

Enhancing Community and Collaboration 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, the emphasis which is often placed upon convenience of access tends to reinforce the perception of the use of information resources as a solitary activity. In fact, information retrieval (IR) in the conventional library is often a highly collaborative activity, involving users' peers and experts such as librarians. Failure in the design of virtual library services to take into account the ways in which physical spaces help engender a sense of community and facilitate collaboration will result in its users being denied timely and effective access to valuable sources of assistance.

We report an investigation of collaboration issues in IR. We begin by defining a generic model of collaboration, and of collaborative spaces. Finally, we describe the design of a prototype multimedia-based system intended to facilitate a sense of community and collaboration between its users.

Keywords: information retrieval, collaboration, virtual library

1 Introduction

The increasingly widespread use of on-line information retrieval (IR) systems represents for many people the first tentative step in the realisation of the much talked about digital, or virtual, library. However, whilst the convenience of IR from the desktop has a very powerful appeal for many users of library services, there are potential drawbacks to this development (Ackerman 1994). For example, the opportunity that library users would normally have to consult with staff — and with each other — so as to help resolve their IR problems may be seriously limited: if library users no longer visit libraries, one question is how best to bring the expertise of the library community to individual users'

desktops. On the evidence of various studies, users of OPACS (On-line Public Access Catalogues) and other bibliographic databases presently face significant difficulties in finding the information they want (Borgman 1996). These problems 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 to be had from encouraging and supporting a collaborative approach to IR problem-solving. Recent studies of library users have shown how they tend to seek help from their peers¹ — as well as from professionals — when they encounter IR problems (Levy and Marshall 1994; Procter et al. 1996, Twidale and Nichols 1996).

In this paper, we explore ways of using multimedia to support community and collaboration in the virtual library. We begin with an investigation of a particular library community. We then present a generic model of collaboration and of collaborative spaces, and finally we describe work in progress to develop a prototype multimedia-based implementation for the library user community.

2 Community and Collaboration in the Library

The use of information resources such as libraries has traditionally been pictured as a predominantly solitary activity, and collaboration in IR has received relatively little attention. In the Library and Information Sciences (LIS) literature, for example, collaborative IR is identified rather narrowly with the formal procedures of the reference consultation (Taylor 1968). Unfortunately, an assumption of the stereotypical 'lonely scholar' has been carried over into the discussion and design of digital library services and user interfaces. Taking their cue from the philosophy of multi-user system design (McKinlay et al. 1994), the typical OPAC and library WWW site goes to great lengths to disguise the fact that users are sharing resources, when being aware of sharing might actually be helpful. The effect is to atomise the user community, anonymise its activities and make its members largely unaware of each other's presence (Ackerman 1994).

There is increasing evidence, however, that the 'turn to the social' now commonplace in the wider information systems and human factors literature (Shapiro, et al.(1996) is beginning to make an impact within the digital library community. Recent studies have emphasised the importance of informal collaborative and social activities to IR work (Levy and Marshall 1994; Twidale and Nichols 1996; Procter et al. 1996). Contrary to their reputation (and, as we later observe, official reminders to users to comply with it), such studies confirm that libraries are social, communal spaces in which users help each other when they encounter problems, learn from each other, and consult with professional experts such as librarians. For example, Twidale and Nichols' studies of university library users reveal that many users acquire competence in using OPACs

¹ This finding is in line with observations of computer users across a wide range of contexts.

through informal and spontaneous collaboration with their peers (Twidale and Nichols 1996). As a simple illustration, they report that users will often share a terminal, or lean over to look at an adjacent terminal and discuss and point at screens.

Interestingly, the importance of the library as a social space has not been lost on architects of modern library buildings: here the emphasis is often quite deliberately to provide spaces for collaborative learning (Kelly 1997). In contrast, the designers of digital ‘information spaces’ have yet to acknowledge the importance of collaboration issues. With the potential that they provide for the remote access of information resources, there is a real danger that users’ opportunities to collaborate with their peers and with librarians will be lost as the use of digital library services grows. In a more fundamental sense, we believe that the users’ experience of community which physical library spaces afford — and upon which ultimately users’ collaboration depends — must also be weakened.

