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Supporting Collaborative Information Retrieval in the Virtual Library

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Abstract

The advent of the virtual library is usually presented as a welcome development for library users. Unfortunately, this tends to reinforce the perception of the use of information resources as a solitary activity. In fact, as many studies have emphasised, information retrieval (IR) in the conventional library is often a highly collaborative activity, involving users' peers and experts such as librarians. Failure to take this into account in the design of virtual library services may result in its users being disadvantaged and denied timely and effective access to sources of assistance. Our focus here is on collaboration between users and librarians. We report an investigation of collaboration issues as seen from the perspective of librarians' and users' contexts and encapsulated in the notion of genre. Finally, we describe the design of a pilot multimedia-based system intended to support collaboration between librarians and IR system users.

Keywords: information retrieval, collaboration, genre, virtual library

Introduction

The increasingly widespread use of on-line information retrieval (IR) systems represents for many people the first tentative steps in the realisation of the much heralded 'virtual library'. However, whilst the convenience of IR from the desktop is clearly very attractive for many library users, there are potential drawbacks to this development. For example, the opportunity that library users would normally have to consult with experts in IR to help resolve any problems they encounter may be seriously impaired; if library users no longer visit libraries, the question is how best to bring librarians' expertise to users' desktops.

The very circumstances that may be making expert help less accessible to users also seem to underline how important this expertise can be to success. On the evidence of various studies, bibliographic database users presently face significant difficulties in finding the information they want; for example, it is reported that between 30 and 50% of searches result in no 'hits' (Borgman, 1996; Yee, 1991). These poor results may be attributable to various causes, ranging from poor user interfaces, to users' lack of knowledge of the domain and poor search strategies (Marchionini, 1995). Whilst better user interfaces for IR systems will undoubtedly alleviate some of these problems, concentrating on this factor alone ignores the benefits of restoring and promoting a collaborative approach to IR. Recent studies of library users have shown how they frequently seek help from their peers when they encounter problems (Twidale and Nichols, 1996), and that less often they consult with domain experts such as librarians (Procter et al, 1996). In this paper, we explore further this latter

dimension of collaboration in IR. We begin by reviewing the reference consultation through the perspective of genres and the role of librarian as a 'situated intermediary' in users' IR tasks. We then describe work in progress to develop a pilot multimedia-based service to support consultation between reference librarians and remotely-located users of bibliographic databases.

Collaboration Between Users and Librarians in IR

In the Library and Information Sciences (LIS) literature, collaborative IR is closely identified with the reference consultation. Historically, this has been described as a question and answer session: "one of the most complex acts of human communication ... (in which) one person tries to describe for another person, not something he knows, but rather something he does not know." (Taylor, 1968). Studies point to a frame work of conventions that are observed 'inside' the reference consultation (e.g. Spink and Saracevic, 1993) in what may be termed 'classic' reference interviews. Such frame works take for granted, however, circumstances which may not be available or reproducible in the digital, virtual library environment.

To understand the nature of collaborations in the virtual library, we must turn to the concept of genre, with its focus on the medium within which the collaboration is embedded (Erickson, 1996). Genre theory has been successfully introduced into the study of organisational communication -- including oral, paper-based and electronic -- as "an analytic device to study how organizational actors use new electronic media over time, and how such use influences communicative practices" (Yates and Orlikowski 1992). Genre theory has also been used to analyse communication outside the organisation, in communities on the World Wide Web (Crowston and Williams, 1996). Yates, Orlikowski and Rennecker (1996) observe that 'genre systems' can be identified within established communities: these are characterised by "an interrelated sequence of genres enacted by members of a particular community ... composed of a well-coordinated set of communicative moves that together accomplish an interaction ... the system as a whole, as well as the individual genres constituting the system, can be said to have a socially recognized purpose and common characteristics of form" (op cit, p. 51). In the case of the classic library reference interview, the 'community' is that of patrons and professionals, the communicative 'moves' are the phases of the on-line reference interview, the 'interaction' is the shared search, and the purpose and form are the provision of information within the institution of the library.

