interface*, *Clear what is being searched* and *Usable interface*. P3 is a book studies student researching bindings, so he makes great use of metadata in catalogue records that describe the bindings of the book itself. Even though P3 has long experience of libraries and even a working knowledge of the Anglo-American Cataloguing Rules (Gorman and Winkler, 2005), he wanted a better interface with greater clarity and less 'library jargon' than the ones currently offered.

P5's grid (Figure 10) clearly shows a difference between the WebPAC and Encore, but doesn't rate either as closer to the ideal catalogue. P5's constructs result in the WebPAC and the element he introduced of the Aleph Web OPAC being very closely clustered at 92% agreement. What is interesting is that both of these catalogues, and Encore, were at a similar distance to the ideal catalogue – this suggests the ideal would be something better than either of the catalogues investigated. The WebPAC and the Aleph Web OPAC are similar based around the procedural clusters in the middle of the grid: *Layout of catalogue emphasises most useful features*, *Sup-*

ports refining results, *Appearance supports use – it is clear what you can do on the catalogue*. There is a further cluster between *Matches expectations from other Web sites*, *Scannability of search results*, and *Pleasant look and feel*. There is likely a correlation here as P5 was very keen on emphasising Encore as something he considered a close match to other Web sites he uses rather than the "quirky and off-putting" interface of the OPAC and emphasised Web-like behaviour of 'scanning' pages rather than properly reading them (Nielsen, 1997) during the search tasks.

P7's grid (Figure 12) demonstrates examples of strongly polarised constructs. P7 also introduced Copac as an element but did not want to rate Copac for every single construct. P7's reactions to Encores features and behaviour lead him to very firm constructs about Encore and the WebPAC with Encore often at the 'bad' end. Overall agreement between Copac, the WebPAC, and Encore with the ideal were 43%, 41%, and 32% respectively. There are two main clusters, with procedural and evaluative constructs. The first is between *Clear how to explore search results*, *Supports exploration of results*, and *Attractive presentation* – there being a difference between the first two constructs as although exploratory search features might be present they could be difficult to use. The second is between *Ability to pre-limit search*, *Relevance of results to query*, and *Googlish rewriting of results / suggestions*. This reflected what P7 saw as key requirements or 'must-have' features in a catalogue and were the areas he felt Encore fared most poorly against Copac in particular. 'Googlish' was explained by P7 as meaning helpful or useful suggestions, such as those provided by the Google auto-completion features for search (Google, 2010).

10.4.4 Miscellaneous type – no strong contrasts

P4's grid (Figure 9) is marked by having many constructs that are not particularly strongly contrasting. Her only very strong view was about the procedural construct *Search based on pre-limits* versus *Search based on post-limits*. A probable reason for this is that P4 had some difficultly engaging with the RGT method and the interviewer had to fall back on the dyadic difference method of probing to encourage her to express differences between Encore and the

WebPAC rather than comparing all three at once. It is interesting that for the evaluative and emotional constructs such as *Overall pleasant interface*, *Clear presentation of data*, and *Manageable number of results* P6 rated Encore very well, although during the interview she explained that she was finding it difficult to evaluate Encore because the topic of 'Liberal Democrats' was not one she was familiar with.

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11 Conclusions

We may tentatively conclude that Encore is a step forward as an online catalogue because there was almost complete agreement among the participants in their grid data that Encore was a better match to the ideal catalogue than was the WebPAC.

Qualitative data gathered from cognitive walkthroughs and RGT interviews demonstrated extensive 'Web-like' behaviour from participants, based around behaviour such as fast skimming of results, iterative reworking of search results rather than browsing in any depth, and a tendency to put trust in the relevancy ranking. RGT grid data demonstrated several different views or models of Encore, some strongly contrasting. This presents a real challenge for the library and system vendors, as Sierra, Ryan and West (2007) point out in an article on library catalogues as Web platforms, "a single catalogue application cannot be optimized for all library users and uses".