To address this problem, we are seeking to develop ways in which experience of community support for formal and informal collaboration can be incorporated into virtual library spaces. The aim is not simply to replicate the properties of physical information spaces, however, but to explore how the use of multimedia technologies may make it possible to go beyond them (Meyrowitz 1985). Above all, we wish to explore ways in which network and multimedia technologies can restore — and possibly extend — the experience of community and social context of work to the virtual library.

3 The Investigation

We have used a variety of techniques to build up a picture of forms of collaboration in a contemporary academic library community. These included interviews with librarians, questionnaires administered by email distribution list to a target group of around 150 on-line bibliographic database users, and ethnographically-based observations of interactions between library users and librarians. Librarians and library users at Edinburgh, Heriot-Watt and Napier Universities took part in the study. (For a more detailed account and discussion of the results, see Procter et al. (1997).)

The initial service focus for the investigation was the BIOSIS abstracts database, recently introduced as a networked reference resource, and available to participating institutions via the Edinburgh and Stirling Metropolitan Area Network (EaStMAN).

Overall, our observations suggest a picture of interaction between users and librarians which is at odds with that implied by the classic reference interview studies of the LIS literature. The librarians in our study are subject to a barrage of miscellaneous and heterogeneous questions, in a pattern of interaction with library users which is characterised by high volume, impersonal, uninformed, and short exchanges. Most of the interactions with users recorded were short (three to five minutes) interactions of the ‘help desk’ kind, rather than subject searches. Where the latter did occur, they typically involved multiple ‘starting

overs' rather than sustained problem solving reference work (Taylor 1968). In performing these 'starting overs', valuable time was spent in (re)establishing important contextual information for dealing with the problem, such as the user's background and the history of their search activities.

Such spasmodic librarian-user interaction is in keeping with a library community in which users find themselves needing to be self-reliant, and conforms to the trends identified in a series of longitudinal studies by East and his colleagues (East et al. 1996). One factor behind this trend is that librarians' time is an increasingly scarce resource. Some libraries, for example, heavily restrict the hours when a professional 'reference service' is available. In interviews, all the librarians described full schedules, and constant interleaving of tasks (answering a phone query, for example, while working with paper, or dealing with email; cataloguing, on-line searching and dealing with verbal inquiries at the reference desk).

Besides these organisational factors, however, our study also points to the mediating influence of computer-based IR systems — and the assumptions of their designers — upon the library community: the use of computer-based IR systems and remote access has the effect of making users' activities invisible to the librarians. For example, two librarians in our study stated that after induction or training sessions on a given database, "... users just disappear, we don't know where they go". Another librarian commented:

"We have library [WWW] 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."

These comments point, in particular, to librarians' lack of feedback from users about the value and effectiveness of the services they are providing. In itself, this should be a cause for concern. More generally, they point to librarians' lack of day-to-day awareness of users' activities, and of the kinds of problems that users face. Amongst other effects, this lack of awareness increases the overheads librarians encounter in 'getting started' when they do have to deal with a user's problem.

A user questionnaire was designed to help build up a broad view 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%). Significantly, a majority reported that they accessed BIOSIS from their office PCs, rather than in the library.

Part of the questionnaire was designed to explore how users tackled the problems they encounter when using the BIOSIS database. Specifically, they were asked what strategies they employed to solve IR problems and how they rated these strategies for effectiveness. The results show that BIOSIS users most

frequently turned to trial and error as a problem-solving strategy, even though this was not rated highly from the point of view of outcome. In contrast, seeking assistance from both librarians and other BIOSIS users was highly rated in terms of outcome, but more rarely used.