The concept of 'communicative moves' has been the focus of reference research for some years. The reference interview has been explained as a series of steps at both the level of the interview -- e.g. turn-taking between participants. At the broader level of the user's project: on the basis of analyses of transaction logs, verbal protocols, and qualitative studies of sense-making, Kuhlthau has constructed a six-stage model (Kuhlthau et al, 1992). Advice seeking and giving is manifest in some of these stages (e.g. induction; breakdown) more than others, as users derive their own heuristics to cope with the search space, which will conform, more or less, with the practices recommended by experts associated with the design and exploitation of that space. Recommended practice will also be articulated in such documentation as IR system help screens and manuals, though a user may choose to proceed on the basis of experience gained with other systems, or discussed with a peer or colleague. This

suggests that genre systems which are often alternatives to the 'classic' reference 'set' may be brought into play.

In addition to analysing steps and turn-taking, we would suggest that an approach using genre analysis may assist researchers and designers of systems to support reference consultations between librarians and remote users to capture salient features of the reference collaboration. Erickson (1996) in his discussion of an analytic framework based on genre theory for on-line discourse suggests a focus on:

- communicative purpose of the discourse
- nature of the discourse community
- regularities of form and content of the communication, and the underlying expectation and conventions
- the properties of the recurrent situations in which the genre is employed, including the institutional, technological, and social forces that give rise to the regularities of the discourse.

The Investigation

We have used a variety of techniques to build up a picture of forms of collaboration between librarians and library users in the contemporary academic library, and the 'reference consultation' in particular. These included interviews with librarians, questionnaires distributed by email distribution list to a target group of around 150 on-line bibliographic IR system users, and ethnographic-based observations of interactions between library users and librarians. Librarians at Edinburgh, Heriot-Watt and Napier Universities took part in the study. The investigation's scope included:

- devising a taxonomy of the problems users typically encounter,
- analysing how problems and solutions are articulated, including the rules which operate within reference consultations, and
- the factors which circumscribe reference consultations and shape librarians' practices.

The initial service focus for the investigation was the BIOSIS abstracts database, recently introduced as a networked reference resource, and available to participant institutions via the Edinburgh and STirling Metropolitan Area Network (EaSTMAN). Our exploration of the issues, however, has subsequently led us to broaden the focus of the inquiry to consider the BIOSIS work (or reference consultation) as just one component of a reference librarian's remit.

We now present and discuss in turn the results of our investigation as they relate to librarians and IR system users.

Librarians and Library Work

Overall, our observations of librarians suggest a picture of reference work which is very different from that suggested by the classic reference interview of the LIS literature. Each participant librarian was asked to keep a diary for one complete week at different stages of the investigation. These indicate that the librarians are subject to a barrage of miscellaneous and heterogeneous questions, from users whom they do not know, in a pattern of interaction which is characterised by high volume, impersonal, uninformed, short exchanges.

The dearth of sustained IR consultations reflects that fewer such demands are made of librarians in a world where end-users tend to serve themselves. The rise of autonomous searching by end-users has been mapped in a series of longitudinal studies by East and his colleagues (East et al., 1995). The comments of East's interviewees are echoed in those of two librarians in our study who stated that after induction or training sessions an a given database, users just disappear: "we don't know where they go". The picture emerges of a community whose members (both librarians and users) are increasingly anonymous, a situation which if not directly attributable to the growth of digital information services, is at least exacerbated by them. As one librarian commented:

> "We have library [web] pages which we use to communicate news and services. But it depends how often people look at it. You could see how many times a page has been visited, but it doesn't give us any indication of who's been looking at it. I wonder whether they all know about it really."

