A Multilevel Analysis of Sociability, Usability, and Community Dynamics in an Online Health Community

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The aim of this research is to develop an in-depth understanding of the dynamics of online group interaction and the relationship between the participation in an online community and an individual's off-line life. The $2\frac{1}{2}$-year study of a thriving online health support community (Bob's ACL WWWBoard) used a broad fieldwork approach, guided by the ethnographic research techniques of observation, interviewing, and archival research in combination with analysis of the group's dynamics during a one-week period. Research tools from the social sciences were used to develop a thick, rich description of the group. The significant findings of this study include: dependable and reliable technology is more important than state-of-the-art technology in this community; strong community development exists despite little differentiation of the community space provided by the software; members reported that participation in the community positively influenced their offline lives; strong group norms of support and reciprocity made externally-driven governance unnecessary; tools used to assess group dynamics in face-to-face groups provide meaningful information about online group dynamics; and, membership patterns in the community and strong subgroups actively contributed to the community's stability and vitality.

Categories and Subject Descriptors: K.4 [**Computers and Society**]; K.4.2 [**Computers and Society**]: Social Issues

General Terms: Human Factors

Additional Key Words and Phrases: Online community, patient support community, health, electronic support groups, self-help via the Internet, sociability, online group dynamics, online social support, usability

1. INTRODUCTION

This article describes a $2\frac{1}{2}$-year multilevel study that utilized a broad ethnographic approach in order to develop a deep understanding of a thriving

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online health support community, Bob's ACL (Anterior Cruciate Ligament) WWWBoard (the Kneeboard). The Kneeboard is an online self-help group for persons who have experienced knee injury, especially those injuries related to the anterior cruciate ligament. It contains a message index and a number of pages that support the community and provide additional information about knee injuries. This online community is particularly interesting to the researchers because of its longevity (it has been in existence for eight years), the high level of message activity on the Kneeboard, and the strong evidence of social support and trust among members as revealed in earlier studies. This research builds upon and extends studies of the Kneeboard conducted by Preece [1998, 1999] and Preece and Ghozati [2001]. This earlier research focused on documenting the role of social support within the group.

The focus of ethnographic research is to examine the ways in which all aspects of a culture are related [Nardi 1997]. The ethnographic research techniques of observation, interviewing, and archival research [Crabtree and Miller 1992; Fetterman 1998; LeCompte and Schensul 1999; Miles and Huberman 1994; Wolcott 1999] help the researcher build a thick and rich description of the culture being studied. Ethnographic research, broadly defined, is becoming an increasingly popular method for studying the Internet because of the unique way it can be used "to develop an enriched sense of the meanings of the technology and the cultures which enable it and are enabled by it" [Hine 2000, p. 8]. Lave and Wenger [1991] contend that in order to understand a community, one must look at the activities in which the community members engage. Therefore, we also used research tools from the social sciences to increase our understanding of this online community. We analyzed messages posted to the community over a one-week period to examine the social network. We explore group dynamics on the Kneeboard employing standard research tools used to analyze face-to-face groups: Group Membership Roles Analysis and Interaction Process Analysis (IPA). A secondary research goal was to investigate how these tools from social psychology could be used in the online environment and if they could provide the same type of information about online group dynamics as they do for face-to-face groups.

Other studies of online community have used an ethnographic approach [Baym 2000; Mynatt et al. 1997; Silver 1999], message analysis [Preece 2001; Braithwaite et al. 1999; Herring 1996] group dynamics analysis [Korenman and Wyatt 1996], analysis of communication patterns [Quan-Haase et al. 2002]. Combining these research approaches with an analysis of the technical environment helped us to develop a deep understanding of the relationships between the social and technological aspects of this particular online health support community.

A major challenge facing designers and developers of online communities is to facilitate social engagement and interaction among members [Millen and Patterson 2002]. Bob's ACL WWWBoard has a high level of social interaction and participation. We sought to develop an understanding of how this community functions in order to enhance the work of online health community designers and developers. Some of the significant findings of our study offer new insights; others appear to contradict existing ideas, and some support the

work of others by adding new or additional evidence. For example, it has been recognized by community developers that a narrowly focused purpose promotes the success of an online community [Preece 2000; Kim 2000; Powazek 2002]. This study confirms the importance of the narrow focus of the Kneeboard in the success of the community. However, it throws new light on how a community's purpose can be reflected through the interface to its members. We hope our findings stimulate online community designers, developers, and managers to engage in further research and lively debate about the best practices for building and using online health support communities.

2. PREVIOUS WORK

Textual communication environments on the Internet are frequently said to be impoverished because they do not support nonverbal communications cues (e.g., body language, facial expression, voice tone) [Sproull and Kiesler 1986; Walther 1992, 1996]. However, in spite of the problems associated with the narrow bandwidth, the most frequent use of the Internet is to communicate with others [Fox and Rainie 2002] using text, particularly email. For this reason, email is known as the "killer app". Between 1995 and the end of 2002, the number of Americans online grew from 25 million to 117 million [Fox and Rainie 2002]. They went online to chat, to find like-minded people, to debate issues, to play games, to give and ask for information, to find support, to shop, or just to hang-out with others. They go to chat-rooms, bulletin boards, join discussion groups, or they create their own groups using instant messaging software. These online groups are known by a variety of names including *online community*, a name coined by early virtual community pioneers like Howard Rheingold [1994].

There is considerable debate about calling online groups communities, and for over 50 years, sociologists have defined and redefined the concept of community and still do not have a standard definition [Wellman 1982]. Therefore, for the purpose of this study, we define an online community as a group of people with a *common interest* or a *shared purpose* whose interactions are governed by *policies* in the form of tacit assumptions, rituals, protocols, rules, and laws and who use computer *systems* to support and mediate social interaction and facilitate a sense of togetherness [Preece 2000]. While there has been a good deal of research on communicating and relating on the Internet, researchers are seeking new understanding of the relationships between participation in an online community and an individuals offline life and the dynamics of group interaction online.