These results contrast with the picture revealed by Twidale and Nichols of informal collaborations within the general academic library user community (Twidale and Nichols 1996). We suggest that, by comparison, the BIOSIS user community's informal peer support networks are relatively weak: the community is physically dispersed and with many users taking advantage of access from their desktop PCs, it would not be surprising if members of the BIOSIS community membership are largely unknown to one another and unaware of each other's activities. As a consequence, the BIOSIS user community's capacity to collaborate is correspondingly much reduced. The BIOSIS user community already is effectively virtual, and as Erickson observes, the attributes of conventional communities are not easily reproduced in their virtual equivalents (Erickson 1997).

In summary, the picture that emerges from our investigation of librarians and BIOSIS users is of a community whose members are increasingly anonymous and unaware of each others' activities, to the obvious detriment of their capacity to collaborate with one another. Undoubtedly, there is a number of factors contributing to this impoverishment of community, but it seems clear that the use of on-line IR services is a major one. The question is how, in the virtual library context, the use of network and multimedia technologies may provide a solution to this problem. Before attempting to address supporting collaboration in the virtual library, however, we must first of all consider the nature of collaboration as a more general social phenomenon.

4 Cooperation and Collaboration in Virtual Communities

The challenge of understanding what motivates the cooperative and collaborative behaviour of members of conventional communities has long occupied social psychologists. Simply put, community members may find themselves facing a dilemma: having to choose between furthering their own interests, or those of others in the group. In a series of studies, Ostrom (1990) identified a number of attributes common to communities cooperating successfully. These include:

- Clearly defined group boundaries
- A capacity for members to monitor each others' behaviour
- A graduated system of sanctions.

More recently, studies of computer-mediated communication (CMC), and its effects on social relationships, suggest that patterns of cooperation may be different in virtual communities (Kollock and Smith 1996). On-line discussion groups (e.g., Usenet newsgroups) exemplify many issues that may be of relevance to collaboration in the library, and so it may be instructive to examine the behaviour of their users more closely.

A comparison of Usenet newsgroup characteristics with Ostrom's cooperation attributes reveals several interesting, but inconclusive, differences (Kollock and Smith 1996). For example, a newsgroup's boundaries are often ill-defined and difficult to defend: where they exist, they are usually voluntary, and so are easily circumvented. This also has an impact on the kinds of sanction that may be imposed on 'wrong-doers'. On the other hand, the capacity that Usenet provides for the monitoring of posters' activities arguably affords very effective application of whatever informal sanctions newsgroup members may choose to employ.

One key principle of collaboration in conventional communities is reciprocity: whatever is given should be repaid. There has been much debate over whether the 'weak ties' typical of on-line relationships are adequate to sustain reciprocity in virtual communities (Wellman and Gulia 1997). As Kollock and Smith have observed:

"Whatever the goal of the newsgroup, its success depends upon the active and ongoing contributions of those who choose to participate in it. If the goal . . . is to exchange information and answer questions about a particular topic, participants must be willing to answer questions raised by others, summarize and post replies to queries they have made themselves and pass along information that is relevant to the group." (Kollock and Smith 1996, p. 117)

So far, unambiguous evidence of the impact of weak ties on virtual communities is lacking: it is probable that they may reduce the motivation to collaborate in some contexts, but increase it (or reduce collaboration inhibitions) in others (Wellman and Gulia 1997). What is undeniable, however, is that newsgroups do work: though some people 'free-ride', or 'lurk', sufficient numbers contribute. A more significant influence on motivation to collaborate may perhaps be found in the concept of social identity, and the related notions of affiliation and self-esteem (Donath 1997). Helping others is supportive of social identity in that it engenders feelings of belonging to the group, and of individual worth, but especially so if the helper can be identified:

"... building reputation and establishing one's on-line identity provides a great deal of motivation . . . In most newsgroups . . . reputation is enhanced by contributing remarks of the type admired by the group. To the writer seeking to be better known, a clearly recognizable display of identity is especially important. No matter how brilliant a posting is, there is no gain in reputation if the readers are oblivious to whom the author is." (Donath 1997)

In the following section, we consider the implications of the behaviour of virtual community members for the design of a library collaboration space. In particular, we draw upon self-categorisation theory to explore social identity further and to relate it to issues in the representation of self in virtual spaces. Like Usenet, and unlike fantasy-based multi-user dungeons (MUDs), the library collaboration

space is intended to foster collaboration between people based upon their ‘real world’ identities. Not least, this is because we anticipate that participants may wish to transfer collaborations initiated in the library space to the real world, and vice versa (Wellman and Gulia 1997).

