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Network Communities: Something Old, Something New, Something Borrowed . . .

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Abstract. Collaboration has long been of considerable interest to both designers and researchers in the CHI and CSCW communities. This paper contributes to this discussion by proposing the concept of network communities as a new genre of collaboration for this discussion. Network communities are robust and persistent communities based on a sense of locality that spans both the virtual and physical worlds of their users. They are a technosocial construct that requires understanding of both the technology and the sociality embodying them. We consider several familiar systems as well as historical antecedents to describe the affordances these systems offer their community of users. Based on our own experience as designers, users and researchers of a variety of network communities, we extend this initial design space along three dimensions: the boundary negotiations between real and virtual worlds, support for social rhythms and the emergence and development of community. Finally we offer implications for designers, researchers and community members based on our findings.

Key words: Affordance, identity, media space, MOOs, MUDs, network community, technosociality

1. Introduction

The CSCW community has long recognized the importance of collaboration in the context of informal, awareness-rich, and serendipitous practices of long-term collaborators. In this paper, we extend this discussion by describing an emergent genre of collaboration: network communities. Network communities are robust and persistent communities based on a sense of locality that spans both the virtual and physical worlds of their users. Drawing on prior work as well as our own experience, we offer observations about these technologically-mediated communities and suggest design implications associated with them. This discussion will be based on an understanding of the affordances of the technologies used to support network communities and their relation to other forms of community.

Community as a social phenomenon deals with establishing and working with meaningful connections between people. Technology has always played an important role in this (Dourish, 1993; Grudin, 1990). 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) (Nye, 1992), task-focused or work-modeling solutions (memos, forms, manuals) (Yates), and one-to-many broadcast solutions (radio, TV, newspapers) (Nye, 1992; Yates, 1989). 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:

- Point to point connections tend to support individual interactions, not multiple 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 have attempted to address these concerns by creating persistent, predictable, multi-user connections that support a wide range of user interaction and collaborative activity. Media spaces (whether analog or digital) are multimedia environments connecting geographically dispersed spaces. In contrast to teleconferencing, these *persistent* video and audio connections create a new sense of locality by bridging these separate spaces. MUDs are computationally-based environments that provide access to a persistent, online "world". Like media spaces, these persistent, flexible, multi-user environments can generate a sense of a known virtual place that can be inhabited and shaped by an emerging community.

This paper is a reflection on our previous and ongoing experiences as designers, users and researchers of media spaces and MUDs. Stemming from our initial discussions, we worked from a shared intuition that these seemingly different environments demonstrated common technical and social affordances for nurturing community. We use the name *network communities* to refer collectively to these environments. Although many other technologies such as chat, net news and email share some of these technological capabilities, we argue that media spaces and MUDs are exemplary systems in that they were designed to support multiple aspects of network-mediated communities. In this paper, we describe these common capabilities or affordances as well as common design implications in the genesis and sustenance of network communities. Some of these observations will be familiar, as they have also been noted by designers and users of individual systems. Our

goal is to weave a collective pattern illustrating the richness and intertwined issues of technology and sociality, design and use.

In this paper we primarily refer to four systems: Pueblo, Jupiter, the analog media space used at PARC and EuroPARC, and the digital media space used at Georgia Tech. Although this work is a reflection of past experiences in contrast to a planned case study or an exhaustive survey, these system represent a diverse spectrum in the technology employed, the demographics of the inhabitants, the applications and motivations for their use, and their physical settings. The authors also represent diverse perspectives as users, designers, and researchers with different backgrounds and expertise. One shared characteristic is that all of these systems have been used for multiple years by small to medium-sized communities (under 1000 people).

Pueblo (O'Day et al., 1996) 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. Pueblo is a network community with both geographically distributed and co-located members. Activities in the classroom and other physical settings play an important part in shaping online activity in the network community. Pueblo members also depend on reliable rhythms of interaction and newcomer orientation practices to establish a robust sense of community.

Jupiter (Curtis et al., 1995) 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. As a MUD with live video and audio, Jupiter creates an intriguing, and sometimes contradictory, virtual space. Also, its use among members who are located near each other physically and organizationally highlight different relationships between physical and virtual space.

The analog media space used at PARC and EuroPARC supports 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. Although simpler technologically compared to MUDs, media spaces create another form of persistent virtual space engendering many of the same issues in communication and authorship. Additionally, the differing reaches of the audio and video links create a complex boundary of the space

and provide opportunities for creative construction and well as misunderstandings and social faux pas.

Our approach to network communities includes participation and use, ethnographic observation, and design. The theoretical and analytic frameworks we draw on include: participatory design approaches, computer-human interaction studies, research in interface design, social, historical, and cultural studies of technology, and architecture and urban planning. We also draw from previous research on Internet-enabled communities, including social scientific studies (Allen, 1996; Cherny, 1995; Ito, 1996; Turkle, 1996), journalistic treatments (Dibell, 1993; Goldberger, 1995), CSCW (Ackerman and Malone, 1990; Bly et al., 1993; Harrison and Dourish, 1996; Carroll et al., 1996; Dourish et al, 1993; Orikawski, 1992), architecture (Mitchell, 1995) as well as design studies reviewed below. Our work differs from most previous studies of Internet-enabled communities in that it involves an integration of multiple disciplinary perspectives as well as experience with many related systems. We see the strength of this approach not in the depth of coverage of any particular system or set of practices, but rather in the effort to abstract a series of insights from a cluster of different, but interestingly related experiences of our research team. Each member has analyzed at least one particular system or set of practices in depth. The data we draw on include: interviews of Jupiter, Pueblo, and combat MUD users; multi-year online participant observation in Jupiter, Pueblo, mediaspaces, and combat MUDs; classroom observations of Pueblo users; videotape of Jupiter use for design meetings; online transcripts for Pueblo; and design experiences. Insofar as our research team is comprised of people who have each played multiple roles, including users, designers, and researchers, we see the analytic perspective of this paper as related to a model of participatory design and action research, where the perspectives of research, design, and practice are articulated in relation to one another (Suchman and Trigg, 1991).

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. 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, drawing on relevant notions of community and the relationship between community and technology. Using media spaces and MUDs as starting points, we describe the particular affordances of network communities. This discussion highlights the important interrelationship between technology and sociality in these environments. We then explore three major design dimensions: the relationship between the "real" (physical) and "virtual" (computational); the rhythms that underlie interaction among inhabitants; and the constant reformulations of social practice and technology use in these communities due to change and learning. 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.