Since the early 1990s, research has indicated that participants of online support groups report that the information, social support, and empathy they gain from their online groups help them cope with their illnesses [Brennan et al. 1991; Brennan and Ripich 1994; Cummings et al. 2002; King and Moreggi 1998; Miyata 2002; Preece 1998, 1999a, 2000; Schoch and White 1997; Shaw et al. 1999]. Finn's research [1998] on online self-help groups suggests that these groups are valuable because they possess the advantages of mutual aid and the accessibility of computer technology. They provide benefits to the general population in a time of limited access to medical help and services.

Studies by Brennan et al. [1991], Brennan and Ripich [1994], King and Moreggi [1998], Mynatt et al. [1997], Preece [1998, 1999a, 2000], Rice and Love [1987], Schoch and White [1997], Shaw et al. [1999], and Finn [1998] indicate that members of online support communities provide important opportunities for learning, social interaction, and support. Critics argue that the limited communication environment on the Internet cannot support the same type of interaction between individuals as in face-to-face groups [Culnan and Markus 1987; Cummings et al. 2002; Spears and Lea 1992; Sproull and Kiesler 1986; Walther 1992, 1993, 1994, 1996]. However, as researchers work to understand and document the effects of online support groups, more and more people are turning to them in times of need.

Gustafson et al. [1994] conducted a study of the Comprehensive Health Enhancement Support System, a Web site that provids information and discussion groups for people with health concerns. They found that those who used the system reported a higher quality of life and lower use of healthcare services. In a tightly controlled clinical study of participants in Hutchworld, an online community for cancer patients, Farham et al. [2002] found that use of the online community helped to buffer bone marrow transplant recipients during recovery (a period of isolation) from a reduction in life satisfaction and social support. They also found that the asynchronous features in the community were used more often than synchronous ones.

A study conducted by Braithwaite et al. [1999] of communication of social support in an online group for disabled people analyzed the messages in a bulletin board community to identify the types of social support exchanged by community members. They found that emotional support, information, and esteem support were the most common types of social support offered by community members. In addition, they found that humor seemed to be an important part of the exchanges between community members. Studies by Turner et al. [2001] and Cummings et al. [2002] found that people turned to online groups when they had lower levels of real world support.

Fussell and Setlock's [2003] long-term study of a work-oriented chat community found that the ways in which chat is configured facilitate informal conversation in much the same way as physical proximity. In addition, they found that the sharing of *virtual food*, images and music, and *excursions* to other Web sites helped to build interpersonal relationships among community members. As researchers continue their investigation into the dynamics of online social interaction, each new study adds valuable contributions to this ongoing discussion of how to build and manage successful online communities so they meet the needs of their members.

The Pew Internet & American Life Project Report, *Vital Decisions* [Fox and Rainie 2002] found that 73 million American adults, or 62% of those with Internet access, researched a disease or medical condition on the Internet, and the number continues to grow. Forty-eight percent of those who sought health information online reported that the advice they found improved the way they take care of themselves or a loved one, and 55% said that access to the Internet improved the way they get medical and health information. According to the report, about 25% of those that search for disease-related information join an

online support group. The report reveals that people who go online for health information want several things: to find information about improving their health/fitness; to better understand a health problem; to obtain information about diseases, drugs, and treatments; to find support; and to help others. As we move into the future where mobile communication and pervasive computer technologies are expected to change, once again, the way people communicate and relate to one another [Rheingold 2002] and the range and variety of people seeking healthcare support online will continue to increase.

The Internet has great potential for improving the lives of people, but we must take great care to shape the technology so that it facilitates social interaction that provides the information and support people are seeking. To do this, we have to step outside of our own specific fields of study and explore findings from other disciplines

The structure of the remaining part of our article is as follows: Section 3 outlines the research approach and techniques used in the study, Section 4 describes the Kneeboard's Web site, and Sections 5 and 6 present and discuss the significant findings of the study. The article ends with a discussion of the implications of the findings for HCI designers, community managers, and healthcare professionals and suggests topics for future research.

3. THE STUDY

Ethnography research requires a long-term immersion in the community under study, and this immersion may be as a participant-observer or as an observer. The researcher in this study observed the community and did not participate in it because that would have required faking an injury which is unethical and may have tainted the findings of the study. Through observation of the interaction in the online health community over $2\frac{1}{2}$ years, the researchers were able to build a thick and rich understanding of the community. The use of research tools from the social sciences provided additional insights into the communication patterns, norms, and governance structures of the community and the role the online community played in the lives of its members [Maloney-Krichmar et al. 2002; Maloney-Krichmar and Preece 2002].