Whatever is done, there will be users who are upset by the changes and resist learning a new interface. Indeed, the ULRLS has never actually turned off the previous character-based second-generation catalogue, and there are still readers who prefer it as the WebPAC is not quite feature-complete with the older system.

In Holman's work on 'millennial' student mental models of information retrieval (Holman, 2009), she concludes that information literacy training should be revised and the interfaces of scholarly databases should be improved to account for the needs of young, Internet-savvy cohorts of students (pp.95-101). The idea of the 'digital native' or 'Google generation' is itself controversial and has been strongly criticised by some researchers (reviewed by Bennett, Maton and Kervin, 2008) while at the same time accepted as a real phenomenon by others (Gunter, Rowlands, and Nicholas, 2009). This investigation does not conclude there is a specific need to alter this training for younger students, but does conclude that it is reasonable to expect many, perhaps most, users to behave differently when using Encore compared with the

previous catalogues. There is a need to alter what training is provided, which for ULRLS is mainly at the level of the approaches taken by staff explaining how to use the catalogue to users within the library. In this spirit, recommendations for library staff are made below.

This is not to encourage a new program of user training or information literacy training at libraries using next-generation catalogues. It seems very unrealistic to expect to solve the problems of library catalogues with information literacy training - in Web usability terms, 'fix the user' is a bad approach, rather than try this we should align our Web design to the user rather than the other way around as "users spend most of their time on *other* sites", and would prefer our sites to be similar to those they already know (Nielsen, 2000). Encore and other next-generation catalogues represent a step towards doing this, and not before time.

11.1 Guidelines

The following are guidelines for staff at libraries implementing a next-generation catalogue or discovery interface similar to Encore; they are written for ULRLS and Encore in particular.

- Because Encore looks 'new' and different from the WebPAC there is a natural assumption that it is doing something differently from the previous catalogue and returning different results. In fact the relevancy ranking is the same, bar a few small changes for exact matches on journal titles. Along similar lines, readers may assume book jackets and external links to tables of contents are new; in reality these have been present in the WebPAC for a long time but may not have ever been noticed.
- In common with Web search engines, many readers will very reasonably show little understanding of how the catalogue is returning the results it does. Many will simply treat it as a 'black box' and trust the relevancy ranking to provide good results at the top. Become familiar with the way the relevancy ranking

works to become aware of potential problems (ranking summarised in Leeds University Library, 2010).

- The look and feel of the new interface will delight many readers who will view the new catalogue as similar to modern Web sites they are used to using. They will be able to make better use of their existing understanding of the Web when using the catalogue, and are likely to perceive the new interface as more usable because it is more attractive.

- It is expected readers will have many procedural questions about Encore such as asking how to replicate a particular feature from the WebPAC. However in advising and training readers on using Encore look for opportunities to emphasise the features that are different from the WebPAC and particularly ones that aren't possible in the WebPAC and represent improvements. The main feature that participants tended to miss was the ability to combine facets together, so for example you could carry out a search for `london`, and then limit this to maps that were published in 1771.

- Encore can only act on metadata contained in the catalogue or indexed using its harvesting service (Innovative Interfaces, 2010b), it cannot act on metadata that does not exist. The main implication of this for the WebPAC is the increased focus on searching by subject headings that is encouraged by the subject tag cloud. This could cause problems if readers use a tag to limit their search and assume they are seeing everything about this subject. We know this is not the case, so emphasise other approaches such as using the tag cloud to suggest search terms rather than relying on it for limiting searches.

- Ongoing usability testing of Encore is worth doing using low-cost qualitative 'discount usability testing' methods (Nielsen, 1994). Data gathered as part of the

cognitive walkthroughs have been used to modify the Encore functions to match user mental models better. For example the default metaphor used for storing a list of items and then exporting it to email or a citation manager was that of a 'Book Cart' This was intuitively understood by several participants as a way to somehow acquire the books or place a reservation on them in the catalogue. In fact it does no such thing, so this was changed to 'Saved Items'.