Interviews with librarians also addressed the context, from the librarian's perspective, in which these consultations take place. All described full schedules (confirmed under observation and by the diaries), to have work distributed in space, and to parallel process at least some of the time (answering a phone query, for example, while working with paper, or dealing with email; cataloguing, on-line searching and dealing with verbal enquiries at the reference desk), with the result that ground had to be cleared before the 'communication moves' that characterise classic reference interaction are brought into play. As the diaries indicate, few of them carried out extensive IR consultations of the sort described in the LIS literature, with face-to-face interaction over a workstation and finessing of feedback. Most of the collaborations logged in diary records were short (3 to 5 minutes) interactions of the 'help desk' kind, rather than subject searches, and followed a pattern of multiple tracking of user needs.

It appears that where sustained consultations with a user occurs, 'rules' are 'followed' on the basis of the librarian's professional training. These may relate to the librarian's perceptions of the stage of the search, perceptions of the user's expertise (competence in 'encoding' the search in terms of formal search statements, or interpretation of 'user needs' which may guide the librarian in decoding (assessing the relevance) of retrieved material. Such actions, which constitute the classic reference interaction, may be described in terms of a genre system. In many cases, however, the demands made of librarians are not amenable to treatment by means of rule-based consultations that relate to a subject area; clients' demands are not only concerned with content, but with technical or other kinds of problem. The content of consultations involves multiple 'starting overs' rather than sustained 'problem solving' reference work (Taylor, 1968), and reference Librarians may benefit from mechanisms (like genre analysis) which allow them to 'fast track' into a relationship with the client. Twidale et al have explored an alternative approach to 'instant client history' (Twidale et al, 1996).

If users overall are making less use of expert's advice, but experts are still required to make them themselves available 'just-in-case', does this constitute a waste of highly salaried expert time? Some libraries appear to take this view and heavily restrict the hours when a professional 'reference service' is available. Other libraries retain the

presence of experts at a reference desk, but require them to catch up with cataloguing backlogs and other professional duties when not engaged in subject consultations. In cases where restricted professional service is unacceptable to users, a shared inter-institutional service with seamless remote consultation may be a solution, providing the infrastructure is in place. In cases where professional time is squandered sitting at the reference desk, remote intra-institutional consultation may also be acceptable. To promote understanding of why such developments might represent an enhancement rather than a degradation of service (an issue of some concern to participants in the project), we have started an analysis of the activity which surrounds the reference consultation and reflects the 'situation' of the intermediary or librarian.

In order to elicit stories about their work and its context, we asked the librarians to describe how they handled multiple concurrent demands on their time: how did they multi-task? how might new media help with problem areas? All of the librarians did appear to apply criteria to structure their handling of complex demands. For example, some librarians appear to have established rules for priority: in a mediated interaction, a hierarchy appears to determine that visual demands have precedence over audio, and audio has precedence over text. Other rules to accommodate multiple tasks in limited time appear to be based on a hierarchy of perceived user needs, and the level of skill required of an expert who attempts to satisfy them.

The BIOSIS User Community
A user questionnaire was designed to help build up a broad picture of usage, users' views of the BIOSIS system and to develop a picture of the kinds of problems that were typically encountered. Over a period of 6 months, a total of 38 questionnaires were returned. The largest group of respondents were academic staff (30%), followed by postgraduate students (24%), undergraduate students (20%), research staff (14%) and finally miscellaneous library and information services staff (12%). As a sample user population, this group is arguably unrepresentative of IR systems users as a whole: the majority (56%) are in occupations where the ability to find and utilise information is a skill essential to membership; of the student users, only the undergraduates (20%) might justifiably be considered as relatively unskilled and/or inexperienced IR system users.

Users were asked how successful they thought they had been when using the IR system. Only 2% replied that they had been unable to find anything they were looking for, whereas 44% replied that they either found exactly what they wanted or a lot of relevant information. However, this positive picture is somewhat diminished by the 36% of replies from users who stated that they only found some useful information. Users were also asked questions regarding their competence in performing searches. The majority of respondents -- 61% -- stated that they judged themselves as either competent or very competent at performing complex searches; however, a significant minority --39% -- replied that they did not consider themselves competent in this respect. As anticipated, the majority of undergraduates placed themselves in this latter group. Problems reported ranged from the technically trivial -- but practically significant -- (e.g. forgotten passwords), to procedural (e.g. command language syntax) and conceptual problems (e.g. compound searches).

