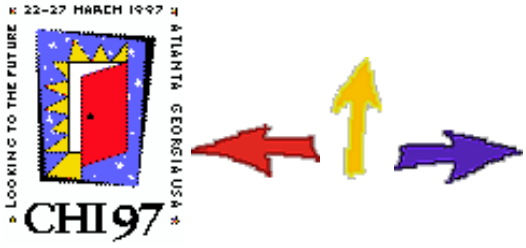
CHI 97 Electronic Publications: Papers



Design For Network Communities

Elizabeth D. Mynatt
Xerox PARC
mynatt@parc.xerox.com

Annette Adler
Xerox Systems Architecture
adler@parc.xerox.com

Mizuko Ito
Stanford University & Institute for Research on Learning
mito@portola.com

Vicki L. O'Day
Xerox PARC
oday@parc.xerox.com

ABSTRACT

Collaboration has long been of considerable interest in the CHI community. This paper proposes and explores the concept of network communities as a crucial part of this discussion. Network communities are a form of technology- mediated environment that foster a sense of community among users. We consider several familiar systems and describe the shared characteristics these systems have developed to deal with critical concerns of collaboration. Based on our own experience as designers and users of a variety of network communities, we extend this initial design space along three dimensions: the articulation of a persistent sense of location, the boundary tensions between real and virtual worlds, and the emergence and evolution of community.

Keywords

media space, MUDs, network community, shared space, metaphor, identity, virtual world

---

INTRODUCTION

There has long been interest in the CHI community in supporting groups of people collaborating, in particular, the informal, awareness-rich, serendipitous, and robust practices of long-term communities. In this paper, we will extend this interest with a focus on systems designed to support this rich sense of community over networks. Drawing on prior work as well as our own experience, we will explore an initial set of defining characteristics of technologically-mediated communities and suggest design implications associated with them.

Community as a social phenomenon deals with establishing and working with meaningful connections between people. Technology has always played an important role in this[7][10]. Historically, systems for linking and supporting robust social connections between people, whether they are in close proximity or distributed over longer distances, have included point to point solutions (letters, the automobile, telephone)[18], task-focused or work-modeling solutions (memos, forms, manuals)[22], and one-to-many broadcast solutions (radio, TV, newspapers)[18][22]. More recently, computationally-based systems have been designed to support various aspects of collaboration, coordination and community: email, newsgroups, bulletin boards, and shared task tools are just a few examples. These systems have all been useful in collaboration and further, supporting community, yet they also share similar limitations that could be addressed by network-based community support:

- Point to point connections tend to support individual interactions, not multiple or connections within groups to establish shared context on an ongoing basis.
- Task-focused or work-modeled connections can be too narrowly specialized to handle ad hoc and unanticipated group activities as well as evolution over time.

- Unbounded, uncertain connections or high turnover participation make it difficult for groups to establish and maintain common awareness, group coherence, shared experience, and trust.

Media spaces and MUDs [f1] have attempted to address these concerns by creating persistent, predictable, multi-user connections that support a wide range of user interaction and collaborative activity. They have had some success but also some interesting failings.

The promise of networked computational devices for collaboration and community-building is compelling. This paper qualitatively explores both the technical and social features of this design space, drawing on our own experiences in investigating, designing and using network communities. [f2] This paper is an effort to abstract a set of shared features and issues from several related system designs. Our primary audience is designers, implementors and members of network-based communities. We first introduce the concept of network communities, using media spaces and MUDs as starting points, describing the underlying constellation of characteristics that constitutes their bare-bones technical infrastructure. We then explore three major design dimensions: the unifying metaphor for locational and social connections; the relationship between the real (physical) and virtual (computational); and the evolution of community. Most importantly, we stress that network communities emerge from the intertwining of sociality and technology in ways that make it difficult, if not impossible, to cleanly separate these individual influences. Given this hybrid nature, we advocate exploring design dimensions that require a balance between technological and social elements.

WHAT ARE NETWORK COMMUNITIES?

In the introduction, we introduced network communities as embodying a particular design direction in supporting collaborative activity. In this section, we attempt to characterize network communities in more detail.