5 A Model for Collaboration in the Virtual Library

We describe here a logical model of an enhanced collaboration space for the virtual library. It is based upon a layered representation of collaborative tasks consisting of three domains, the task domain, the inter-individual social domain and the social domain.

The task domain represents that aspect of collaboration which is in some ways the most obvious element of interactions among library staff and users. This comprises specific work-related communications episodes and the sharing of information pertaining to the support of the task’s common ground.

Taken together, atomistic, task-related speech acts such as requesting, informing or complaining constitute a whole inter-individual communication episode. For these episodes, it is important that the interactants are able to manage features such as refusals of requests and to provide non-helpful answers to questions in such a way as to avoid adverse impression formation. Thus the inter-individual social domain represents those aspects of collaboration in which interactants can be seen to relate to one another as individuals. Here, the participants’ concerns focus on managing the communicative episode, attending to matters of interpersonal perception, weaving into the ongoing interaction shared knowledge of previous contacts and current context.

The social domain represents that aspect of library collaborations in which the inter-individual collaborations are set within a wider social context. Here, the focus is not so much on the micro-analytic detail of what happens in a particular interaction. Rather, it is on how the totality of such collaborations within the library represents a communal framework in which classes of interactions can be understood at a more generic level. It is here also that we can apply the concept of social identity with respect to issues such as motivation for collaboration.

5.1 Social Identity and Self-Categorisation Theory

Social identity has been defined as “the individual’s knowledge that he belongs to certain social groups together with some emotional and value significance to him of the group membership”. This idea that the group is in some ways the primary level of explanation of social interaction lies at the heart of self-categorisation theory (SCT) (Turner 1987). According to SCT, each individual belongs to a variety of social groups which range from broad categorisations such as ethnicity, gender and nationality to narrower categorisations such as specific occupation, local family or affiliation networks, and other groupings determined by interest and lifestyle. For example, within the terms of SCT, an individual may at different times think of himself as white, or as male, or as Scottish, or

as an academic, or as a brother, or as an amateur footballer. The particular self-categorisation which a person adopts, within a specific context, will be that categorisation which best fits the interactional requirements of that context. Thus, if the context is a discussion about political devolution, an individual's Scottish nationality may become salient. On the other hand, if the context is a debate about football, the individual's amateur footballer self-categorisation may become salient. According to SCT, then, we carry about with us a constellation of different possible self-categorisations, and each is susceptible to being triggered by different social contexts.

A feature of self-categorisation is that, through ascribing group membership to oneself, one thereby subscribes to certain group-oriented ways of thinking — i.e., to group stereotypes. These are shorthand ways of thinking about other people which allow us to form an impression of those others, with a minimum of contemplative thought, by classifying those others as belonging to a certain type or category of person. For example, if someone is identified to us as an Italian then we are likely to form a stereotypical impression of that person which will include properties such as volubility, warmth and stylishness. If, on the other hand, the person is identified as a German then our stereotypical impression is likely to include features such as efficiency and earnestness² Because stereotypes of this sort are a general 'inheritance' acquired through group membership, people could possess stereotypes of groups whom they as individuals have never encountered, but whom other members of their group have.

The uniformity of stereotypes across members of a group is explained by appeal to a process of social conformity to group norms. The idea here is that membership of social groups affects the way we think because social groups have pre-established ways of understanding the world and we, as group members, tend to fall into accord with those ways of understanding. Moreover, a group's common stereotyped way of thinking about the world is usually designed so that the group benefits in terms of collective esteem from this stereotyping process. For example, the Scots may have a stereotype of the English as cold and unemotional, while they view themselves as warm and fun-loving. The English may have a stereotype of the Scots as drunken and aggressive, while they view themselves as sober and peaceful.