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12 Reflection

The main thing I noticed during literature searching on the subject of mental models in library catalogues is there is a relative lack of studies on this specific area. For this reason we cannot avoid thinking about mental models of Web search engines, indexing and abstracting databases, and other forms of information retrieval alongside library catalogues to get any kind of reasonable comparison. Within these studies, those that are similar to this one use various different techniques and the authors have different ideas about what a mental model actually is, which makes it more difficult to make comparisons and tease out the threads that run through the literature.

It is notable there are a few well-known studies such as Borgman's (1986) and Dimitroff's (1992) that are now relatively old. Unfortunately, concerns of time and space in a master's dissertation mean there was no way to design this investigation in such a way that findings could have been developed more fully into a complete theory applicable to catalogue users in general. This is however suggested as a future direction for research in this area.

About the qualitative methods employed. It was Raya Fidel's (1993) defence of qualitative research methods and their particular appropriateness to information retrieval research that convinced me these methods were workable for my investigation, nevertheless it took some time to become confident enough to 'let go' and allow theory to emerge from the data gathered in an inductive manner. Glaser and Strauss's book (1967) about this was particularly useful. The repertory grid technique provided a useful approach to structuring the interviews a little more than the more 'stream of consciousness' results that can result from cognitive walkthroughs, and I felt it was effective at focussing the participants on their real understanding of the catalogues involved. George Kelly's personal construct psychology (Kelly, 1955) provided a useful theoretical underpinning for this work.

This said, my education in the post-positivist scientific tradition inevitably meant I have found it difficult to get away from the feeling that a fuller picture would be obtained by including data that can be tested quantitatively, and I think it could be a useful step to examine understanding of next-generation catalogues using quantitative methods. A quantitative approach was taken by Zhang and Chignell in their work on mental models in information retrieval so there is certainly a precedent for doing this. In their study, constructs were generated by IR experts (faculty and doctoral students at their university) and supplied to participants, rather than being developed by the grid interviewee. Clearly there is a question about whether the supplied constructs really relate to the interviewee's own personal construct system (Zhang and Chignell, 2001), but the great benefit of this approach is that it allows for easier quantitative comparisons between grids if all the constructs and elements are the same. There are methods of combining grid data from multiple participants where constructs differ - essentially a qualitative process based on content analysis of the constructs (Jankowicz, 2004 pp. 148-163) so you could not easily combine both approaches in one study.

One interesting qualitative approach to eliciting a mental model is the idea of sketching a picture representing the system in question. Due to time constraints on the interview – particularly a need to spend a generous amount of time on the grid interviews – it was not possible to include this element. Although this approach may encourage the idea of a mental model as a visual image which Johnson-Laird (2001 p. 86) is keen we not do, it is certainly a straightforward way to explain what we are talking about to the layperson and ask them to express a mental model in a concrete way. This kind of 'sketch-the-system' approach has been used for example by Hendry and Efthimiadis (2008) to represent users' models or metaphors of how Web search engines work. It could be introduced relatively easily as a warm-up exercise into information literacy and postgraduate researcher training held at Senate House Library.

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14 Appendices

14.1 Appendix A: participant information sheet

Northumbria University

School of Computing, Engineering and Information Sciences

Participant information sheet

User experience of a next-generation library catalogue

My study aims to investigate and build up a picture of users' understanding of a 'next-generation' library catalogue and compare this qualitatively with findings from previous studies which have been carried out over the past 25 years.

To do this I will use a style of structured interview that will help compare your experience of Encore with that of other catalogues you have already used. The interview will be in two parts:

- A familiarisation session with Encore where you are asked to carry out several example tasks and 'think aloud' as you do it. This is similar to current methods used in Web site usability testing. This will take about 20 minutes.
- A structured interview where themes that emerge during the familiarisation session are discussed in more detail and you are asked to compare different aspects of the next-generation catalogue with other catalogues you have used. This will take about 60 minutes.