In addition to extended observation of the community, an analysis of the site was conducted using sociability and usability guidelines from the field of human-computer interaction [Jacko et al. 2000; Kim 2000; Larson and Czerwinski 1998; Lynch and Horton 1999; Nielsen 1998; Preece 2000; Shneiderman 1998]. Messages posted during a one-week period in November 2001 (492 messages) were analyzed to determine the group membership roles played by members [Bales 1958; Benne and Sheats 1948; Brown 2000; Finn 1998; Forsyth 1999; Hare 1976; Hiltz et al. 1986; McGrath 1984; Mudrack and Farrell 1995; Sampson and Marthas 1990; Torres et al. 1996] and patterns of behavior within the group (Interaction Process Analysis) [Bales 1951, 1958; Forsyth 1999; Sampson and Marthas 1990]. An analysis of communication patterns was conducted by examining the exchanges between community members, length of message threads, and subgroup activity [Wellman and Frank 2001]. For each person who posted a message between November 11–17, 2001,

Table I. Research Phases, Activities, and Aspects of the Online Community That Are Examined

Research Phase	Research Activity	Research Questions
Phase I	The researcher observes the Kneeboard for $2\frac{1}{2}$ years	What factors contribute to the vitality, longevity and character of Kneeboard?
Phase II	Sociability and usability analysis of the Kneeboard and its Internet Site	What is the relationship between the social and technological aspects of the online community?
Phase III	Analyze patterns of communication, subgroup activity, and length of message threads Analyze 492 messages posted to the Kneeboard November 11–17, 2001 using: a) Group Membership Roles b) Interaction Process Analysis	What are the norms, values, beliefs, and patterns of behavior and participation on the Kneeboard and how are they expressed?
Phase IV	Interviews with Kneeboard members	What role does the online community play in the lives of its members?

the researcher used archival data to track and record their participation in the community for the corresponding week in November 2000 and then for a week in September 2002. Twenty community members were interviewed online over a period of several months.

The study consists of four research phases as presented in Table I. Each phase of the research examined different aspects of the social environment and the interactions within the community. By combining a long-term immersion in the community as an observer with systematic data collection, analysis, cross-checking, and triangulation of observations and data, a thick and rich description of the culture, norms, and dynamic processes of the Kneeboard emerged.

In the next section, a description and evaluation of the technical environment of the Kneeboard is provided and the effects of this environment on communication and social interaction are discussed. This discussion provides a framework for understanding the context in which the community is embedded.

4. A DESCRIPTION OF THE KNEEBOARD

In *Virtual Ethnography*, Hine [2000] suggests that the spaces in which social interaction takes place on the Internet are cultural artifacts. She contends that developing an understanding of the Internet space helps us to develop insights about how meaning is produced within the space. It is within this context that we examine the Internet home of Bob's ACL WWWBoard. The site is composed of eight major pages: Home; who's Bob?; Kneeboard News from virtual Bob!; Knee-Injury-Article Library Database; Create A Profile; View User Profile; Search; and, Set Preference. Unlike more recent online communities that have novel spatial organizations for online communication (e.g., Donath [2002]; Erickson and Kellogg [2002]; Halverson et al. [2002]; Jung and Lee [2000]; Xiong and Donath [1999]), the communication space for this community is relatively undifferentiated. Figure 1 provides a snapshot of a portion of the home page.

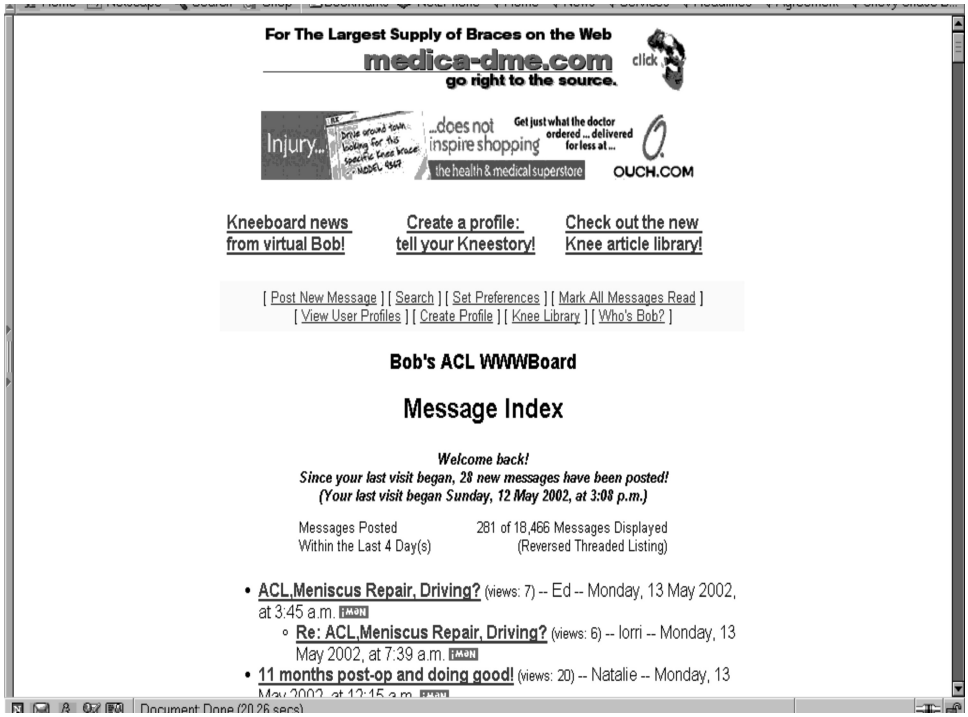

Fig. 1. Bobs ACL WWWBoard Home Page captured May 12, 2002.

4.1 The Home Page

The Home page is the heart of the Kneeboard because it contains the message index which is the location of the exchanges of messages between community members. Other pages may contain information posted by community members, but the message index and post message box are the major means of communicating on the Kneeboard. The message index, which dominates the site and is prominently positioned on the home page, is the primary means by which members of the community express the purpose of the community and exhibit norms of behavior. The messages posted to the bulletin board contain frequent comments from community members concerning the purpose of the board, how people should interact, suggest ways in which community members may contribute to the group, and chastise those who interact in ways deemed inappropriate. Messages provide a history of social interaction and form the basis for members' expectations about future interactions. This reinforces the importance of the Message Index and the role it plays in fulfilling the purpose of the Kneeboard. A review of the messages reveals that the majority are narrowly focused on topics related to coping with knee injuries.