Since a group's stereotypical ways of viewing the world tend to offer benefits in terms of social esteem, an individual's falling into line is often experienced as a form of social pressure to conform with how the group sees the world. SCT states that stereotypes are consensual precisely because all members of the social group are expected to follow them so as to establish the desired esteem-enhancing outcome. It follows that as one moves from one context to another, one's own self-categorisations are likely to vary. As this occurs, the stereotyped ways of thinking about others which attach to particular self-categorisations are also likely to vary. For example, if an individual's Scottishness is salient during an interaction with an English woman, then judgments of that woman as cold

² We would like to emphasise that we have chosen these example stereotypes merely to ground the discussion in an accessible way and no endorsement of them is implied.

or unemotional, based on an Englishness stereotype, may ensue. If, on the other hand, the individual's maleness becomes salient, then judgments of that woman as warm and caring, based on a femaleness stereotype, may occur instead.

5.2 Applying SCT to the Collaboration Space

When considering collaboration across the library as a whole, those involved can be thought of, at any one time, as displaying membership of a particular social category. The categories to which people may be ascribed include such notions as library staff, lecturer, student etc. We argue that when people collaborate within the library, they not only attend to the micro-detail of the specific interaction, but also make sense of it by locating it within this wider social framework. Access to this wider social framework also affords motivational factors. As a consequence, the library collaboration space must not only enable interpersonal management at the level of individual interaction episode, but must also provide for dissemination of knowledge and identity at the more general social level. Thus where an individual is looking for help, she may have an interest in locating other library users of the same general sort as herself; motivation for responding to a request from someone else may depend upon whether she has access to salient information concerning the requester's identity. Similarly, where a librarian is having to prioritise requests for help, it may be important for her to distinguish particular classes of users such as student, staff and the general public.

Interaction and collaboration within the virtual library space can be construed in terms of SCT in that people will view themselves as belonging to one or other of a range of social groups (and this self-categorisation will vary across different contexts). They will also view others within the virtual library in terms of their group memberships. The consequence of this will be that those others will be viewed in terms of the stereotypes which are held as representative of their group. We argue that this places a requirement on collaboration tools that they offer resources to allow people both to manage their own self-categorisations, and to 'read off' those of others. For example, a member of academic staff may enter the virtual library collaboration space with the aim of offering assistance to students using the library. However, the stereotypes associated with categories such as 'Professor' (e.g., busy, important, unapproachable) may inhibit students from contacting that person within the virtual library space. If, on the other hand, the collaboration space allows for manipulation of self-categorisation, the member of staff may choose to display self-categorisations which promote contact. Thus, instead of categorising himself or herself as 'Professor', the staff member may categorise himself or herself as 'Member of University French Society' or 'Member of University Computer Club'.

5.3 Structure and Control in the Collaboration Space

Having established our model of collaboration, we must now consider its implementation within the collaboration space, and how multimedia technologies

may be mapped onto it. In addition to the representation of identity, important issues to be considered include (Mynatt et al. 1997):

- Presentational issues related to representation, including users' control over their accessibility — i.e., their visibility to others, and the opportunities for interaction that they are prepared to grant to them
- Structure, how the collaboration space is organised to facilitate navigation and identification of neighbourhoods of interest to individual users
- Relationships between structure and collaboration, including the permeability of, and movement across, the space's structural boundaries and means of interaction.

A sketch of the simple model we propose for the enhanced collaboration space is shown in Figure 1. The top half shows how users are able to determine some aspects of their identity and presentation in the collaboration space. The user has a formal, default identity which is derived from their institutional status. The user may embellish this nominal identity by adding information to their personal 'biography', including an optional link to their WWW page. In this way, the user is able to manipulate their self-categorisations without retreating behind a fantasy identity. Users also have a control over whether their image is displayed, and of what kinds of interaction they are prepared to engage in with other participants of the collaboration space. The chosen combinations of these various presentation options have the important side effect of determining the user's location within the collaboration space.