2. Communities and technology: Toward network communities

In the introduction, we described the idea of network communities as embodying a particular technological design direction in supporting robust collaborative activity. In this section, we briefly review some understandings of community from both theoretical and practical directions, considering some past examples of relations between community and technology. We then conclude by characterizing technologically-mediated communities in more detail to set the stage for our subsequent discussions.

2.1. Understandings of community

The notion of community has a long and complicated history in relation to social scientific theorizing, and it is not our intent to comprehensively review this literature. Rather, we discuss the relevant trends in the conceptualization of community as background for describing the new kinds of social formations that we point to with the term "network communities".

In social scientific literature, community is often a taken-for-granted category of social group, characterized by such things as ongoing face-to-face interaction, spatial proximity, and shared institutions such as religious institutions, kinship, or schools (Hillery). Some of the foundations for these understandings of community can be traced to nineteenth and early twentieth century social theorists and planners, who tended toward conceptualizing human society as progressive and evolutionary. Community was seen as a step along the way – but one associated with "primitive", small-scale, and premodern social formations (Durkheim, Lewis, Maine, Redfield, Tonnies, Weber). The ties that bound people together in such communities – close proximity, kinship, status, and folk culture – were seen as likely to give way with the advent of modern industrial society. This dissolution of community was viewed largely as a good thing. In fact, the continuation of communities was seen at first as dysfunctional – holding people back from taking advantage of the wonders of modern life.

Subsequent work on communities – for example, in sociology (Lynd and Lynd, 1930; Whyte, 1941) and architecture and urban planning (Jacobs, 1961; Mumford, 1961) – began to consider some of the more positive dynamics of community as it persisted in modern societies, looking at such issues as how communities promoted social integration as well as a healthy diversity. Instead of seeing community as a fixed (and obsolete) type in contrast to modern society with its egalitarian individuality, community began to be seen as the basis for considerable meaning and support. Later theorists (Jankowski) came to see community as an achieved

social construct, a nexus of mutual ties and orientations, and the basis for people fitting into the context of both local and wider society. In other words, while the nature of community might be different in modern and premodern societies, in both cases, community points to relatively small-scale social groups that are crucial to social life. For example, neighbor associations concerned with children and safe playgrounds might play a similar role in some communities as extended families and kinship formerly played. Planners increasingly saw the role of design in supporting orientation and meaning for communities, particularly in light of the disastrous experiences with urban redevelopment and public housing (Jankowski, 1991; Witold, 1992).

Drawing from these conversations, we see community as a particular kind of social production, one that grows out of both enduring features of small-scale social groups, as well as a shifting landscape of social relations, design efforts, geographies, and technologies. We extract three broad defining features of community to guide our subsequent discussion:

- Community is a *local* form of social group in the sense that it is based on bounded and relatively small-scale sets of relationships. We depart from a necessarily spatially determined notion of the local, and suggest that the boundaries of a community can be various: spatial, relational, technological, institutional, etc.
- Community is based on *meaningful and multi-layered relationships*. In other words, community is not only a local social group, but one that is characterized by dense social relationships that are significant and persistent for members. For example, while a local social group might be defined by people who consume a particular brand of breakfast cereal, this group would not constitute a community unless the ensuing relationships were meaningful for members, and they extended beyond the single practice of consuming a particular product. These relations become a mutual source of orientation and definition of what's appropriate and what's not – that is, they begin to establish the terms of social responsibility and expectations within the community.
- Communities are *dynamic* and are always under development. They require constant processes of production, reproduction, and evolution. While some communities may be relatively stable in size and organizing features, they are never static. Every community needs to reproduce itself or adapt to survive across generations.

Further, we would like to use the term community to stress the *continuities* between premodern, modern, and postindustrial forms of social life, not by romanticizing or essentializing a notion of "primitive" sociality but rather by stressing the ways in which local groups have *always* been produced in the face of a shifting and interconnected set of social, geographic, and technical relations (Gupta and Ferguson, 1992, p. 8). Our theoretical stance on community follows some of the current work in cultural studies around global/local relations (Appadurai, 1995; Gupta and Ferguson, 1992; Strathern, 1995): we suggest that locality and community are

complex productions that occur at the intersections of translocal flows of people, technologies, media, and resources of various kinds. Our focus on computational technologies focuses on global informational networks, but fundamentally, we see network communities as just one more variation on a historically resilient theme of community.

2.2. TECHNOLOGY AND COMMUNITY

While Internet-enabled social groups may seem to uniquely feature the role of technology in constituting community, we would like to highlight the historical role of technology in community. Technology has always been involved in the production of locality and community. For example, Arjun Appadurai has pointed out that the traditional technological objects of anthropological study, such as house building, garden cultivation, and the like, can all be reconsidered as part of the spatial production of locality (Appadurai, 1995, p. 205). Other forms of technology that might be relevant to the production of community are transportation, food production, waste disposal, agriculture, irrigation, architecture, distribution, and industrial production.

When examining the relation between technology and community, it is important to keep in view the ways in which technology and sociality are intertwined in the constitution of community. Technosocial constructs such as communities evolve out of flexible couplings between technical and social systems, to the extent that the two become inseparable. We borrow this notion of "technosociality" from a variety of work in technoscience studies (for example, Bijker, 1995; Haraway, 1991; Hughes, 1987; Latour, 1987). For example, just as cities, street layouts and sewer systems bring people together, they also redefine how those people see themselves and live.

Certain technologies reshape notions of physical space and proximity. A car moves faster than a person walking and hence redefines the idea of how far a person can get easily in ten minutes – which redefines what might be considered local. "Spanning technologies" (Kern, 1993) such as bikes, radio, TV, telephones and telegraphs, and autos have each, in turn, led to reconceptualizations of time and space, and hence of what it means to be local and the possibilities for human interconnection. The impact of this reconceptualization has been interesting; in some situations, locality has been strengthened even as it has been extended and distributed. For example, Benedict Anderson's historical study of the role of print media in constructing "imagined communities", is a foundational work in this vein. He links the development of printing technologies to the rise of language communities, and the ability to imagine the nation state as a community of shared sociality. At the same time, locality has been threatened or even subverted by the increased standardization supported by spanning technologies such as television. In this sense, spanning technologies do not necessarily mean either a fragmentation or reinforcement of a particular definition of the local. The combination of particular

technologies and their affordances, on the one hand, and particular communities and their dynamics, on the other, makes for particular outcomes.