The final part of the questionnaire was designed to gather users' opinions and expectations of the different ways of dealing with the problems they encounter when

using the IR system. Specifically, users were asked to rate various combinations of sources of assistance and their delivery genres in terms of:

(a) their effectiveness in providing assistance and
(b) their convenience i.e. their timeliness and ease of access.

The results are summarised in Figure 1 (-2 = very ineffective/inconvenient, 0 = neutral, 2 = very effective/convenient). The genre options are grouped according to communication modality: synchronous, unmediated interaction (face-to-face, FTF), followed by synchronous, mediated interaction (telephone, T) and mediated, asynchronous interaction (email, E).

Consider first of all those combinations which were rated negatively for both effectiveness and convenience. The combination least favoured by users for both measures was being left to their own devices -- i.e. *trial and error*. The other combination to score negatively in both categories were consulting *computer support* (not shown) and consulting a *BIOSIS user by email*. The fact that the assistance of a technical specialist was not highly rated reflects the nature of the problems users face; these are predominantly domain problems, rather than more generic computer problems. It is more surprising that consulting a *BIOSIS user by email* was also rated poorly on both counts. Several combinations were rated positively in one category and negatively or neutrally in the other. One combination was rated positively for effectiveness, but negatively for convenience: consulting a *librarian by telephone*. Another combination -- consulting a *BIOSIS user face-to-face* -- was rated positively for effectiveness, but only neutrally for convenience. Finally in this group, consulting a *colleague* was rated as a mirror image of the previous combination: neutrally for effectiveness, but positively for convenience. The last group of combinations were rated positively for both effectiveness and convenience. These include: consulting a *librarian face-to-face*, consulting *on-line documentation* and consulting a *librarian by email*. Ranked by effectiveness, consulting a *librarian face-to-face* was rated most highly and consulting *on-line documentation* least highly. Ranked by convenience, however, these ratings were reversed.

Figure 1: Users' ratings of help service combinations.

It has become something of a truism in HCI circles that users prefer to consult with other users rather than read documentation: "If all else fails, read the manual" is the despairing refrain of computer service user support desks everywhere. However, the results of our survey suggest that users' attitudes and behaviour may be changing in this respect. Consulting a *BIOSIS user face-to-face* was only rated as effective as consulting *on-line documentation* and both were rated significantly more effective than consulting *a colleague*, but the former is rated significantly less convenient than on-line documentation. This result may be due the improved quality of on-line help, but a more realistic conclusion might be that BIOSIS users' informal support networks are relatively weak; its community is virtual, dispersed and its membership largely unknown to one another. Some corroboration for this view is evident in the poor rating for consulting a *BIOSIS user by email*. As Erickson observes, attributes of conventional communities are not easily reproduced in their virtual equivalents (Erickson, 1996).

Further analysis of the results reveals interesting interaction effects between sources of assistance and delivery genres. Consultation with domain experts scored most highly for effectiveness across all genres. The interesting differences here lie in users' perceptions of convenience: of the three communication modalities, email was the most highly rated, and the telephone the least highly rated, with face-to-face coming somewhere in between. The explanation for this may lie in users' experience of the work patterns of the experts: as we have seen, these mean that experts' availability may be a very hit and miss affair.

Some differences were also found between different user categories. For example, staff rated the convenience of all forms of unmediated interaction as less convenient than did students. Of the mediated interaction forms, staff rated the telephone as more convenient than students, but rated email as less convenient. In contrast, ratings of effectiveness were broadly similar.

A Pilot Remote Reference Consultation Support System
A pilot remote reference consultation support system using various forms of communications genre, including videoconferencing, WWW, email and FAQ lists, has been implemented in order to investigate their possible roles in supporting reference consultations between librarians and remote users of IR systems.