Determining accessibility within the collaboration space is potentially problematic: in the real world, accessibility is a situated and negotiated achieved state between collaborators (Pedersen and Sokoler 1997). Figure 1 reveals how the collaboration space is partitioned into three concentric zones of accessibility which are defined by a combination of the level of users' visibility and the interaction opportunities afforded between them. The outermost accessibility zone is reserved for lurkers. Lurkers have zero visibility to others, only a minimal awareness of others, and are not allowed to interact with them. In order to play a more active role in the collaboration space, lurkers must move towards its centre, gaining increased awareness of others, but at the cost of themselves becoming progressively more visible and more available. The organisation of the collaboration space thus enforces the principle of reciprocity with respect to accessibility: to gain access to others, users must allow themselves to be more accessible to others. In this aspect, the collaboration space provides for more sophisticated support of group boundary concepts than is available, for example, to newsgroup members.

The second structuring principle of the collaboration space is based upon the notion of group membership, or affiliation, and enables partitioning of the space to be achieved across accessibility zones. In general, an individual's affiliation may be a complex attribution determined by many factors. We argue that for the library collaboration space, a default affiliation may be usefully defined by the notion of academic group membership (representing long term subject interests). In the top half of Figure 1, the radial lines define sectors of distinct

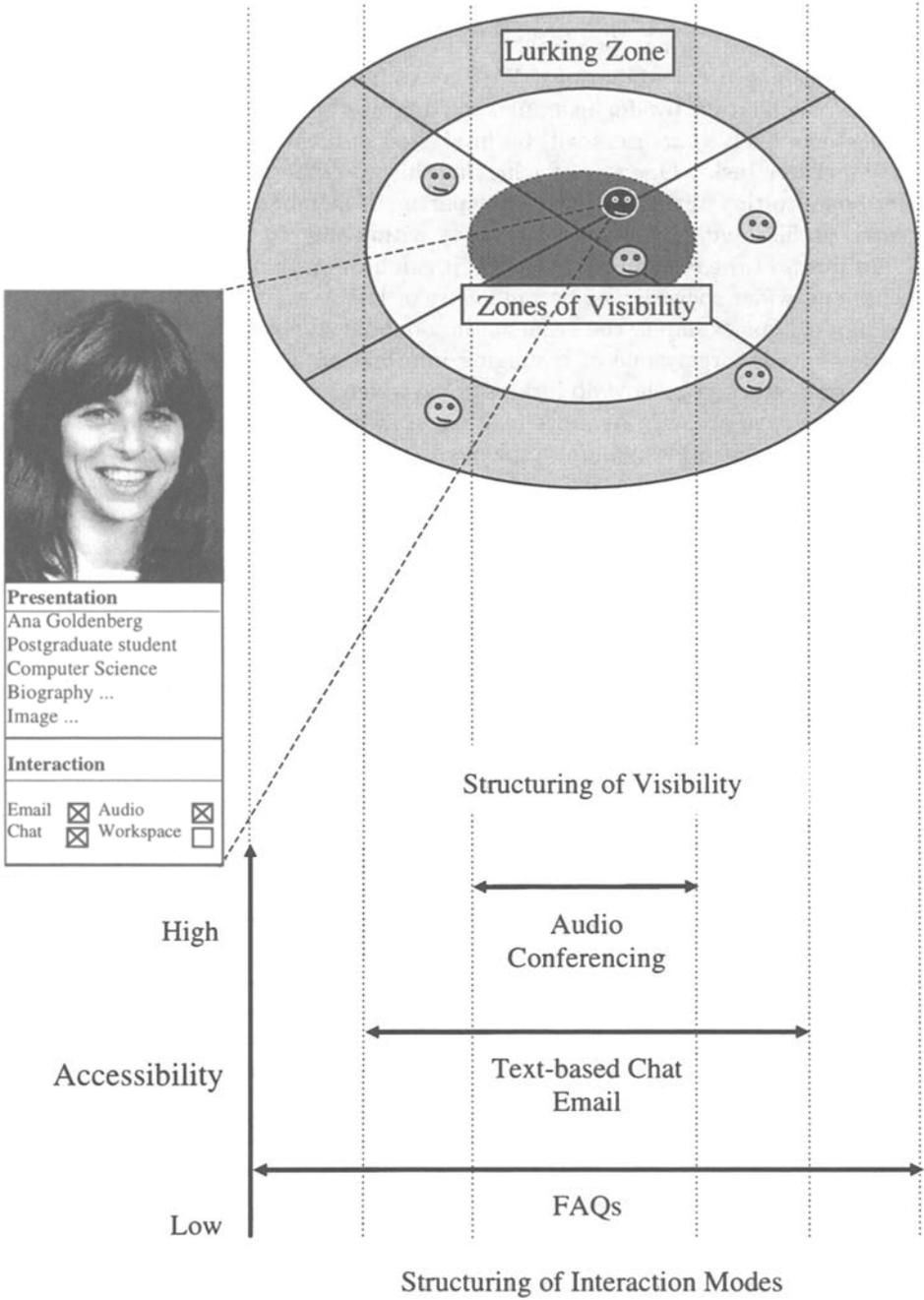


Figure 1. The Collaboration Space Model

sub-communities of academic interests (e.g., departments) within the collaboration space. We recognise, however, that by itself, this is too crude a mechanism for establishing users' affiliations. We plan to investigate ways of extending the notion of affiliation by, for example, making use of task-relevant information, as it seems likely that users will be interested in identifying others engaged in similar search tasks. One way of achieving this would be the addition of dynamic attributes to the static attributes of department membership e.g., users' recent search profiles and current search activity within the virtual library space.