The remaining major pages of the site, Who's Bob?; Kneeboard News from virtual Bob!; Knee-Injury-Article Library Database; Create A Profile; View User Profile; Search; and Set Preference, provide basic functions for the members of the community. They provide current information from the site administrator,

articles from research journals related to knee injury and treatment, a photo album, a page where members post their personal information, an archive of the past two years' messages, and a page that allows members to set bulletin board preferences.

The focus of the community is conveyed on each page of the site. The name of the community, *Bob's ACL WWWBoard*, tells newcomers that it is a bulletin board concerned with ACL. For those with an ACL injury, the use of ACL in the name of the site sends the message that the bulletin board addresses knee injuries. For those who do not know what ACL is, the name is puzzling and would not encourage them to peruse the site. Prominently placing the name of the community on each page reinforces the message that the site is narrowly focused on issues related to the anterior cruciate ligament of the knee. This narrow focus is an important factor in the success of this online community because of its affect on group dynamics within the community.

The Kneeboard's Internet site is not complex. It does not contain a large number of pages and does not have any of the newer elements of some online communities such as 3D graphical environments, avatars, chat rooms, and so on. Bob's ACL WWWBoard uses bulletin board technology which has been available for around 20 years. In style it is similar to some of the boards currently used on the Internet and predates popular Web boards. However, it provides the basic elements for interaction in the online community and for members to establish social presence [Maloney-Krichmar 2003; Preece 1999]. Kneeboard members express satisfaction with the Kneeboard and indicate that the advantages of the asynchronous, text-based community, embedded in a Web site, are:

—flexible access to the community (e.g., from home and/or work);
—flexible time management (access 24/7);
—the ability to communicate across time and distance barriers;
—access to a wide variety of members, information, and experiences;
—the ability to think about and edit responses;
—the ability to store and retrieve messages;
—access to research articles and hyperlinks within the community related to the focus of the community; and,
—the ability to establish permanent social presence through photographs, textual profiles, and archived messages, and the ability to easily control one's level of participation in the community.

The researcher, an external expert reviewer, and six graduate students examined the software supporting the online community. Neilsen's heuristics [1993] were used to guide these informal reviews in which each reviewer independently examined the community site and commented. Particular attention was paid to the communications software and to issues related to sociability [Kim 2000; Preece 2000, 2001].

The evaluators found that the Kneeboard site does not address issues related to sociability well in its design. However, they noted that the lack of clear

Table II. Key Sociability Feature on the Kneeboard

Key Sociability Features	Present on the Kneeboard
Statement of Purpose	No
Statement identifying Site Administrator	Present—but weak
Statement of Moderation Policy	No
Guidelines for Netiquette (online etiquette)	No
Registration Policy	No

statements related to purpose, policies, procedures, administration, moderation, or registration on the kneeboard do not appear to affect the community in a negative way. Levels of social interaction on the Kneeboard are strong as indicated by the high level of message posting and viewing. During the $2^1/_2$-year study, there were an average of 492 messages posted to the Kneeboard per week; 3.6 messages per active member per week; each message received an average of 43 readings; and, average thread length was 5.8 messages. Also, the longevity of the community (established in 1996) and the positive and supportive communication among members are indicators of strong social interaction.

There are no rules, regulations, or guidelines concerning acceptable levels of free speech or online etiquette. The wife of virtual Bob, the site administrator, participates in the community and provides light moderation of the Kneeboard. She indicated in an interview that on occasion she had to ask members to settle a heated argument off the Kneeboard. There is a filter for curse words. Yet, the Kneeboard has extremely low levels of aggressive or hostile behavior [Maloney-Krichmar 2003]. Table II presents an overview of the status of key sociability features on the Kneeboard.

The Kneeboard's technical environment is relatively simple and easy to use, especially when viewing or posting messages which is the major activity on the site. There is good navigational support on the site, and moving within the pages of the site is easy and fast. Due to the simplicity of the Web site's design, standard use of colors and limited use of graphics, download times for the site are within suggested guidelines for using a variety of computers and browsers. Nonetheless, there are usability problems as users go deeper into some pages or follow links offsite. There is no consistency for returning to the index on several major pages. At times, the back button on the browser must be used and, at other times, the user is required to close a window. However, these problems do not interfere with the main focus of the community, the exchange of messages [Maloney-Krichmar 2003; Maloney-Krichmar and Preece 2003].

The site provides little technical support or information about user requirements. Users may email virtual Bob with questions, but general technical guidelines are not available on the site. A small number of community members have occasionally posted messages suggesting that the kneeboard needs to be updated, incorporate new technologies, and/or get a new look. However, the major technical issue for the community is when the server breaks down and members cannot access the Kneeboard. Once access is reestablished after a server breakdown, a flurry of messages plead that server breakdowns be avoided in

the future. In an interview, one community member indicated that the only drawback of the community is:

> . . . when you need to talk to someone and the server went down, you sort of felt more isolated than was actually the case. The first time I experienced losing the server was a three-day event. I dreaded it and finally contacted the server host to learn what the problem was. Turned out I wasn't the only one having trouble breathing. Many others had done the same. (Peter, 7/15/02)

This comment reflects the opinion expressed by a majority of the Kneeboard members who were interviewed, i.e., that the most important technical concern for the community is to have a reliable means of communication.

The most significant finding from the observation and evaluation of the Kneeboard is that developing and sustaining an online community is not dependent on state-of-the-art technology. The premise of sociability and usability guidelines is that certain minimum standards should be met to insure the success of an online community. However, the Kneeboard does not meet many of the criteria yet members were extremely satisfied with the community.