2.3. Affordances of network communities

Internet technologies can be considered one of the more recent form of spanning technologies, and one amenable to new reformations of community. The particular affordances of these technologies in the context of varying social agendas leads to new methods for forming and maintaining community. Affordances refer to what an environment *offers* – relative to the person or group perceiving or recognizing that quality of the environment (Gibson, 1979, p. 127). Gibson, and others (Gaver, 1992) use the term ecology to refer to this combination of environmental capability relative to those who recognize it.

Analyzing network communities in terms of their affordances is appropriate because the network communities emerge from the intertwining of sociality and technology. It is the appropriation, and re-appropriation, of technology to accomplish the daily workings of social life that influences the character of a network community, including its eventual failure or success. Affordances suggest and support this appropriation. In this section, we discuss five affordances of network communities that appear to span the various technologies used in Internet-based communities.

Persistence

Network communities offer a perceivable sense of persistence. They 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 some objects may be more persistent than others. This sense of enduring ecology is crucial and contrasts with particular activities that may happen within the context that are short-lived (e.g., communication channels). At the same time, this ecology includes the physical as well as the virtual worlds within which the participants live. So the sense of persistence must be addressed in some manner in each part. Once a network community is perceived to be persistent, ecological changes can be comprehended as social acts. The ability to perceive and interpret change is crucial to the formation of social structures.

Periodicity

Network communities have many palpable senses of periodicity, established and communicated through a variety of rhythms and patterns. This periodicity bounds how activity and time are recognized and made meaningful in the community. For example, the pace of a timely response via email is likely different than via a chat room. Likewise periodicity establishes the sense of remoteness or unresponsiveness

relative to the particular technology in use. As with persistence, periodicity allows users to perceive and interpret routines as well as deviations from the these – providing a base for the mutual production of expectations about social life within the community. This feature is required to establish and sustain the community both from situation to situation and over time. What is unique about network communities in this regard is that periodicity derives from both the virtual and physical worlds together, since participants inhabit both.

Boundaries

Network communities rely on mutually understood differentiation of units, from single to multiple, from proximate to remote. This ecology relies on notions of boundaries to define and distinguish these units in both physical and virtual space and time and achieve that differentiation. That is, it offers a sense of boundaries that differs dramatically from either the physical or virtual worlds alone. In a media space, the local space of the network community is created by a reconceptualization of the physical spaces connected by the a/v media. In a MUD, a spatial metaphor leads to the creation of a virtual geography of connected "rooms". The spatial boundaries within a network community afford different social groupings. MUDs have public and private rooms where the room boundary determines who can "hear" what has been said. Various types of connections in media spaces (e.g., bullpen, office share, glances) support different social groupings.

Engagement

In order to support the social rhythm and density of engagement necessary for community-building, network communities enable participants to come together in diverse ways. We do not mean just having multiple technical possibilities, such as multiple media or even multiple channels, although these spaces may indeed include both. Rather, we are pointing to the ability to participate in many different kinds of engagement and even many different engagements at the same time, using the possibilities of both the physical and virtual spaces available. Engagement in network communities is not tightly tied to a particular task or channel, but allows for different kinds of participation along several different characteristics: number of participants (1 to 1, n to n simultaneously); degree of participation (ambient awareness, peripheral, full); style of interaction (informal to formal); and opportunity (ad hoc, scheduled, private, public, and anywhere in between).

Authoring

Network communities allow their participants to use and manipulate their space, whether as designers or users, in the sorts of flexible interactions described above. But not only interactions are produced; the very ecology: social, virtual and phys-

ical, is in a very real sense available to participants to author and reauthor continuously in the process of living in and developing the community.

2.4. Further design dimensions

These affordances provide a starting point for our analysis of network communities. We would like to suggest a list of three further dimensions that must be addressed to support the evolution of collections of people using network technologies into socially cohesive communities.

First, while computer networking in some sense transcends certain forms of spatial relations, network communities are also importantly tied to space, albeit in new ways. Users are physical beings located in physical space and this too must be considered. The definition of "local" in these communities is a fusion of the virtual and real spaces. Traditional notions of community, such as membership, now must incorporate and build upon these new notions of local.

Second, the livability of network space requires the ability to pursue different but reliable social rhythms. These rhythms include routines and breaks in routine as well as interactional rhythms ranging from intermittent interaction to conversation across various degrees of proximity and awareness. Ultimately, these patterns become the basis for communal expectations and mutual intelligibility.

Our third and final dimension returns us to the more general problems of community and social cohesion. Network communities also undergo constant processes of production, reproduction and development. Changes in a community such as new membership or modified charters may require reformations in the bindings between technology and sociality. New technical mechanisms may be needed or old mechanisms may be reappropriated for new uses. In this discussion, we examine events that are the catalysts for re-interpretation of the couplings between technical mechanism and social acts.

3. Managing the "real" and the "virtual"

Network communities are conglomerates of people, practices, and places that are both computationally and otherwise embodied. In other words, the definition of "local" for network communities includes both physical and virtual components. Network communities 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.* For example, representations of users and objects in online environments often draw upon pre-existing social conventions. Additionally, events in the physical space, such as

* We use the terms "real" and "virtual", hereafter, not in quotes, as a shorthand to refer to non-computational and computationally embodied elements respectively. These terms do not point to an ontological status.

the arrival of a colleague may have repercussions for events in the online space. Finally, reproducing actions, such as indicating interest in a conversation, may require new mechanisms when being adopted in an online space.

3.1. 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 anonynmity, pseudonymity, and alternative embodiment (Allen, 1996; Ito, 1996; Turkle, 1996). 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 a/v 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 a/v 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. This duality may lead to confusion as users try to interpret contradictory online representations. For example, I may try to find Annette in Vicki's online office because I can see her in the video image of Vicki's office in the physical world. In other words, when a single real element is identified doubly in the virtual world, breakdowns can occur.

Implication: Minimize conflicts in identity representations.