We have chosen to use the term community rather than collaboration to point toward a more long-term and multi- layered relationality. Community has been defined variously as being based on geographic area, social norms, or types of social interaction. Without contesting the particularities of these differences, we would like to point to the loose consensus around community as referring to a multi- dimensional, cohesive social grouping that includes, in varying degrees: shared spatial relations, social conventions, a sense of membership and boundaries, and an ongoing rhythm of social interaction.
Our goal here is to consider network communities as one type of emergent and viable design direction in supporting community, and to explore some of the design considerations particular to these systems. Network communities embody a unique constellation of characteristics that distinguish them from earlier forms of media, as well as from other types of computational systems. These basic characteristics are:

- **Technologically Mediated:** Here, we are pointing to the role of technology in overcoming spatial distance to achieve social cohesion. Historically, we might compare mass media such as radio, television, and print media, as well as transportation, messengers, telephone, or telegraph in traversing these distances. Network communities, by contrast, rely on relatively immediate computer network communications to span these distances.

- **Persistent:** Network communities are durable across time, users, and particular uses, providing an ambient and continuous context for activity. There may be levels of persistence in a space: walls are more durable than objects, and objects may be more persistent than particular avatars (user representations). A metaphor of physical space may be leveraged in order to provide this sense of enduring space, like an office or a building that one enters, exits, and expects to remain open for other users. This persistence contrasts with communication channels that are mobilized for specific uses.

- **Multiple Interaction Styles:** In order to support a social rhythm and density of interaction necessary for community- building, network communities enable participants to communicate in different ways.

We do not necessarily mean multiple media or even multiple channels, although these spaces may indeed include both. Rather, we are pointing to the ability to engage in many different kinds of interaction, such as "face-to-face" conversation, "hallway" meetings and greetings, or peripheral or ambient awareness of "distant" noise or conversation. Interaction in network communities is not tightly tied to a particular task or channel, but allows for different kinds of participation: peripheral, informal, formal, or serendipitous.

- **Capability for Realtime Interaction:** While we expect network communities to have more than one mode or channel of communication, they are defined by a certain sense of interactional immediacy. Network communities embody at least one form of interactional modality that is analogous to conversation or co-located peripheral awareness (whether co-location based or not). While distribution of mass print media, snail mail and most email and newsgroups generally do not support this aspect of network communities, the usage patterns of some newsgroups or email lists approximate this immediacy.

- **Multi-User:** Network communities also differ from point-to-point and broadcast media in that they allow multiple writers/readers or senders/receivers to flexibly define engagements with each other. Generally, network communities allow for both private, person-to-person engagements, and semi-public communal presence, often occurring at the same time. Multiple authorship and multiple participants are basic features of network communities.

Design Dimensions of Network Communities

The characteristics outlined above constitute the minimal technical parameters of these systems. We suggest a starting list of three further issues that must be addressed to support the evolution of network communities into socially cohesive spaces.

First, network communities require some sort of articulation of a persistent sense of location. This sense of proximity has commonly been resolved through fairly literal spatial metaphors of spatial proximity: virtual offices and meeting rooms, or online fantasy worlds. As we explore this issue, we delve into the notion of connected virtual spaces and the management of these spaces.
Second, as users inhabit both "real" and "virtual" spaces, network communities require a complicated management of markers that link elements (i.e. people, environment, objects, and actions) of these two spaces. This design dimension stresses the need for coherence between "real" and "virtual" worlds as well as the challenges of migrating social practices from the "real" world to "virtual" worlds.
Our third and final issue returns us to the more general problems of community and social cohesion. What, finally, are some of the broader social factors that interact with and contextualize technical features in sustaining, supporting, or failing to support social activity? In this discussion, we stress the need for flexible couplings between technical mechanisms and social acts that can evolve over time.
We discuss each of these design dimensions in turn.

Design Examples

In these paper we refer to four systems: Pueblo, Jupiter, the analog media space used at PARC and EuroPARC, and the digital media space used at Georgia Tech. Pueblo [19] is a cross-generation, school-centered, text- based MUD. The community is open to Internet participants, but it is grounded in several real-life institutions that sponsor its development: Longview Elementary School, a kindergarten through sixth grade school in Phoenix, Arizona; Phoenix College, a community college in Phoenix; and Xerox PARC. One of the authors is a designer and participant in Pueblo.

Jupiter [5] is a hybrid MUD and media space, developed at Xerox PARC and available to members of the Xerox research and development community. Its MUD-like features include connected places, shared objects, and text- based communication mechanisms. Unlike traditional MUDs, Jupiter also supports partitioned audio/video links between participants' offices and graphical representations of MUD objects. All of the authors have used and studied Jupiter, with experience levels ranging from a few days to several

years.