5. MEMBERSHIP PATTERNS IN THE COMMUNITY CONTRIBUTE TO STABILITY AND VITALITY

Analysis of communication patterns is used to examine the underlying social structure on the Kneeboard and provides a framework for understanding community interaction. This analysis contributes to the study by providing data that describes the community's composition, size, range, density, patterns of interaction, and flow of information. It provides information on the social structure and relationships in the community and the effects of the network on its members by identifying key people in the community, the patterns of their ties, membership patterns within the group, and existence of strong subgroups.

5.1 Data Collection Techniques

The researcher conducted a pilot study in November 2000 that analyzed active membership in the community. The corresponding week in November 2001 was selected for analysis so that membership data could be compared to determine longevity of participation for members of the community.

Four hundred ninety-two messages were posted to the Kneeboard November 11–17, 2001. These messages were coded and data collected for each member posting a message to the Kneeboard for the following variables:

—number of messages posted;
—number of words posted;
—number of messages and responses posted by each community member;
—number of male and female (as self identified by name, or photos and specific reference to gender in user profiles or photo album);
—number of times that a healthcare professional was mentioned in a message;
—number of responses sent to each community member; and,
—number of times a messages was viewed.

This analysis reveals that the Kneeboard is a highly interconnected network in which members are linked through messages that are viewed and posted. It is primarily through these two activities that Kneeboard members come to know each other, establish connections, and interact. The community is composed of several types of members: key community members who post messages on a regular basis over long periods of time, community members who are highly active for a period of time, community members whose activity levels are less intense over long and short periods of time, and lurkers who view messages but do not post or post infrequently. Some of the relationships on the Kneeboard are marked by characteristics that are associated with offline strong tie relationships such as frequency, companionable contact, reciprocity, empathy, supportiveness, and longevity [Wellman 2000]. One Kneeboard member expressed his feelings this way:

> " From the beginning, I saw them as dearly loved family members who had gone through the same injury I had. For some reason I had a high level of trust of the members who replied to me, and that trust seemed to build the relationship. These people were the family I could talk to about my condition, and they would never get tired of talking about it." (Peter, 7/15/02)

It is often implied that open bulletin boards like Bob's do not support strong social structures. Our findings suggest that this is not the case for Bob's Kneeboard. We found evidence of several subgroups within the Kneeboard community.

—The ACL Boyz Cub, a group of men and women who checked in weekly to update each other on their progress and concerns.
—The Mom's and Pop's Club, a group of members who had children with ACL injuries.
—The Old Broads' Club, women and men who had experiences with healthcare providers that discouraged them from certain treatment options based upon their age.
—The WiseA$$ Club, a group of members who made lighthearted fun of the ACL predicament.

The exchanges between club members are informal, personal, and very warm in tone. The clubs serve as hubs around which social interaction is densely clustered accounting for some of the longest message threads and highest viewing rates on the Kneeboard. The Clubs' borders are very porous. A core of members check in regularly, but there are a number of community members who post less frequently to the Clubs and many who only view the messages. The clubs have overlapping membership and members of these subgroups tend to participate at a higher rate on the Kneeboard in general. Participants in the Kneeboard Clubs also tended to be long-term members of the community.

The interaction between key community members and active community members who provide stability, support, information, and companionable contact, and newcomers who bring their need for information and support, provides the social context in which the Kneeboard operates and is a key factor in the success of the community [Maloney-Krichmar 2003; Maloney-Krichmar

and Preece 2002]. Walther [1994, 1996] points out that a narrowly-focused discussion forum may promote the development of strong feelings of closeness between members because discussion is limited to a few topics. This effect can be seen on the Kneeboard where interaction between new and old members is focused on ACL injury and treatment which fosters a feeling of sameness that encourages cooperative behavior.

In the week analyzed, 66% of the Kneeboard members posted between one and three messages. In comparison, in a recent study of 204 unmanaged and unmoderated email-based listservs communities, Cummings et al. [2002] reported that 50% of participants contributed no messages in a 130-day period. Analysis of communication patterns revealed that Kneeboard members view messages at a greater rate than they post messages. Messages in the week analyzed received an average of 47 viewings per message. This evidence suggests the presence of a large number of lurkers on the Kneeboard, and it indicates that getting information and learning about the experiences of others is more important to some individuals than posting messages [Nonnecke and Preece 2000, 2000a].

Ninety-three (93%) of the exchanges between community members were composed of one exchange between two community members. These exchanges are embedded in message threads viewed by other community members. Therefore, while these messages were a one-to-one exchange, messages averaged 47 viewings which means that communication is multilayered in that it is read by many members of the community. The average length of message threads on the Kneeboard is 5.8 messages. In a recent survey of 204 online communities, Cummings et al. [2002] found an average thread length of 1.58 messages. Using average message thread length as an indicator of community interactivity [Rafaeli et al. 1998], it can be said that the Kneeboard exhibits a high level of interactivity. The data reveals that message threads containing between 9 and 48 messages represent 16% of all threaded conversations. Figure 2 presents the percent of message threads by length of thread.

A participation pattern emerges on the Kneeboard consisting of a group of key community members who participate in leadership capacities for long periods of time, members who have high participation rates for shorter periods of time, members who have been active participants and have left but come back to help new members for time to time, newcomers to the community, and those who do not participate but view the messages. This combination of participation patterns means that there are always newly injured individuals coming into the community who need information, advice, and support and there are long-term members who possess the knowledge and experience to meet these needs and have the desire to do so. This mix of a stable core of long-term members and newer participants is another important factor that contributes to the success and the vitality of the Kneeboard community.