3.2. 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 audibility 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 (Dourish, 1996). In the design of the Georgia Tech media space system, cameras were purposely placed in conspicuous locations to inform visitors about the virtual space. The auditory space is more difficult to design since it is less conspicuous and its space extends past the video images.

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.

3.3. 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 pictorial forms. An example from Pueblo* illustrates a translation of this sort:

A warm fuzzy feeling approaches you...

HugHugHugHugHugHugHugHugHugHug
HugHugHugHugHugHugHugHugHugHug
HugHugHugHug HugHugHugHug
HugHugHugHug Tinlizzie HugHugHugHug
HugHugHugHug HugHugHugHug
HugHugHugHugHugHugHugHugHugHug
HugHugHugHugHugHugHugHugHug

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

* Hobbes and Tinlizzie are the character names used by two inhabitants of Pueblo. Their names are used with permission.

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 (Harrison and Dourish, 1996). 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.

4. Rhythm

Rhythmic dynamics ranging from co-presence to conversation, from daily routines to annual events are foundational to network communities. As the predictable

ebb and flow of activity, the rhythm of the place establishes grounds for shared expectations and comprehension of behavior.

In daily interactions, the rhythm of a MUD or media space, despite unique conversational registers (Curtis et al., 1995), shares similarities with co-located interaction, allowing inhabitants to leverage social norms based on co-location. Users can shift attention easily between foreground, intermittent, and background interactions with others, as they can in physical settings where people work side-by-side. Another similarity to co-located interaction is the potential for multi-modal communication, including speech, gestures, and shared awareness of objects. Each form of multi-modal communication includes a rhythmic component establishing the pace and duration of the interaction. By appropriating these various communication building blocks, inhabitants build associations between communication styles and social meaning. There are also important differences in the rhythm of online and face-to-face conversation. For example, near-synchronous and possibly overlapping streams of talk online offer users interesting affordances and difficulties.

These daily interactions become the basis for social routine. Each community develops a pattern of high and low energy periods, when there will be more public discussions and when most people are engaged in private conversation. The routines of individual inhabitants may be comprehensible so that deviations for these routines can carry meaning.

4.1. RELIABILITY AND INTELLIGIBILITY

Observation: Successful network communities carry intelligible rhythms of interaction and awareness, which can vary in different communities.

The rhythm of a network community is determined in part by the properties of the communication mechanisms of the community, and in part by the normal, everyday flow of activity within the community. These rhythms establish expectations of activity in the network community. For example, in a MUD or media space, real-time synchronous communication is afforded by the technology and is an important measure of activity level in the online world. The rhythm for newsgroups is necessarily much slower-paced, because of the news mechanisms and the news-reading habits of most participants. Conversations usually unfold over hours and days rather than seconds and minutes. Nevertheless, newsgroups with a sense of community have their own characteristic interactional rhythm. A hot topic in a discussion group generates a flurry of rapid responses and a corresponding sense of excitement. There are unspoken assumptions about how long one should expect to wait for a response to a new posting.

The technical infrastructure of a network community constrains the possible tempos for the rhythms of interaction and awareness. The foremost requirement

for this infrastructure is supporting the reliability, the therefore the intelligibility, of these rhythms. Although the *use* of interaction mechanisms, such as talking in a text-based MUD, may be opportunistic and sporadic, the pace of the underlying transmissions must be reliable and predictable. If the technical infrastructure is unreliable or unpredictable, then it will be impossible for users to ascribe behavior to varying uses of interaction mechanisms.

Implication: The technical infrastructure of a network community must support intelligible rhythms of exchange between participants. The system should be optimized for predictability, not for opportunistic, and therefore unpredictable, bursts of transmissions.

4.2. MULTI-MODAL COMMUNICATION

Observation: The availability of different modalities of communication in network communities adds richness and depth to online interactions.

Communication in network communities is more layered and complex than it may appear on first examination. It is important that there are multiple mechanisms and modalities for participants to choose in different social circumstances. Each communication possibility has a particular sense of audience, is composed of speech or action, may be synchronous or asynchronous, and may be public or private.

In a MUD, for example, users can talk in a room to others located in the room, talk on a channel* to other members of the channel, privately page a particular person, express gestures to provide backchannel information such as typing "lol" (laughing out loud), send mail to an individual or mailing list, post an article to the online newspaper, create an object to leave in a place for others to see, or perform an operation on objects that are visible to others in the same room, such as petting a cat which then gives a loud purr.

Instead of text-based mechanisms, multimedia MUDs will usually support a set of visual gestures, such as a hand wave, jumping up or down, facial expressions, or manipulation of graphical objects. Speech, sound effects, and other auditory cues are also possible resources in some systems. Like text-based comments, these gestures can be appropriated to indicate various messages.

Traditionally, media spaces have not offered as wide a range of communication mechanisms. Users could replace their video image with caricatures of themselves or signs such as "out to lunch". Some media spaces support private glances at

* A channel in a MUD allows participants to converse with inhabitants who are in different MUD rooms. The contents of a channel can either be transient or recorded for later review. Activity on a channel is invisible to those who are not members of that channel even if they are in the same room with users talking on the channel.

other members as well as private connections in addition to bullpen, multi-person connections. Smith hass investigated backgrounding conversations where speakers can be identified but not understood, akin to hearing voices murmuring in the hallway.

Each communication modality within a network community has its own rhythm. In Pueblo, for example, a conversation between people in the same virtual room or on the same channel might last minutes or a small number of hours. A delayed response longer than that would not qualify as an entry in the conversation. But on the recorded "programming" channel, people sometimes speak on the channel even when they can tell (from a "who" command) that other programmers are not currently active; they know that when people become active again, they will catch up on channel talk they have missed and respond.

The availability of multiple modalities gives complexity to the interactional rhythm, because people have *choices* about what modality to use at any particular moment and for any set of conversation partners. Some communication choices take the floor more aggressively (such as talking out loud); others project a more low-key presence (such as emoting that you are listening politely or petting your cat). It is a useful affordance of online environments to have these choices. Because different communication styles are possible, the choice of what style to use in any particular interaction is significant and carries its own message. What is striking is that these choices are made from moment to moment, from comment to comment. It is routine for fluent participants to mingle public and private speech. (Of course, there are risks to doing this; one can accidentally use the wrong communication command at any time.)