The analog media space used at PARC and EuroPARC supported point to point connections between participants, including frequent office shares (persistent connections between collaborators' offices). The digital media space at Georgia Tech linked several physical locations into one virtual bullpen via video and audio links. In both media spaces, cameras and microphones were often pointed at common areas in addition to individual offices. Each of these media spaces has been used extensively by an author of this paper.

SHARED SPACE

One of the design dimensions of network communities is developing a sense of persistent, shared space - an environment that frames the presence of multiple actors and provides mutual awareness. The shared space of a network community offers the potential for verbal and non-verbal communication at all times, but the space does not exist only when explicit communication is taking place. There is a "there" there, even when participants are quiet or absent.

Spaces with Boundaries

Observation: Spatial boundaries support and define social interactions and the development of social networks.
In a MUD, the organizing metaphor of the space is a virtual geography, a spatial layout of connected places or "rooms". At any moment, every person and object is located in one particular place, with its own identifying features and position in the geography. These distinct locations partition the space into areas that support different social groupings, since the mechanisms for communication and action are sensitive to the room boundary. When a participant "says" something, only those in the room "hear" what has been said. The room also provides a boundary for sharing objects. For example, when someone tosses a frisbee, others in the same room see the action; in Jupiter, where objects can have graphical presentations, a checkerboard can only be seen and played with by people in the room with the checkerboard. Places in a MUD acquire particular objects and a history of particular inhabitants or activities, which are cues for future interactions. As in the physical world, boundaries make the social setting more comfortable.

Implication: Partition online spaces to provide levels of interaction and awareness.
Using the room as a boundary for co-presence is intuitively easy to understand; it makes sense that your comments can be heard by people in this room, but not by people in other rooms. However, strict adherence to the spatial metaphor is limiting for designers and users. In MUDs, there is a disjuncture between the constraining properties of the physical world and the navigation and communication possibilities in the MUD. The spatial metaphor is a good starting point, but participants routinely go beyond it to establish new and useful capabilities. For example, chat channels permit spatially-scattered users to talk as if they were in the same room together, and teleportation allows instantaneous movement to a different place.

Communication channels are popular in Pueblo. Though it may not be aesthetically satisfying to transcend the geographic metaphor, channels provide a useful capability that has been appropriated by participants of all ages. People have created channels for conversational themes, social groups, project groups, and on-line help episodes. However, there is nothing about the spatial metaphor itself that leads users to believe that a channel capability exists. Users have to be taught about channels, and in the textual command interface, people routinely have problems remembering channel-related commands.
Spatial boundaries provide useful support for social interactions and the development of social networks. But it is also important to support extensions to, or even breakage of, the spatial metaphors in network communities. However, the disadvantage of metaphor supersets is that users may not easily discover or learn the added functionality [17].

Implication: Pay extra care when adding features that transcend spatial metaphors.

Space and Social Organization

Observation: Spatial layout can both reshape and reinforce social groups and conventions.
In the version of Jupiter used at PARC, the theme for virtual places reflects the workplace setting. Instead of treehouses, castles, or beach shacks, rooms are typically designated as offices and lab areas, which are clustered to reflect the organizational groupings (labs and projects) at PARC. Mynatt's virtual office in Jupiter is located in the Computer Systems Lab area and O'Day's office is in the Systems and Practices Lab area, just as their offices are in real life.

Jupiter's office metaphor is ambiguous about whether it is intended to help people cross organizational boundaries or work more effectively within them. Participants have found the environment useful in providing awareness of distributed team members, and a few have used group areas to provide locations for storing shared resources or holding online meetings. The Jupiter team members, whose offices are scattered throughout the building, use Jupiter extensively for collaborative work.
Some participants, however, reported uncertainty about the proper etiquette of wandering around to different labs and offices. The virtual Jupiter Lab was a hub of online activity, since the Jupiter designers were usually present there. It attracted visits from other participants, but some non-Jupiter team members were not sure whether it was acceptable to hang around or to take part in conversations there. A few people left hints of their own social expectations to people who might visit their own offices, such as a guest book or whiteboard with an inviting message.
Almost no Jupiter users we have talked with reported holding a conversation with someone they didn't already know. Since Jupiter's metaphor was based on existing organizational structure, its users adhered to that structure, refraining from substantive interaction that would be the basis for reshaping communities.
Implication: Design the online space (e.g. naming, contents, ambience, and connectivity) to fit the social activity and expectation of the user community.