6. ONLINE GROUP DYNAMICS AND GROUP MEMBERSHIP ROLES

Group Membership Roles Analysis and Interaction Process Analysis have been used since the 1950s for analyzing role differentiation in face-to-face groups and

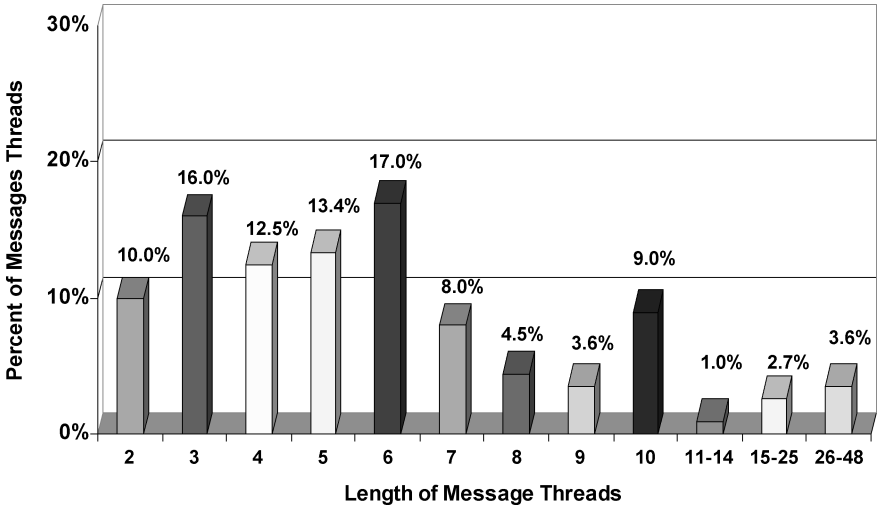

Fig. 2. Percent of message threads by length of thread.

forms of interaction (behavior) within a group. These tools are a standard part of leadership training for professions where people work with groups, for example, in social psychology, social work, mental health, healthcare, human resource development, management, community development, and education. They are used to identify the norms and values of a group and the predominant forms of behavior. These tools enable group leaders to understand the dynamics of interaction in a group and help diagnose problems within groups [Bales 1951, 1958; Benne and Sheats 1948; Brown 2000; Finn 1998; Forsyth 1999; Hare 1979; Hiltz et al. 1986; McGrath 1984; Mudrack and Farrell 1995; Sampson and Marthas 1990; Torres et al. 1996].

6.1 Group Membership Role Analysis

Group Membership Role analysis is a classification schema developed by Benne and Sheats [1948] for identifying differentiated group membership roles that is widely used today [Brown 2000; Finn 1998; Forsyth 1999; McGrath 1984; Mudrack and Farrell 1995; Sampson and Marthas 1990; Torres et al. 1996]. This method focuses on the behavior of individual members according to the roles they play in the group. Role differentiation is a pervasive characteristic of all face-to-face groups, formal and informal, and serves to divide the labor of the group to facilitate the attainment of the group's goals [Brown 2000; Forsyth 1999; Sampson and Marthas 1990]. Brown [2000] points out that roles within groups perform three functions: 1) they provide for a division of labor and specialization that prevents a few members from becoming overburdened; 2) they provide order and predictability in the life of the group because, functioning as norms, roles imply expectations about one's behavior and the behavior of others; and 3) they form part of group members' self-identity and their place within the group. Individual members may play more than one role. However, in order for a group to accomplish its goals, both the tasks of the group and the

interpersonal relationships within the group must be attended to [Benne and Sheats 1948; Brown 2000; Forsyth 1999; Sampson and Marthas 1990]. There are membership roles that are associated with accomplishing the task of the group and others related to attending to socio-emotional aspects of the group. Benne and Sheats' [1948] classification schema identifies 27 group membership roles divided into 3 major categories: 1) task roles related to goal-oriented, task-focused behaviors; 2) socio-emotional roles related to meeting the interpersonal and emotional needs of group members; and, 3) individualistic roles that serve the individuals' own needs and tend to impede group process. Our focus was to determine if members of an online group assume differentiated roles and if these roles could be identified through their textual messages.

6.2 Data Collection and Analysis Techniques

Four hundred ninety-two messages posted to the Kneeboard in the week of November 11–17, 2001, were coded by breaking each message into meaningful units and categorized according to the role played by the sender following the classification schema developed by Benne and Sheats [1948]. In order to control as much as possible for researcher bias, a second researcher coded the material and inter-rater reliability was established at 85% agreement between the researcher and the second coder [Maloney-Krichmar 2003]. An example of a coded message follows. In this message, it is possible to identify several different roles played by the member. It is a response to a message posted by a woman who had been told by an orthopedic surgeon that she was too old to have reconstructive surgery:

Posted By Betty
Date: Monday, XX November 2001, at X:XX a.m.

> "I am 49 now, 48 at the time of my knee injury. I posted about my 1 year Anniversary last Saturday . . . I only had a meniscus resection so I was scooting up the stairs on my but the first night and hobbling up and down the second day. (*information giver*) Just be careful and take it slow. (*opinion giver*) I was a slacker and didn't keep up with my exercises so I may still be having some problems. (*information giver*) Don't let that happen to you. Best of luck! Take care (*encourager*) Betty"

We are able to identify group membership roles though analysis of the text messages exchanged by Kneeboard members. Of the 27 group membership roles identified by Benne and Sheats [1948], 17 were demonstrated in the messages posted to the Kneeboard. Table III lists Group Membership Roles and those played on the Kneeboard revealed through the messages analyzed.

Analysis of the messages revealed that of the total number of roles played by community members, the three primary roles were *information-giver* (39.9%), *opinion-giver* (15.0%), task-related roles, and *encourager* (23.0%), a socio-emotional role. Task-related roles accounted for 70% of the roles played, socio-emotional roles accounted for 28%, and 2% were individualistic roles. This information shows that the primary activities on the Kneeboard are sharing information and opinions, and providing socio-emotional support for community members.