Implication: Network communities must provide multiple modalities for communication that can be appropriated for varying uses. The ability to engage in public and private conversation as well as provide low-key presence and gestures is important to establishing a multi-layered environment.

4.3. FOREGROUND, INTERMITTENT, AND BACKGROUND INTERACTION

Observation: Users move easily between foreground conversation, intermittent interaction, and background awareness.

People in network communities sometimes hold highly participatory, rapidly paced conversations, and they sometimes let long silences go by, punctuated with intermittent speech. Even in a newsgroup, shifts in pace are evident; a hot topic might generate several dozen messages in a day, while a less compelling topic might see only a handful of responses before the thread dies.

The ability to move between rapidly-paced talk, intermittent comments, and silence is a significant factor in the livability of these spaces. Co-present people can

move easily between close collaboration and simply keeping each other company. It is easy to pick up the thread of a previous conversation without expending effort to relocate conversation partners or re-establishing permission to speak. In these circumstances, initiating a conversation is a light-weight operation, socially as well as technically. This is important in enabling fluid transitions between background and foreground activities and facilitating long-term co-presence in the community setting.

When there are silences, it is important that users know that their companions are still there in the online space. A temporarily silent conversation partner feels different from an absent conversation partner. Activity-based awareness indicators are available in MUDs; a user can use the "who" command to find out when someone last typed something. In Pueblo, many students and adults use the "who" command periodically throughout an on-line session as an non-intrusive way of checking up on the activity levels of others.

A primary purpose of media spaces is to provide awareness indicators of other inhabitants. A quick glance at a set of video windows provides clues as to the absence or activity of other users. Hudson and Smith describes other visual clues that can indicate the recent history of users' actions.

Experienced users know that a potential conversation partner's attention may not be focused on the communication region, even if they are actively doing something online. Users develop conventions for checking attention (such as paging someone to ask, "You there?") or trying to command attention with an especially large-scale gesture such as Hobbes' hug, which can be seen from the comer of one's eye. In a media space, one may glance at another user where the glance is accompanied by an auditory cue heard by the target of the glance. Users may also broadcast queries to the group such as asking who is ready to go to lunch.

One example of an audio-only media space points to the need for awareness of audience as well as appropriation. For a period of time, users of a typical media space were forced to use an audio-only connection due to being separated on opposite coasts of the U.S. Although the media space supported conversation, users could not determine the present audience without a voiced query. The participants quickly adopted the notion of modifying their name descriptions to indicate their current activity as well as their availability as shown below.

Implication: It is important to provide ways for users to be aware of the presence of others, without intruding into their activities. Communication mechanisms should not require equal, foreground attention from all conversation partners; long-term co-presence is facilitated when each partner can move easily between foreground and background attention as he or she is available.

4.4. NEAR-SYNCHRONOUS CONVERSATION STREAMS

Observation: The affordances of textual conversation streams lead to unique possibilities for interaction.

Conversation in a network community that uses text-based or action-based communication mechanisms is not quite synchronous, though it has a real-time flavor. Some people are faster typists than others, and there can always be lag due to network delays. In addition, there are delays in text-based environments due to the chunking of text delivery into conversational turns. That is, talk isn't broadcast to participants as the "speaker" is typing each character, but is sent in a chunk when the speaker has signaled the end of a turn by hitting the carriage return. This chunking completely changes the nature of floor control from a face-to-face setting. In physically co-located groups, it is usually considered rude to interrupt others (not waiting for one's turn). In a MUD or other textual communication environment, strict turn-taking is not only not required, it is actually hard to sustain. You can never know when someone else is composing a turn, and it is common for several people to be composing at once.

This feature of textual communication has some interesting effects. One is that conversations quickly become multi-threaded. Among face-to-face conversation partners, it would feel rude to insist on sustaining several conversational threads, if they had accidentally arisen due to a collision between two participants. But MUD conversations easily fragment into a multiplicity of topics, each of which persists. This parallelism can be very disorienting to new users. The larger the number of participants in a conversation, the more likely it is for fragmentation to occur. Even among two participants, multi-threading is common, because of the overlapping composition of conversational turns. Online meetings with more than a handful of participants are dizzying. Pueblo members have attempted to hold weekly online meetings for groups of senior citizen volunteer mentors, but most seniors have found them too frustrating to attend on a regular basis when there were more than a half dozen participants. The most successful of these meetings have held to a strict agenda and have been strongly led – in effect, deliberately inhibiting the parallel composition and cross-talk that are easy and fruitful in pairwise or small group conversations.

This type of conversational multi-threading can be seen even in simple, two person talk programs, again due to the pace of sending and receiving text fragments. In this way, these conversations are akin to the multi-threaded discussions in news groups. The difference is the pace of the newsgroups is likely slower than a MUD. In both cases, however, the predictability of the conversational rhythm supports complex and prolonged discussions.

Combining the multi-threading with multi-modal communication mechanisms gives an unusual flexibility and depth to online communication. When the same pair of participants have different communication modalities available (such as

paging, collocation in the same virtual room, co-participation on the same channels) they use different modalities to disentangle different conversational threads. For example, Tinlizzie and Hobbes might talk about a new kind of pet object in a room conversation (where the actions on the pet can be demonstrated, since objects are visible to everyone in the room); at the same time they might be discussing their weekend plans in a paged conversation while also talking about an upcoming project meeting on a recorded channel.

When different communication modalities have overlapping sets of participants, meta conversations occur – conversations in which primary content occurs in one setting and commentary occurs in another. For example, adults who help with an after-school program in Pueblo talk with one another and with children on one communication channel while giving each other advice and encouragement on an adult-only channel. (See the example at the close of this section.)

Implication: Recorded (even if for a short time) textual communication channels will lead to multi-threaded conversations. Other affordances of network communities that are dissimilar from co-presence will also likely produce new interaction styles.