In terms of the collaboration model, it can be seen that both inter-individual issues and wider social issues become more or less relevant at different points in the model. For example, the issue at the boundary between lurkers and visible participants is largely one of managing information associated with the wider social framework, e.g., how do lurkers know which people within the virtual library space to approach? As movement occurs within the model from peripheral zones to the centre, design and implementation issues become more focused on supporting inter-individual interactions by enabling individuating features such as personal recognition, person perception and impression management and conversational management.

6 A Prototype Collaboration Space

A prototype library collaboration space based on the collaboration model is being implemented in order to investigate the roles of various network and multimedia technologies, including video- and audio-conferencing, WWW, email and FAQ lists. For accessibility, the entire implementation is WWW-based and in its simplest form requires only a WWW browser.

In the prototype, the visual rendering of the collaboration space is derived directly from the two-dimensional representation shown in the top half of Figure 1: later implementations may be based upon more sophisticated virtual reality techniques (e.g., Benford et al. 1997). The 'face' icons represent individuals currently active within the collaboration space and may be given distinct visual characteristics so that people's roles, status etc. can be distinguished. In this way, some basic information about affiliations can be accessed. As shown in Figure 1, clicking on an icon opens it up and enables the person it represents to be identified. It also provides the means to initiate an interaction using the media options relevant for the accessibility zone in which that person is currently located. The options include synchronous and asynchronous conferencing and workspace sharing (the workspace checkbox).

It is important to recognise that the digital collaboration space offers opportunities to transcend the limitations of conventional social spaces, and the physical library in particular (Bly et al. 1993). In the latter, people are expected not to behave in ways which would interfere with others; interaction is thus relatively inhibited when compared with more conventional workplaces. In one of our pilot library sites, for example, notices bearing the legend "*It's good to talk ... but not in here!*" are prominently displayed. In digital spaces, however,

where users can have a far greater degree of control over its communication affordances, there may be a role for forms of interaction which would not be tolerated in its physical equivalent. In particular, we suggest that in contrast with the etiquette of the conventional library, in the virtual library space talk will be quite acceptable. Studies of audio-only spaces in other application contexts suggest that they can be very effective (Ackerman et al. 1997).