Table III. Group Membership Roles Identified by Benne & Sheats [1948] and Those Played by Kneeboard Members November 11–17, 2001

Group Membership Roles as Identified by Benne and Sheats [1948]	Group Membership Roles Identified in Kneeboard Messages November 17–21, 2001
Task Roles	
Information giver—provides data and facts	√
Information-seeker—asks for data and facts	√
Initiator—recommends novel ideas	√
Opinion-giver—provides opinions, values & feelings	√
Opinion seeker—asks for opinions, values & feelings	√
Elaborator—gives examples, rephrasing, implications	√
Coordinator—shows the relevance of each idea	√
Orienter—refocuses discussion on the topic	√
Evaluator-critic—appraises the quality of the group's methods, logic and results	√
Energizer—stimulates the group to continue working when discussion flags	√
Procedural technician—cares for operations details	
Recorder—takes notes and maintains records	
Socio-emotional Roles	
Encourager—rewards other thought agreement, warmth, and praise	√
Harmonizer—mediates conflicts among group members	
Compromiser—shifts position on an issue to reduce conflicts	
Gatekeeper-smoothes communication by setting up procedures and ensuring equal participation from members	√
Standard-setter—expresses or calls for discussion of standards for evaluating the quality of the group process	√
Group commentator—points out the positive and negative aspects of the group's dynamics and calls for change if necessary	√
Follower—accepts the ideas offered by others an serves as an audience for the groups	√
Individualistic Roles	
Aggressor—expresses disapproval of acts, ideas, feelings of others, attacks the group	√
Blocker—negativistic, and opposes the group	
Dominator—asserts authority or superiority	
Evader/self-confessor—expresses personal interests unrelated to the groups goal	
Recognition-seeker—self-aggrandizing	
Help-seeker—expresses insecurity, confusing and self-deprecation	√
Playboy/girl—uninvolved in the group	
Special interest pleader—remains apart for the group by acting as a representative of another group/category	

(*Source*: Forsyth [1999, p. 127]).

Researchers [Brown 2000; Forsyth 1999; Sampson and Marthas 1990] contend that roles function as norms. Therefore, it follows that the roles that members play on the Kneeboard express the values of the group. Information-giving, opinion-giving, encouraging, information-seeking, elaborating and commenting on the group are behaviors that help the group fulfill its purpose. Performing one of these functions fulfills the expectations held by community members that, on the Kneeboard, they will find information, encouragement, and people who care and pay attention to their problems and provide information and advice [Maloney-Krichmar 2003; Preece 1998, 1999, 2000; Preece and Ghozati 2001]. Research states that in face-to face groups the roles that members play provided structure and predictability in the life of the group and served as models for community involvement. They help establish the climate of the group by exhibiting what roles are accepted and respected within the community [Bales 1951, 1958; Benne and Sheats 1948; Brown 2000; Finn 1998; Forsyth 1999; Hare 1976; Hiltz, Johnson, and Turoff 1986; McGrath 1984; Mudrack and Farrell 1995; Sampson and Marthas 1990; Torres et al. 1996].

In the $2^1/_2$ years of observation of the Kneeboard, we found evidence of additional roles played by community members. The roles of reconciler and harmonizer were found in the exchange of messages; and, the roles of procedural technician and recorder were fulfilled by virtual Bob, his wife who lightly moderated the community, and the member of the community who maintained the library database pages of the site. Our findings show that even within the limited bandwidth of the Internet, people still play membership roles, and it is possible to identify group membership roles played by Kneeboard members through observation and analysis of the messages. In previous work, Preece identified a subset of these roles (e.g., requesting and giving information and support) [Preece 1998, 1999]; however, this research goes much further and shows more complexity in the roles played and in the distribution of task roles, socio-emotional roles, and individualistic roles played. We feel that group membership role analysis can serve as a useful diagnostic tool in the online environment for determining if there are differences in the stated purpose of a group and the roles that members play. Research shows that members of a group tend to be more satisfied when the purpose of the group closely matches the roles played in the group [Brown 2000; Sampson and Marthas 1990].

If the membership roles exhibited in the group act as norms and provide structure and predictability to the group as claimed by other researchers [Bales 1951, 1958; Benne and Sheats 1948; Brown 1996, 2000; Forsyth 1999; Mudrack and Farrell 1995; Sampson and Marthas 1990; Torres et al. 1996], then it should follow that the interaction (behavior) within a group reflects those roles. Interaction Process Analysis [Bales 1951, 1958; Forsyth 1999; Sampson and Marthas 1990] examines the interaction between group members. It resembles group membership role analysis but examines social behavior rather than the roles assumed by community members. We used Interaction Process Analysis to build an interaction profile that reflects the percentage of specific behaviors in which community members engaged.

6.3 Interaction Process Analysis

Interaction Process Analysis is a coding scheme devised by Robert Bales [1951, 1958] for classifying behavior (verbal and nonverbal) performed by groups [Forsyth 1999; Sampson and Marthas 1990]. Bales focused on behavioral patterns that emerge in a group in order to serve functions that are necessary for a group to accomplish its goals (i.e., succeed). Some of these functions are concerned with the tasks of the group and some are concerned with maintaining socio-emotional relationships within the group. Task-oriented behavioral categories include: *gives suggestions*, *gives opinions*, *gives information*, *asks for information*, *asks for opinion*, and *asks for suggestions*. Socio-emotional categories are divided into positive and negative behavior. Positive interaction includes: *shows solidarity*, *dramatization*, and *agrees*. *Disagrees*, *shows tension*, and *shows antagonism*s are negative interactions [Bales 1951, 1958; Forsyth 1999; Sampson and Marthas 1990].