In this sample from Pueblo*, Nebula, Jansen, RoadWarrior and Hobbes are conversing on three parallel channels. All are on the Wizard of Oz channel (Oz-Talk), the programming channel (Prog) as well as the general chat channel (Chat!). Only Hobbes and Jansen are on the meta "adults only" channel (Some Adults).

|Oz-Talk| Jansen: Baum died that year too.
|Oz-Talk| Hobbes nods and sighs . . . made me sad, 80 years later!
|Oz-Talk| Hobbes liked the way in the fore or afterward they said he was going to heaven to tell the little boys and girls there about oz, etc . . .
|Oz-Talk| Hobbes thought that was a nice way of putting it :)
|Oz-Talk| Jansen nods.
The city clock chimes, the time is: 3:00 P.M. (MST)
|Prog|(rec) Nebula: ok . . . now what?
|Prog|(rec) RoadWarrior: got it done?
|Prog|(rec) RoadWarrior: (pict.html that is)
|Prog|(rec) Nebula: i think so . . . what about index2?
|Prog|(rec) RoadWarrior: hold on for that . . .
|Prog|(rec) Nebula: ok . . .
|Oz-Talk| Jansen had no idea how many Oz books were written by different authors.
|Prog|(rec) RoadWarrior: okay, after the <FRAME> tag, put <FRAME> SRC="pict.html"
NAME="bottom">

* "All names but Hobbes have been changed".

|Oz-Talk| Hobbes: unreal, huh?
|Oz-Talk| Hobbes doesn't think any of them are as good as baum's
|Prog|(rec) Nebula: ok . . .
|Prog|(rec) RoadWarrior: after the second <FRAME> tag, put in <NOFRAMES> (i'll explain what that does in a second . . .
|Prog|(rec) Nebula: ok . . .
|Prog|(rec) RoadWarrior: <NOFRAMES> is what it tells browsers that can't handle frames . . .
|Oz-Talk| Jansen: Probably. And I didn't even know there was more than Baum book.
|Prog|(rec) Nebula: ok . . . oh . . . I see . . .
|Oz-Talk| Hobbes grins and was happy to open your world up in that way ;>
|Prog|(rec) Nebula: thats where the index2.html comes in?
|Prog|(rec) RoadWarrior: so after the <NOFRAMES> tag, put in <P>Sorry! It seems like your browser can't handle frames! Please use the <A HREF="index2.html">no n-frames</A> version of my page!</P>
|Prog|(rec) RoadWarrior: yep!
|Prog|(rec) Nebula: ok . . .
|Oz-Talk| Jansen: ./~ It's a whole new world . . . ./~
|Prog|(rec) RoadWarrior: done with that?
|Prog|(rec) Nebula: yeah..
|Oz-Talk| RoadWarrior: NO!!!
|Oz-Talk| Hobbes: no what?
|Prog|(rec) RoadWarrior: okay . . . after <IP> put in </NOFRAMES>
|Oz-Talk| Hobbes wonders what RoadWarrior is doing on this channel – he hasn't read the books ;>
|Oz-Talk| RoadWarrior: THAT SONG!!!
|Prog|(rec) Nebula: ok . . . now what?
|Prog|(rec) RoadWarrior: </FRAMESET></HTML>
|Prog|(rec) RoadWarrior: now upload all 4 files . . .
|Oz-Talk| Jansen (to Hobbes): Kick him off! You can now. <g>
|Oz-Talk| Hobbes grins
|Oz-Talk| RoadWarrior: i've read WOz-Talk! (and seen the movie too)
|Oz-Talk| Hobbes: it's a two book requirement!
|Oz-Talk| Hobbes: has been since the beginning! :>
|Oz-Talk| RoadWarrior: okay – tell me where to find #2!
|Oz-Talk| Hobbes: even tig made the requirement :)
|Oz-Talk| Jansen nods.
|Oz-Talk| Hobbes: they're all on the web, actually!
|Prog|(rec) Nebula: ok . . .
|Prog|(rec) RoadWarrior: they're uploaded? cool
|Oz-Talk| Nebula (to RoadWarrior): that also means you need to help with the oz project ;)

|Some Adults| Hobbes Grins – last time he said he didn't want to read them . . . hee hee . . . banishment frightened him I think <g>
|Oz-Talk| Hobbes grins
'neb you go! ;>
You message is telepathically transferred to Nebula.
You paged Nebula with: you go! ;>
|Oz-Talk| RoadWarrior: okay . . . i'll, uh, supervise! <g>
|Some Adults| Jansen lol!
|Oz-Talk| Hobbes laughs
|Oz-Talk| Jansen (to RoadWarrior): Uh, no. You must CREATE!
|Oz-Talk| RoadWarrior: then i'll create those flying money things – billions of them (run an infinate loop <g>)
|Prog|(rec) Nebula uploaded . . .
|Chat!| Hobbes: is anyone reading the geek-camp thing on fox trot? it's TOTALLY hilarious!
|Oz-Talk| Hobbes: you'll have to create them the way they were in the book then ;>
|Chat!| Nebula is . . .
|Prog|(rec) RoadWarrior: okay . . . now we start the debug phase
< < Nebula has disconnected. Total: 7 >
The city clock chimes, the time is: 3:15 P.M. (MST)

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4.5. ROUTINES: LONG-TERM RHYTHM

Obervation: Network communities also have rhythms that span days, weeks, and years.

The pace of life in a network community is the cumulation of the routines of its inhabitants. In some communities, activity, such as large discussions in public places, may peak after most members have returned home from a day at work. These routines may be affected by rhythms in the physical world, especially if community members live in different time zones. Nevertheless, intelligible rhythms for individuals and for the community as a whole emerge. Akin to rhythms of interaction and awareness, deviations from routines also carry social meaning.

One example comes from an observation of a media space that spanned the Atlantic (Dourish, 1992). A researcher on the West coast of the US developed a pattern of working on his dissertation late into the night. Inhabitants of the media space in England noticed his efforts and encouraged him by placing notes on a white board viewable on his monitor. When his routine changed, the crowd in England interpreted (correctly) the deviation as progress on his dissertation.

When a network community cannot support the natural rhythms of its constituency, the community may not survive. Combat MUDs have had to contend

with the problems of providing a reliable and persistent locale in environments often hostile to MUD server operation. Since combat MUDs usually operate on borrowed server space at universities, they generally cannot be open to players 24 hours a day, and often have to migrate to different hosts as universities become increasingly unwilling to support recreational MUD use. Combat MUDs will often post their hours of operation to try to provide a reliable rhythm for use, but successful MUDs must be available during peak play hours. Combat MUD death is common if a MUD is not consistently available, or if server changes are too frequent for players to follow.

Implication: Network communities exhibit social routines that are key to comprehending the behavior of individuals and of the community as a whole.