Spatial Metaphors and Physical World Affordances

Observation: Media spaces reinterpret physical space through the positioning of the audio and video elements.
Media spaces have been used to support conversation and awareness across different physical locations, such as offices, coffee areas, and meeting rooms[2][3][8]. While MUD places are purely virtual representations, media spaces have been described as providing a new kind of hybrid place with both virtual and physical elements[12]. In these hybrid places, there are physical affordances of the media that may or may not match the spatial metaphor maintained by the media space.

A media space creates a common area for interaction among media space participants, but the ambient properties of the audio and video communication media have the effect of including features of each local environment in media space interactions as well[8]. At each access point, "extra" people might come and go, and the views of who and what are arranged around primary speakers are relevant. In a media space that connects offices, sound may be projected or picked up from beyond the boundaries of the office, or may fail to be projected or picked up throughout the office.

It is useful for designers to conceptualize media space boundaries to have the permeability and flexibility of the physical spaces from which the media space is accessed. Instead of labeling a video window as "Annette Adler," it would be more appropriate for it to read "Annette's office." Upon seeing Vicki in the video window, the reaction is now "Vicki's in Annette's office" rather than "That's not Annette." The community of the media space is broadened, including people who regularly pass through these spaces. It is also important that users be able to participate as authors of the virtual environment by positioning cameras and microphones to capture different portions of their physical worlds. In [8], Dourish relates how Bellotti rearranged her camera to allow Dourish a view into the hallway as well as her office, so he could see other people who were part of her local environment. In each local setting, different features of the physical environment will be relevant, and these must be expected to change over time as the social uses of both the physical and hybrid environments change.

Implication: The varying boundaries of a/v elements (e.g. sound and video) should work in tandem with the extended media space (e.g. hallways, passersby and ambient sound).

MANAGING THE "REAL" AND THE "VIRTUAL"

Network communities are conglomerates of people, practices, and places that are both computationally and otherwise embodied. They are neither transparently virtual nor physical, and a myriad of technical and social structures and conventions are required to manage the linkages and disjunctures between computational and "real" elements. Some issues in managing these relationships are discussed below: identity and representation of people and objects, managing spatial relations, and reshaping activity.

Identity and Representation

Observation: Social acts in network communities grow out of pre-existing social conventions.
One of the central problems in designing network communities is managing references, representations, and identity between "real" and "virtual" elements.

For example, recreational MUDs have traditionally relied on a disjuncture between real life and virtual identities for avatars, objects, and environments, in order to support a robust fantasy role-playing situation. Much of the research around these MUDs has focused on ways in which online participation enables alternative and decentered identities through mechanisms of anonymity, pseudonymity, and alternative embodiment [1][14][21]. While these studies vary in the degree to which they tie the formation of virtual identities into real life (RL) contingencies, all describe ways in which online identities are at least partially decentered from RL identities.

When turning to professional or educational settings, however, different concerns arise around the issue of identity and representation. While the fabric of the online environment may still provide the space for different sorts of identities or communication to occur, these identities will be formulated around activity largely originating in RL, rather than in an alternative (fantasy) activity setting. For example, teachers, administrators, and students at Longview Elementary School, where Pueblo is used, see Pueblo as an extension of the school environment. People's RL roles matter in some interaction contexts. Students, teachers, senior-citizen mentors, researchers, and others have expectations of one another based on their institutional roles. It is helpful to know who you are talking to, yet character creation and other identity play is still an enjoyable and important aspect of life in the MUD. To address both needs, Pueblo characters have both a description (in character) and an "info" property, which by convention describes something about this person in real life.
Implication: Provide identity markers (e.g. name, age, profession) that draw on pre-existing social conventions leveraged by the online community.
Systems such as media spaces and Jupiter have worked to manage online identity by projecting video and audio from the physical workplace into the virtual world, thereby introducing relatively literal representations of users and their environments into the virtual space. Identity is "authored" by producing the desired visual and auditory effect through the available AV channels and configuration of real life situations. While not seamless, the relation between real and virtual identities is relatively tight in comparison to recreational MUDs.

Additionally, Jupiter, as a hybrid text and AV system, uses multiple media for online representation. There is a lack of accountability, however, between the text-based and video representations, since both refer to the same real spaces and people. The text-based office may be configured entirely differently from the physical office represented by the video stream, or the text-based virtual identity of a researcher might be in a different room than the room occupied in real life, and captured on video. In other words, when a single real element is identified doubly in the virtual world breakdowns can occur.
Implication: Minimize conflicts in identity representations.