To gain your informed consent to take part I'd like to make you aware of the following:

- This study is being conducted as part of my MSc in Information and Library Management at Northumbria University, Newcastle, which I am studying by distance learning, and is being carried out with the support of my employer, the University of London Research Library Service.
- Your contribution to this study is voluntary. You are under no obligation and are free to withdraw at any time without providing an explanation and without prejudice. In return for your time and assistance I am offering an Amazon voucher to the value of £10 to be sent to you by email following the interview.
- If you take part, the interview will be recorded (including notes and videorecording), transcribed and used for qualitative analysis.
- Information you provide may be written into my dissertation, an academic journal publication, or conference publication.
- Your name and any personal details will be kept confidential. If required, an anonymised summary of the interview may be published in my dissertation or other publications, but nothing that can personally identify you will be published.
- Copies of any publications will be made available to participants on request.
- This study will be carried out in accordance with the Research Ethics guidelines for Northumbria University. This includes the assurance that data about you will be held securely, handled in accordance with the Data Protection Act 1998, and disposed of in line with Northumbria University's retention policy. The full

Ethics Handbook is available online at:
http://www.northumbria.ac.uk/static/5007/respdf/ethics_handbook_2.pdf

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14.2 Appendix B: participant questionnaire

Northumbria University
School of Computing, Engineering and Information Sciences

Participant questionnaire

User experience of a next-generation library catalogue

1. What is your sex?

   Male ☐
   Female ☐

2. What age group are you in?

   18-24 ☐
   25-40 ☐
   41-64 ☐
   65+ ☐

3. What degree are you studying for? (E.g. BA, MA, PhD)

   ……

4. What is your degree subject?

   ……

5. What is your University of London college affiliation, if any?

   ……

6. What is your School of Advanced Study institutional affiliation, if any?

   ……

7. How often do you use or visit the following Web sites or services?

	Daily	2-5 times per week	Once a week	Once a fortnight	Once a month	Less often	Never
Web search engines							
Scholarly databases (e.g. Jstor, Firstsearch)							
Senate House Library Website							
Senate House Library catalogue							
Social networking websites (e.g. Facebook, Twitter)							

Interviewer use only: Participant code: …..

Date and time: ……

14.3 Appendix C: questionnaire summary

	P1	P2	P3	P4	P5	P6	P7	P8	P9
Sex	F	F	M	F	M	M	M	F	F
Age group	25-40	41-64	41-64	25-40	18-24	41-64	41-64	18-24	25-40
Degree	MA	MA	MA	PhD	MA	PhD	PhD	PhD	MSc
Subject	Human rights	Classics	History of the book	Classics	Classics	Classics	History of the book	Classics	Latin American development
Institute	ICWS	ICLS	IES	ICLS	ICLS	ICLS	IES	ICLS	ISA
Web search engines	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily	Daily
Scholarly databases	Fortnightly	Weekly	2-5 per week	2-5 per week	2-5 per week	2-5 per week	Daily	2-5 per week	Fortnightly
SHL Web site	Weekly	Monthly	2-5 per week	Monthly	Weekly	Fortnightly	Daily	2-5 per week	Fortnightly
SHL catalogue	Weekly	Monthly	Weekly	Monthly	2-5 per week	Weekly	Daily	Weekly	Weekly
Social networking	Daily	Never	Never	Daily	Daily	2-5 per week	Weekly	2-5 per week	2-5 per week

Table 5: summary of questionnaire data gathered from participants

Institute key:	ICWS	Institute of Commonwealth Studies
	ICLS	Institute of Classical Studies
	IES	Institute of English Studies
	ISA	Institute for the Study of the Americas

14.4 Appendix D: repertory grid sheet

Northumbria University
School of Computing, Engineering and Information Sciences

Repertory grid sheet

Topic: **User experience of a next-generation library catalogue**

Participant code: **……**

Elements

Constructs