As emphasised by the classic reference interview, we may take the face-to-face meeting to be the 'gold standard' for IR consultations. The face-to-face genre is able to draw upon a rich variety of verbal and non-verbal contextual cues which make a significant contribution to communication structure and management. In addition, a shared, physical work context is important for the way in which it helps to sustain the common ground -- i.e. mutual understanding -- with the minimum of effort (Monk et al, 1994). For the design of a remote IR consultation service, however, the question is to what extent the full circumstances of a face-to-face genre need be recreated for it to be effective. Also, the design of a system to support consultation between librarians and remote users must acknowledge:

- the 'rules' which operate within consultations, and
- the circumstances which condition them or shape the practices within which consultations occur.

The kinds of support provided should therefore reflect the variety of forms and styles of collaboration which arise as a result of the interplay of the above factors. We have seen that librarians' time is in short supply and that their capacity to take part in synchronous interactions is therefore severely constrained by the multiplicity of tasks in which they engage during the working day. Librarians would find it an impossible burden if a remote consultation service denied them the power to control their accessibility and manage their time. In these circumstances, asynchronous media are likely to play a more prominent role. In addition, it becomes even more important to help users to help themselves by encouraging amongst the virtual user community the peer collaboration evident in the conventional library space e.g. by making their knowledge and experience gained more easily available to others (Twidale and Nichols, 1996). In this context, resources such as FAQ lists are a particularly valuable low-cost means to accumulate information 'capital' and make it accessible on a user community-wide basis.

Videoconferencing represents the closest practical recreation of a synchronous, face-to-face genre currently available. Initial trials indicate that, for untutored users, the cheaper LAN-based systems (e.g. CUSeeMe) do not provide the quality of videoconferencing required. These same trials do indicate, however, that there is a role for videoconferencing for facilitating peer-to-peer collaboration between librarians. In the pilot service, synchronous consultation between librarians and users is supported through audio and text-based conferencing with workspace sharing to enable user and librarian to jointly observe the results of searches, thereby provide the common ground for the consultation. An example of the latter is shown in Figure 2. For accessibility, these tools are WWW-based and require in their simplest forms only a WWW browser. For asynchronous consultations, WWW-based email tools for sharing bibliographic search histories and for maintaining archives to support the automatic generation of FAQ-like search history lists from the flow of queries and answers are also being developed. An illustration of the former is shown in Figure 3. The latter is based upon AnswerWeb, a WWW-based implementation of Answer Garden (Ackerman and MacDonald, 1996), providing collaborative filtering of queries and mechanisms to 'gracefully escalate' help requests.

Figure 2: Pilot text conferencing tool.

These various genres for collaboration support have different characteristics and as we have seen from the investigation, it is important for both overall service quality and cost-effectiveness to determine the circumstances in which the various options would be most appropriate -- for both librarian and user. Refining the categories of the user survey, three genre-related service characteristics would seem to be especially relevant: 'problem-resolving bandwidth' (capacity to articulate and sustain common ground), availability constraints (limits on initiation), and responsiveness (speed of handling once initiated). We can match the genres against these characteristics as shown in Table 1 below.

	Problem-resolving bandwidth	Availability constraints	Responsiveness
Synchronous: CMC	High	Unpredictable (high)	High
Asynchronous: email	Medium	Low	Unpredictable (low)
Asynchronous: FAQ list	Unpredictable (low)	Low	High

Table 1: Characteristics of genres for remote consultations.

Figure 3: Pilot email tool.

At the present time, we do not know what specific genre systems will emerge as alternatives to the classic reference set. As experience is gained from running the pilot consultation service, we intend to elicit more information on how the demands of a given medium are perceived by both librarians and users, how judgements are made by the former on issues such as the prioritisation of tasks, and how the latter perceive its effectiveness for solving their problems. At the beginning, when understanding of the relevance and consequences of media characteristics is limited, patterns of use may be unpredictable, but we expect to see an 'ecology' of genre use evolving over time as both librarians and users learn to match consultation service

genre systems against their particular constraints and requirements. Yates, Orlikowski and Rennecke relate that in one of their studies, "team members structured the genre systems themselves" instead of conforming with structures imposed by designers (Yates et al, 1996, p. 57). For example, librarians and users may find that mixing genres makes for an effective solution: consultations may be initiated synchronously, and then pursued to a conclusion asynchronously, and vice versa.