Managing Spatial Relations

Observation: People inhabit both the online space and the real world simultaneously.
In addition to effective representations of people and objects, networked communities also require a management of spatial relations to successfully integrate the real and virtual.

For example, we need to consider the ways in which awareness and social management of space has changed with the introduction of media space systems. It is critical to keep in mind the delegation of control, visibility, and hear- ability to remote locales and technologies. Audio and video can be projected at a remote site in ways that the person being represented has no control over; private conversations could be projected into hallways, or visitors to an office might not be aware that their image was being captured on camera. While feedback of one's own audio and video might help mitigate these concerns, it seems likely that media spaces require a strong sense of trust or cohesive social conventions in order for them to be used effectively in private or semi-private spaces[8].

In text-based MUDs, conversely, physical information about a remote locale is systematically unavailable to online participants, and can only be made accessible by explicit acts of representation. For example, the fact that two users are logging on from the same physical space is unknown to other users of the system unless written by one of the co- located users, and a RL conversation could be occurring concurrent with an online one. MUD users face certain problems due to the lack of spatially based information; one might wonder at the silence of an online interlocutor as she needs to answer the door or is not attending to the monitor. Such situations have been resolved by some MUD users by quickly typed indicators of real life activity, such as "brb" (be right back) or "lol" (laughing out loud).
Implication: The online space and the real world may need to share information about events occurring in their respective space.

Reshaping Activity

Observation: Activities in one space do not translate transparently to other spaces.
In addition to grappling with how to identify and describe people, objects and places, network communities must also deal with issues around managing social interaction and activity across real and virtual domains. Mechanisms for social interaction, such as indicating the presence of a new conversational partner, may vary significantly across domains. These issues are related to, but not isomorphic with, the technical problems of representation and identity.

In text-based MUDs, interactional possibilities that are modeled on other media of interaction must all be translated into a text-based medium; most obviously, speech and bodily movement are translated to typing, and all modalities of vision are translated to reading. These translations enable a robust fantasy environment and forms of activity that defy the physical constraints of real life (i.e. easy construction of space, teleporting, multiple private conversations, killing monsters). Conversely, to overcome limitations in text-only modalities, users might attempt to model embodied action in pictoral forms. An example from Pueblo illustrates a translation of this sort:

A warm fuzzy feeling approaches you...

HugHugHugHugHugHugHugHugHugHugHugHug
HugHugHugHugHugHugHugHugHugHugHugHugHug
HugHugHugHug HugHugHugHug
HugHugHugHug Tinlizzie HugHugHugHug
HugHugHugHug HugHugHugHug
HugHugHugHugHugHugHugHugHugHugHugHugHug
HugHugHugHugHugHugHugHugHugHugHugHug

You've been enveloped in a warm hug by Hobbes.

With media spaces, the translation of interaction and practice across domains is both enabled and constrained by the AV channel. The greater sensory richness of media spaces creates a sense of transparency between the real and the virtual, where online activity more closely reproduces conventionally embodied action. Even here, however, users must orient to the specific affordances of the medium which are not isomorphic with real life[13]. If we were to take a meeting as an exemplary workplace activity, the network version would require new conventions for managing the comings and goings of people in the

physical office. A visitor off camera might require acknowledgment for the online participants, and conversely, a RL interlocutor needs to be informed that one is in a meeting online and is not to be disturbed lightly. Further, embodied conventions of glancing, pointing, or gaze direction require translations to be effective online; Jupiter users wanted an online pointer or ways of indicating conversational addressees.

In terms of institutional practices and accountabilities, an example from Pueblo is instructive of issues in translating between the real and virtual activities. With Pueblo's classroom orientation, it has also been natural to experiment with translations of existing classroom practices and artifacts in the new context of the MUD. For example, in RL, Longview students routinely carry out a "plus-delta" session at the end of certain activities, as a way of evaluating how they turned out. Students are given yellow stickies on which to write a "plus" (something that went well) or a "delta" (something that should be changed next time). When they have written their comments, they carry them to the front of the room and place them in the appropriate column of a sheet of poster paper.
Early in Pueblo's history, teachers requested online plus- delta rooms. Though both plus-deltas are anonymous, in the physical-world version students have to walk to the front of the room to place their contributions. Students in Pueblo are co-present while doing plus-delta, but the order and attribution of contributions are not shown, though a list of total contributors is available. Teachers have consistently noticed a jump in the number of students who contributed in the online version, especially including the shyer girls in their classes. This example shows some of the subtleties of the translation process. Designers have different levels of anonymity and awareness available in the MUD, which reshapes even activity modeled on RL.
Implication: When translating pre-existing activities into a network community, focus on the social goals of the activity in relation to the particular affordances of the online environment.