As emphasised by the classic reference interview, we may take the face-to-face meeting to be the 'gold standard' for library collaboration. In addition, the 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 (McCarthy et al. 1991). For the design of the virtual collaboration space, however, the question is to what extent the affordances of a physical meeting space need be recreated for the virtual collaboration space to function effectively. Here, the evidence from other computer-supported cooperative work (CSCW) domains is instructive. Laboratory studies which have tried to recreate the circumstances of face-to-face communications suggest that a voice channel is the most important media for effective collaboration (Gale 1990). A different picture emerges when users' preferences are considered, however, with attitudes generally being strongly in favour of the use of video in CSCW task environments (Olson 1995). Other studies have illustrated how video aids recognition of collaborators, recall of past encounters, and may serve to reassure in some circumstances (Watts and Monk 1997).

The evidence, therefore, is insufficient to identify the best option unambiguously. An important consideration is that many users of on-line library services (e.g., undergraduates) do not enjoy a fixed point of access. This, together with pragmatic factors, such as the relative ubiquity of audio cards in the modern multimedia PC, point to the selection of audio-conferencing for synchronous interaction support in the collaboration space. Figure 1 shows that use is made of digitised images to provide for visual recognition of collaborators. Work-space sharing is provided to enable collaborators to jointly observe the results of searches, thereby supporting the common ground necessary for effective collaborative problem-solving.

Another issue requiring consideration the implications of virtual spaces on the work practices of library staff. We have seen that librarians engage in a multiplicity of tasks during the working day, and so we cannot expect that the time they may be able to devote to synchronous interactions with users in the collaboration space will be any greater than the time they can devote to face-to-face interactions in the conventional library. Librarians would find it an impossible burden if participation in the collaboration space denied them the power to control their accessibility and to manage their work. In these circumstances, asynchronous media are likely to play a more prominent role. Similarly, there is a strong case for supporting a variety of forms of asynchronous collaboration, including those which enable users' knowledge and experience gained to be easily available to others (Twidale and Nichols 1996). In this context, resources such as FAQ lists are particularly valuable, not only as a

lightweight form of collaboration, but also as a low-cost means of accumulating information 'capital' and making it accessible on a community-wide basis.

For asynchronous interactions, 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. The latter is based upon AnswerWeb, a WWW-based implementation of Answer Garden (Ackerman and MacDonald 1996), providing collaborative filtering of queries and mechanisms permitting users to 'gracefully escalate' requests for assistance to librarians (Procter et al. 1997).

7 Conclusions and Future Work

Our investigation of librarians, library users and collaboration in IR presents a picture of a community that is in need of means to reverse a growing fragmentation and the loss of those attributes that normally distinguish community: relationships, mutual commitment, shared values and practices, shared artefacts and persistence (Erickson 1997). We believe that with the growth of WWW and other networked information resources, the scale of this problem can only increase, and collaboration might be compromised on a larger scale. Though our research is conducted within a specific and specialised environment, it should be applicable to many other distributed IR environments.

A prototype virtual library collaboration space derived from the collaboration model is being implemented and will be put through a series of usability evaluations later this year. The current design will undoubtedly require further revision and refinement. In particular, we plan to investigate more sophisticated mechanisms for mapping users' presentation of their identity within different sub-communities. As we have already emphasised, people may belong to numerous social groups, and this points to a need for users to be able to tailor their self-categorisation and presentation to match. Equally, more powerful and dynamic ways for users to define their affiliations need to be investigated. Finally, a virtual library collaboration space may be host to many thousands of users, and at any one time, several hundred may be active. It is essential, therefore, that issues of scale with regard to user presentation and interaction be explored and addressed.

Once initial usability evaluations are complete, the revised prototype will be made available to the local library user community. This study of how its users respond to the facilities it provides for collaboration will form a major part of our future work (Davenport, Procter and Goldenberg 1997). As has been emphasised in many other such studies, it is only when users have the opportunity to gain experience of multimedia technologies in their routine work that their true value can be properly assessed.

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