5. Community development

At the beginning of the paper, we discussed a notion of community that was based on a sense of locality, meaningful and multi-layered relationality, and dynamism. Here, we would like to tie these understandings of community in with a discussion of the design and technological support for network communities. This exploration of design implications is necessarily somewhat global and suggestive due to the multi-faceted nature of how community is achieved.

Here, we would again like to stress a notion of technosociality, that the ways in which communities develop and evolve are based on processes where technology and social life is inextricably intertwined. It is not just possible to design social conventions and policies in conjunction with technical mechanisms, but it is necessary to do this in order to develop a robust and socially cohesive environment. 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 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

For us, the term “community” stands in for an enduring and multi-layered sociality as a goal of design, and the topics introduced below are some starting points to consider design toward this end. We are not suggesting that social groups be evaluated according to their conformity to an ideal of “community”, but rather

that there are a certain set of factors that need to be considered in trying to design for a robust form of sociality. We are conceptualizing community as a constellation of characteristics too various to cover completely in this paper, but that include: group history, learning and social reproduction, and a sense of membership, identity, and social roles. These characteristics coalesce variously into a set of shared practices and norms that can reasonably be called community.

5.1. 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 (Dibbell, 1993).

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 (Cherny, 1995).

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

5.2. Learning and social reproduction

Observation: Successful network communities provide both technical mechanisms and social practices that allow for learning and social reproduction.

In order to understand learning as a component of community development, we borrow from Jean Lave and Etienne Wenger's (1991) "community of practice" approach, which locates learning as a mode of participation in a community (in contrast to a purely cognitive process). The sustainability of a robust network community rests on opportunities for learning that leverage both social practices and technical mechanisms. Lave and Wenger also suggest that learning communities can be characterized by their cycles of social reproduction. One should be able to trace the ways in which newcomers shift from peripheral to full members, and eventually participate in the socialization of other newcomers (Lave and Wenger, 1991, p. 99). Community continuity and integration is established by these cycles of learning and different forms of community participation.

Technosocial practices for how to engage with newbies are well-developed in robust network communities; MOOs will often have 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. The status of wizard in combat MUDs, which confers building and administrative privileges, is usually the result of a series of rites of passage and apprenticeship with a senior wizard. Players changes status from newbies to experienced players, achieving the necessary number of levels and experience points before beginning a wizard apprenticeship. They are taught how to code and their work is subject to review by other wizards before they are given the title of wizard.

Practices for experienced members to engage with newbies serve both sets of participants. The newbies can become better prepared to enter into community life, and the experienced members have a path to community service and increased status in the community For example, there is an online help desk facility in Pueblo to link people who need immediate help with people who are on duty as help consultants. The help staff wear visible "Helpful Badges", which mark them as volunteers in a role that requires social or technical expertise. As newcomers gradually become more experienced, they can acquire Helpful Badges of their own,

if they wish. During the practice period a new helper wears a trainee badge, which allows the trainee to function as a peripheral participant, observing active helping sessions and communicating on a special channel with on-duty helpers.

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.

The workplace systems we looked at generally did not have robust systems of social reproduction, due to the experimental nature of their use. Learning tended to happen through existing workplace relationships, or via documentation, but there were no categories of participation that marked peripheral and full membership in ways that would facilitate learning. If these systems were to support a sustainable community life that was not simply an adjunct to existing workplace relations, more robust practices of social reproduction would be required.

Implication: Systems should support mechanisms for new players to feel welcome and so they are able to interact with experienced members.

5.3. Membership and identity

Observation: Successful network communities are characterized by recognizable members and membership categories.

Closely related to processes of social reproduction, successful network communities also require a sense of membership and identity in the community. In contrast to social groups characterized by relatively anonymous interaction, network communities have identifiable categories of participation and recognizable members. While online identities might be pseudonymous with respect to RL identities, there must be a core membership in a community with ongoing and meaningful identities that are articulated in the online space. In other words, the community is bounded by its members and forms of participation, and the space of interaction.

In the case of MUDs, membership is defined by login access and online names, as well as categories such as newbie, wizard, and player described above. The degree to which these membership categories are defined technically vary depending on the particular community. Combat MUDs tend to have elaborate hierarchies of twenty or more levels from newbie to wizard to God. Social and educational MUDs tend to rely on fewer explicit categories such as simply “wizard” and “user”. A sense of community is fostered by these formal categories of membership, as well as by ongoing participation – the ability to recognize others online and form new relationships based on the social conventions attached to membership roles.

While the actual participants might have come together strictly through the online medium, categories of participation often draw from existing and recognizable practices such as Dungeons and Dragons or educational institutions.

In the workplace systems that we have looked at, social roles are implicitly defined by the workplace community. These systems have the advantage of leveraging a robust set of existing social roles and relationships, but these existing norms may in some cases conflict with some of the goals of the network community. For example, as described above, the roles of administrator versus researcher in Xerox PARC were found to be resilient despite the fact that these roles were not represented by Jupiter. Conversely, existing workplace relationships facilitated interaction between network community members. The Jupiter design team and Xerox media space users quickly and organically developed conventions for working together online.

Users must have access to an understanding of community 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. For example, as discussed previously, management of markers between the real and virtual are important for framing identity and activity. Both technical mechanisms and social practices may be used to ensure the meaning of the information contained in character representations. One common technical restriction is disallowing users from playing more than one online character at a time although users may be allowed to change (morph) between multiple characters.

Boundaries of audiences for conversation and interaction are an important outcome of clear community membership. Interaction mechanisms, such as talking in a MUD room, imply different audience boundaries. A comment in a MUD room can only be heard by others in that room. A comment on a channel may only be read by others on that channel although the comment may be recorded for review by other channel members who are not currently online. Social and technical practices support these audience boundaries such as disallowing a user from invisibly entering a room or covertly recording a conversation. It is important that conversation in a community are experienced as local rather than broadcast indiscriminately.

Implication: Ensure that the community has recognizable membership boundaries and membership categories appropriate to the practices of the community. These boundaries and categories should also be transparent to users, and consistent with accounts of places, identities, and interactional boundaries.

6. Where to go from here

We have taken a reflective approach in this paper, examining our experience in different network communities to arrive at some general observations and implications

for community design. In this section, we shift to a more proactive orientation and suggest particular directions for designers, researchers, and community members.