EVOLVING COMMUNITIES

This section applies some social scientific insights to network communities, providing a more global discussion of necessary conditions to support community development. A network community is a conglomerate of social, technical, material, historic, and environmental factors, and technology design must be understood as one ingredient within this field of relationships. By invoking a notion of community, despite the pitfalls of addressing such a diffuse concept, we have tried to insist on attention to more than just technical factors. We see technosociality, learning, and history/change as three critical aspects of successful network communities.

Technosociality

Observation: Successful network communities allow for flexible and complementary coupling between technical and social elements.
Lessons from a variety of work in science and technology studies indicate that networks evolve out of flexible couplings between technical and social systems, to the extent that the two become conceptually inseparable [11][15]. We borrow this notion of technosociality, and suggest that networked versions of community happen when opportunities for change, repair, and relationality span and integrate both technical and social domains. It is not just possible to layer social conventions and policies around technical mechanisms: it is necessary to do this in order to develop a robust and socially cohesive environment. For example, media space users developed ways of adjusting camera placement to inform other users of availability for interaction or wish for privacy. In MUDs, the same technical capability of room building is often differentiated through user-authored descriptions and conventions, which flag private homes and public areas.

Design decisions and ongoing social interaction feed back into one another continuously. For example, designing an entry-point to the online space has consequences for subsequent social interaction; entering into a public square versus a private office has profound implications for the development of social interactional conventions. Conversely, social practices might develop which work around this design element, as users navigate to and from public and private spaces as locations to idle in. As network community participants and designers gain experience with the properties of their spaces, a more self-aware and technosocial approach to design becomes more common. This approach to design might rest crucially

on the blurring of the categories of designer and user; in every network community we have participated in, the people with the most control over technical innovation were also participants in the community.
Implication: Unreflective and rigid linking of system primitives should be avoided. Ongoing and changeable design, which is as explicit and participatory as possible for users, is a preferable model for development.

Learning Opportunities

Observation: Successful network communities provide both technical mechanisms and social practices that allow for learning.
In order to understand learning as a component of community development, we borrow from Jean Lave and Etienne Wenger's "community of practice" approach, which locates learning as a mode of participation in a community (in contrast to a purely cognitive process) [16]. The sustainability of a robust network community rests on opportunities for learning [16] that leverage both social practices and technical mechanisms.

Technosocial practices for how to engage with newbies are well-developed in robust network communities; MUDs will often have "helpful person" markers for those willing to teach; in combat MUDs, there might be a special "newbie forest," toward which more experienced players will direct newcomers, often with advice and a gift of some weapons and armor. In Jupiter, while core members developed effective social conventions for interaction, peripheral members often lacked a sense of social norms and opportunities for learning, leading to a sense of unease around appropriate behavior. We believe that this disjuncture was a result of both the existing social divisions in the workplace (between, for example, computer scientists and administrator groups), and a lack of technical mechanisms that support social interaction between newcomers and experienced members.
Implication: Systems should support spaces and mechanisms for new players to feel welcome and so they are able to interact with experienced members.

History and Change

Observation: Network communities are located in historical trajectories of social practice and change; in particular, shifts in membership population often require reconfiguration of technosocial conventions.
History and change are crucial to network communities; communities adapt and evolve in response to changes in their ecology and changing spheres of activity. Network communities arise out of and partially reshape existing and historical sets of social practices. We have considered workplace practices, recreation, and education. For example, we discussed how users of media spaces reshaped their space and activities after the introduction of the new system, while still working to accomplish their ongoing work. In this section we focus on changes to network communities brought about by shifts in membership.

When a network community is new, the early participants tend to get to know one another well and understand the purposes for which the community has been formed. Larger populations bring new, diverse agendas for participation and more diffuse interrelationships across the community. The case of LambdaMOO, where an online "rape" led to a virtual (and technically implemented) death penalty and a democratic process, is perhaps the most publicized account of a network community grappling with growth and the need for new technosocial conventions [6].