We can infer from existing BIOSIS user group logs, and from the diaries of library reference help desks that there will be at least three genre sets: classic; helpdesk; peer assistance (Procter et al, 1996). As the archive of use in the pilot system grows, we may see the emergence of genre systems that relate to the archive itself e.g. the refinement of FAQ lists etc.

Summary and Conclusions
Our investigation of collaboration between librarians and users of IR systems has presented a picture of a community that is in some need of ways to reverse a growing fragmentation and the loss of those attributes that normally distinguish membership: relationships, mutual commitment, shared values and practices, shared artefacts and persistence (Erickson, 1996). A pilot service to support remote collaboration, based upon the specific circumstances of this community, has been implemented, and its use will form the focus of future work.

We have presented a taxonomic system which accommodates features from e.g. Erickson's checklist might assist both clients and librarians to interact in a more effective manner and allow differing levels of enquiry to be matched with differing levels (automated and other) of service. If the sustained consultation that characterised the classic reference interview still requires a human expert, other genre systems (like sets of procedural queries at the help desk, for example) might not.

The identification of recurrent activities and rules which might define different genre systems is of particular importance for the design of remote consultation support systems. The rules described that relate to 'demandingness' of media and immediacy of response (which we perceived to have been set by practitioners) may allow for the matching of a 'demanding' medium with tasks where a high degree of specialist skill is required. For example, would videoconferencing, as a near equivalent of face-to-face, have priority over phone and email. Some participants felt they could condone the use of videoconferencing (a 'demanding' medium) only where access to their expertise was managed by means of a timetable of 'office hours' or 'desk hours' arrangements.

The emergence of recurrent responses to recurrent demands can be linked to theories of situated action which have offered explanatory frameworks for both organizational and educational research. Suchman's version of the concept and the methods associated with it (direct observation and analysis of verbal protocols) emphasise organizational ethnology and the emergence of strategies to handle recurrent events are relevant to our investigation. Equally relevant are the observations that lie behind 'situated learning' (Lave and Wenger 1991; Brown and Duguid, 1993) where learner and pedagogue (a ready analogy can be made with patron and expert librarian) seek to establish comparable understandings of each one's expectations of the other. Situated

learning draws on the "ordinary, everyday, finely detailed methodic practices of participants to an activity in specific settings" (Fleming, 1994, p. 525) and learning, in this context, means being able to participate appropriately in the settings ... "where the subject or discipline is being done" (op cit, p. 526). Situated intermediation, by analogy, means "being able to participate appropriately in the settings ... where questions are being asked". In traditional reference consultations, the burden of learning about 'appropriate participation' has fallen more heavily on the user. In a remote reference consultation setting, the onus will be on the librarian, who has to figure out what is happening at the client's desktop. The notion of 'appropriate participation' is further complicated by the implosion of tasks in the library: 'settings' in the case of our participating librarians go beyond the bibliographic database of classic reference work, to include any type of interaction with the institution, and not all of these 'settings' may be the province of the professional librarian.

Future research will combine analysis of genre systems with exploration of 'situated activity sequences', derived from the record of pilot service use. A growing archive of interactions (captured by on-line and off-line logs) will allow us to establish what factors contributed to a positive outcome on a given occasion. Fleming suggests the following steps:

- a structural anatomy -- how are sequences assembled and constructed in the specific settings in which they are used
- a functional anatomy -- the use to which methodic practices are put on a given occasion
- an understanding of the machinery by which such activity works -- how do descriptions, facts, processes work together to produce what participants in the dialogue recognize as an explanation of the phenomenon in question?

From a design perspective, we suggest that this and the work of Erickson and others on genre analysis might contribute to the realisation of a usable and effective remote reference consultation system.

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