6.1. DESIGNERS

Although we have stressed the need for appropriation and evolution of social and technical mechanisms in a network community, by definition, network communities require a well-designed technical apparatus for their continued existence. Designers have a crucial role in laying groundwork for network communities to become habitable and appealing places. An approach that takes seriously the intertwining of the technical and social recognizes how social life requires technological support, as well as how technologies are meaningful only within social life.

Our suggestions for designers are these:

- The design of network communities involves many levels of activity, from developing network infrastructures or generic "community-building toolkits" to arranging the policies, places, and people of one particular community. Designers at one layer should be actively involved with designers at nearby layers. Designers of structures seemingly most remote from users need to be cognizant of the relations between their design choices and use. Of particular importance, designers need to provide clear representations of designed-in constraints. Designers of the structures most visible to users should stay actively involved as participants themselves, if this is possible. If not, they should establish communication paths and ongoing relationships with active participants. Ideally, participants should have a sense of ownership and buy-in to the design process.
- Set up technical mechanisms and social processes that match one another and the community's identity. Create frameworks for activity, but leave as many openings as possible within these frameworks for participants to create the activities that interest them most.
- Establish a community profile. Think about the intended goals and values of the community, as well as the expected activities of its participants. The profile will help the community grow its membership in a coherent way.
- Understand that every community needs wise stewards who may or may not be part of the "official" design staff. These people will emerge, given the opportunity, and they must be supported
- Understand that each community needs to follow its own development path. The fact that the people in LambdaMOO solved a social problem does not imply that every other MOO can avoid it by adopting LambdaMOO's solutions. On the contrary, it makes it likelier that other communities will encounter similar problems, but they will have to make their own choices in dealing with them. All communities travel through stages of growth and adjustment.

6.2. RESEARCHERS

We see five important near-term challenges for network communities, each of which might be investigated by the research community:

Novel user interfaces

Text-only MUDs will probably always exist; they have too many special affordances to disappear. Text excites the imagination in ways graphics can never match, it is compact, and it scales down to the lowest possible computer platform. However, the trend is clearly moving toward more multimedia interfaces for virtual worlds, often mixed with text for conversation or document-like artifacts. Current solutions in hybrid environments have mixed success. In some three-dimensional graphical interfaces, the text of different characters can actually overlap and become unreadable if the figures move too close together. The research challenge is to define uses of graphics, sound, video and text that are optimal for each medium and also blend together well.

Sustainability, scalability, and replicability of successful network communities

Many network communities are too new or have undergone too many radical shifts in population to have reached a state of equilibrium. A growing base of Internet users and increasing commercial interest in network communities are leading to rapid growth of existing network communities and a proliferation of new ones. These trends prompt questions of how communities do or do not scale successfully, and what makes a particular community sustainable over time. For example, when does it make sense to limit or increase community growth, or replicate and found new communities? Some of the issues to be explored are identifying the inherent limits on the size of a network community, learning which features can be replicated, and studying the social and technical processes that are involved in both scaling and replication.

The impact of different business models on community development

New commercial ventures into network communities are financing the communities through a variety of business models, including advertising and subscription. While the marketplace will decide whether these models are successful in attracting and retaining clients, the research community could contribute to understanding which forms of community are achieved through different methods of sponsorship and support. Many of the earlier successful models of network communities grew organically out of the needs of a particular community, and the relevant systems were designed by these community members themselves. Many early Internet communities, whether we consider systems like combat MUDs or the WELL, were “intentional” in the sense that they were founded for and by an initial set

of community members. Commercial interest changes this model by proposing a more distanced relation of production and use. These models are quite different than the models of free communities created in the earlier days of the Internet, and it is unclear what effects they will have on community formation.

The changing demographics of the Internet

The current shift from a primarily academic and government oriented user base to a much more heterogeneous one – including commercial interests, children, as well as a plethora of recreational and casual users – changes the ways in which communities will be founded and developed online. Trends such as WebTV where Internet access is integrated with home entertainment extends access even further. While early Internet communities could often rely on unstated social norms or voluntary rules of conduct, with a more heterogeneous set of users, these norms may require more formalization. This might take the form of creating certain boundaries to membership, formalizing rules of participation, or creating increasingly specialized or well-defined forms of network community.

Federated network communities

As we have discussed above, there is a real value in each network community establishing a unique identity over time, to solidify the meaning of membership and lend coherence to community activities. Yet there are good reasons to cross communities boundaries, too – to provide access to services or people in other communities. For example, Pueblo teachers and students would like to be able to take advantage of valuable learning experiences developed in other community settings. Primitive technical mechanisms to support interaction across communities have existed for some time, and more sophisticated mechanisms are being developed. The design of appropriate metaphors and meanings for these cross-community ventures is still an open issue.

6.3. COMMUNITY MEMBERS

Though we have emphasized the role of designers and researchers here, as the intended audience of this article, we cannot entirely omit a reminder of the central roles of community members. If a network community is going to be a *real* community, participants need to take responsibility for their place – that is, support the extensions of relations from a particular set of tasks or themes to a more robust, multi-layered nexus of social ties and activities. Participants must support the (re)production of the community through their short-term interactions and long-term engagements as well as familiar social practices such as initiation, learning, rituals, and governance.

7. Conclusions

As individual designers, each of us had our own experiences with what we have come to call network communities. As we tried to understand what MUDs and media spaces were an instance of, we first focused on the affordances of these systems such as persistence and engagement. The affordances of network communities make it clear that 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.

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.

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 appropriate 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 depend on the multi-layered, complex relationships among their inhabitants. These relationships are built from varying forms of interaction, spanning conversation to the awareness of each others' presence. Given a reliable infrastructure, users are able to ascribe meaning to the conformance to and deviation from anticipated behaviors. Over time, these behaviors emerge as routines, both individual and for the community as a whole. The support for and adaptability of these routines is key for the longevity of the community.

Network communities undergo constant processes of production, reproduction and evolution. Changes in a community such as new membership or modified charters may require reformations in the bindings between technology and sociality. New technical mechanisms may be needed or old mechanisms may be reappropriated for new uses. This interdependence requires a flexible coupling between the two systems so that the same mechanisms can be appropriated for different uses. As inhabitants author their network community, they will

want to modify technical and social elements in tandem as one, loosely coupled system.

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