The response to population shifts can also draw from a familiar model of an iterative design-use cycle. For example, in Pueblo a large influx of new teachers helped the community to understand the administrative capabilities teachers needed in the environment; they needed to be able to change students' passwords, increase a student's building allowance, create new characters for incoming students, and do other operations that had been privileged in the MUD system to the wizard class of characters. A new teacher utilities package was developed to give all teachers the capabilities they needed.
Another response to a shift in population diversity and size can be to reinterpret existing mechanisms in new ways. For example, the wizard role mentioned above represents a set of technical capabilities that reach deeply into the technical substrate of the MUD. In many MUDs, wizards are also associated with community leadership in social arenas; they are naturally positioned as leaders through their extensive

participation and service. As part of the discussions that spurred the development of the teacher utilities mentioned above, the wizard role was articulated as an "admin" role, providing a technical service to the community but not holding final decision-making authority in areas of social policy. Other network communities have gone through similar redefinitions, e.g. [4].

Implication: Designers should anticipate the need for redesign by paying attention to existing practices as well as the changing demographics of the community.

Future Directions

We suggest further technosocial features that characterize network communities, which we have not had the space to address. These might be considered characteristics general to community, which we believe are elements of successful network communities:

- **Temporal continuity:** Network communities require long- term participation, opening up opportunities for learning, adaptation and change.
- **Social and interactional rhythm:** The livability of network space requires the ability to pursue different but reliable social rhythms for interaction. These include engaged conversational rhythms as well as different degrees of proximity and awareness.
- **Sense of membership and identity:** Network communities require an awareness of who is co-present, and what their relational status is. One must be able to identify membership categories such as newbies or guests, whether they are explicitly represented or diffusely understood.
- **Boundaries and conventions:** Users must have access to an understanding of boundaries, both in the sense of control of and limits to objects and places, as well as shared social parameters of action. This would include various tacit knowledges, recognitions of appropriate and inappropriate behavior, and a sense of trust and shared frames in interaction and the deployment of technology.

CONCLUSIONS

As individual designers, each of us had our own experiences with what we would come to call network communities. As we tried to understand what MUDs and media spaces were an instance of, we first focused on technology characteristics, such as persistence and real time interaction. These discussions led us to describing the experiences that resulted from these technologies. By telling stories of living, working and playing in MUDs and media spaces, we began to appreciate the interdependence of community and technology. What we discovered were the design dimensions of network communities that we have discussed in this paper. We do not insist that these are the only design dimensions of network communities. On the contrary, our future efforts will include exploring new dimensions. These dimensions, however, were the most compelling for us to explore first.

As persistent environments, network communities require a sense of shared space that is independent of the actions of individual users and matches the intended social functions of the space. The space needs to support flexible boundaries for levels of interaction and awareness. The authoring of boundaries also enables inhabitants to partition the space for different uses. The space must be navigable across these boundaries and must support breakages of spatial metaphors.
The virtual space of a network community does not exist in isolation from the physical world, and designers must manage the interrelationship between these two spaces. Social acts in network communities are based on pre- existing social conventions. To facilitate interaction in the virtual space, markers (such as identity, age, profession) key to pre-existing practices must be available in the virtual space. Since persistent spaces (real, virtual) intersect, designers may need to make information about one space (such as co-presence) available in another space. Finally, designers will need to experiment with translating actions from one space to another. In some cases, new practices will replace the utility of actions from another

space. (How does someone clear their throat in a text-based MUD?) Likewise, designers should not be surprised as practices evolve when they are translated to a new space.
Network communities exist at the intersection of complex technical and social systems. Neither technology or sociality can supplant the need for the other, and the two are conceptually inseparable. This interdependence requires a flexible coupling between the two systems so that the same mechanisms can be appropriated for different uses. Likewise, the technical and social systems must be able to evolve to meet the needs of a changing community. As inhabitants author their network community, they will want to modify technical and social elements in tandem as one, loosely coupled system.

REFERENCES

[1] Allen, C. Virtual Identities: The Social Construction of Cybered Selves. Ph.D. Dissertation, Northwestern University, June 1996.

[2] Bellotti, V. and Sellen, A. Designing for Privacy in Ubiquitous Computing Environments, Proc. European Conference on Computer-Supported Cooperative Work, ECSCW `93. Milan, Italy. September 1993.

[3] Bly, S., Harrison, S. and Irwin, S. Media Spaces: Bringing People Together in a Video, Audio and Computing Environment, Communications of the ACM: v.36, n.1, January 1993.

[4] Cherny, L. The MUD Register: Conversational Modes of Action in a Text-Based Virtual Reality. Ph.D. Dissertation, Stanford University, December 1995.

[5] Curtis, P., Dixon, M., Frederick, R. and Nichols, D. The Jupiter audio/video architecture: secure multimedia in network places. Proc. MM'95. San Francisco. 1995.

[6] Dibbell, J. A Rape in Cyberspace or How an Evil Clown, a Haitian Trickster Spirit, Two Wizards, and a Cast of Dozens Turned a Database Into a Society. parcftp.xerox.com./pub/MOO/papers/rape_in_cyberspace. 1993.

[7] Dourish, P. Culture and Control in a Media Space. Proc. European on Computer-Supported Cooperative Work Conference, ECSCW'93. Milan, Italy: September 1993.

[8] Dourish, P., Adler, A. Bellotti, V. and Hendersen, A. Your Place or Mine? Learning from Long-term Use of Video Communication." Computer Supported Cooperative Work: An International Journal, July 1996.

[9] Gaver, W. The Affordances of Media Spaces for Collaboration. Proc ACM Conference on Computer-Supported Cooperative Work, CSCW'92. Toronto, Canada. Novermber 1992.

[10] Grudin, J. interface. Proc ACM Conference on Computer Supported Cooperative Work, CSCW'90. Los Angeles, California. October 1990.

[11] Haraway, D. A Cyborg Manifesto: Science, Technology, and Socialist-Feminism in the Late Twentieth Century. Simians, Cyborgs, and Women. 1991.

[12] Harrison, S. and Dourish, P. Re-Place-ing Space: The Roles of Place and Space in Collaborative Systems. Proc. CSCW 96, Cambridge MA, ACM Press. Nov. 1996.

[13] Hollan, J. and Stornetta, S. Beyond Being There. Proc ACM Conference on Human Factors in Computing Systems, CHI'92. Monterey, CA May 1992.

[14] Ito, M. Virtually Embodied: The Reality of Fantasy in a Multi-User Dungeon. In David Porter Ed.,

Internet Culture. New York: Routledge. 1996.

[15] Latour, B. Science in Action. Cambridge, Harvard University Press. 1987.

[16] Lave, J. and E. Wenger Situated Learning: Legitmate Peripheral Participation. New York, Cambridge University Press. 1991.

[17] Mynatt, E. and Edwards, W.K. Nonvisual metaphors for Computing Environments, in Extra-Ordinary Human-Computer Interaction, edited by A. D. N. Edwards, New York: Cambridge University Press, 1995.

[18] Nye, David. Electrifying America. MIT Press. 1992

[19] O'Day, V.L., Bobrow, D.G., and Shirley, M. The Social-Technical Design Circle. Proc. CSCW 96, Cambridge MA, ACM Press. Nov. 1996.

[20] Smith, I. and Hudson, S. Low Disturbance Audio for Awareness and Privacy in Media Space Applications. Proc. MM'95. 1995.

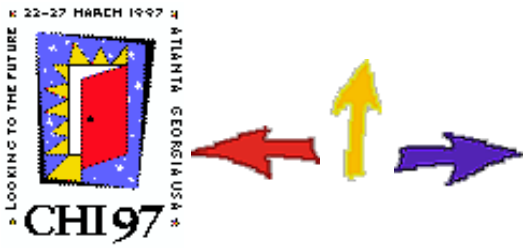
[21] Turkle, S. Life on the Screen: Identity in the Age of the Internet. New York: Simon and Schuster. 1996.

[22] Yates, J. Control through Communication: The Rise of System in American Management. Baltimore: The Johns Hopkins University Press.

ENDNOTES

[f1] Media spaces (whether analog or digital) are multimedia environments connecting geographically dispersed spaces [2][3][7][9]. MUDs are computationally-based environments that provide access to a persistent, online "world." MUDs allow users to establish and describe their worlds and interact or collaborate according to preestablished themes such as combat, education or professional activities. MUDs minimally offer a text-based command-line interface, and in some cases a more graphical or animated display.

[f2] In particular, we draw on our experiences with Pueblo [19], a text-based MUD for a K-6th grade educational community; recreational MUDs [14]; Jupiter, a multimedia MUD at Xerox [5]; the analog Media Space [2][3][8] used by Xerox PARC and EuroPARC; and the digital media space [20] at Georgia Tech.



CHI 97 Electronic Publications: Papers