It is possible to build an interaction profile of a face-to-face group by observing it and coding each behavioral act exhibited by a member into one of the twelve categories identified by Bales. By collating the observations in each behavioral category into the percentages of interaction in the various categories, an interaction profile can be constructed for the group as a whole, for individuals, or for the proportion of time each person spends interacting with others and in what manner [Brown 2000]. The interaction profile constructed in this study is a whole group profile. Bales' work with IPA reveals that, in laboratory settings, the interaction profile for a discussion group is relatively stable and consists of two-thirds task-oriented acts, one-quarter socio-emotional acts, and the remaining individualistic acts [Bales 1958; Brown 2000; Sampson and Marthas 1990].

6.4 Data Collection and Analysis Techniques

The messages posted to the Kneeboard in the week of November 11–17, 2001, were coded using Bales' [1951, 1958] classification scheme to systematically observe, record, and analyze communication on the Kneeboard. Each message posted to the Kneeboard in the week studied (492) was divided into discrete portions of behavior and coded. In order to control as much as possible for researcher bias, a second researcher coded the material and inter-rater reliability was established at 95% agreement between the researcher and the second coder [Maloney-Krichmar 2003].

The most common *task oriented behavioral act* in the week analyzed were *giving information* (33.5%); *giving opinions* (17.4%) and *giving suggestions* (7.3%). In the *socio-emotional behavioral category,* 25.8% of all behavioral acts were *shows solidarity*, 3.3% *dramatization*, 2.5% *shows tension*, and 2.1% *agrees. Shows solidarity*, *dramatizes*, and *agrees* (classified as positive interaction by Bales [1951]) constitute 31% of all interactions in the week analyzed. Negative interactions accounted for only 2.5% of interactions. Both the low proportion of negative interactions and the dominance of interactions in the categories *gives information* (33.5%) and *shows solidarity* (25.8%) shapes the character of the Kneeboard.

The interaction profile, based on this data, reflects a pattern of interaction that was 66% task-oriented, 31% socio-emotional-oriented and 2.5% negative behavior. This reflects a slightly higher proportion of socio-emotional interaction than usually found in face-to-face discussion groups [Bales 1958; Brown 2000; Sampson and Marthas 1990]. However, this in not unexpected as the interactions of the Kneeboard reflects the focus of the online community which is to provide information and support to persons who have experienced an injury involving the anterior cruciate ligament. As discussed previously, the narrow focus of the Kneeboard provides a guiding purpose for the community and fosters interaction that does not stray far from the purpose. The Kneeboard's interaction profile confirms the strong influence that the narrow focus of the group has on behavior within the community.

Group Membership Roles Analysis and IPA confirm the findings of previous research showing a high degree of empathetic behavior on the Kneeboard and the narrow focus of the community. The Kneeboard is an online support group whose purpose is to provide information, multiple solutions, personal experiences, and sources of support (social capital) to its members as they seek to overcome ACL injuries. The data gathered related to group membership roles and group interaction demonstrates that role differentiation and social interaction in online groups can be measured by tools used to examine face-to-face groups. In addition, the data provides valuable insight into the norms and culture of the online community just as they do for face-to-face groups [Brown 2000; Maloney-Krichmar 2003].

There is a great deal of literature that discusses the value of face-to-face self-help groups [Brown 2000; Davison et al. 2000; Forsyth 1999; Sampson and Marthas 1990]. However, to-date, there is conflicting information concerning the value of online support groups [Davison et al. 2000, Wellman et al. 2001; Cummings et al. 2001; Cotton 2001]. Research shows that members of face-to-face self-help groups bond because of compelling shared circumstances; that these groups stress the importance of reciprocal helping; and, that members are reassured by the fact that others share their problem [Jacobs and Goodman 1989; Forsyth 1999; Liberman 1993]. Our work suggests that there are similarities between the online Kneeboard community and typical face-to-face self-help groups. What is perhaps even more surprising is that a complex composition of roles and behaviors exists supported by such undifferentiated technology.

7. STRONG GROUP NORMS MAKE EXTERNALLY-DRIVEN GOVERNANCE UNNECESSARY

Membership roles played in a group function as norms (standards of behavior) as we mentioned in Section 5. They express the values of the community and provide models for members' behavior. Roles provide structure and predictability within the community and help establish the nature and characteristics of the group. As individuals find the Kneeboard and begin to read the messages posted to the message index, they see and experience the way in which members interact and the roles they play. This serves as a powerful example of how a

member should relate to and interact with the community [Maloney-Krichmar 2003].

The low levels of aggressive or hostile behavior and high levels of helping behaviors contribute to the members' ability to develop a sense of trust toward the online community. Trust develops from positive past experiences and through the reputation that the community members and the community develop [Preece 2000; Walther 1996; Walther and Boyd 2002]. The expectation is that future interactions will be governed by the norms they see exhibited in the community. So far, the work on trust in online communities has dealt mainly with individuals (e.g., Zheng et al. [2001]), but it appears that it also functions at the community level and grows out of a history of roles played and social interaction as preserved in the message index and archives of the community [Maloney-Krichmar 2003; Maloney-Krichmar and Preece 2002].

Trust is especially important in health communities and essential for reciprocity to occur in an online community. For an online community to succeed, members need to have a sense of trust that they will be treated with respect and care by the community, that their problems and concerns will be heard, and that others will provide information and support for them [Preece 1999, 2000; Walther 1996; Walther and Boyd 2002].

Ferguson [1996], of the Center for Clinical Computing at the Harvard Medical School, notes that what online self-helpers seek is information within the context of community. Research shows the positive and therapeutic value of helping others and that being helped by others reinforces the desire to play the roles that support the community [Davison et al. 2000; Finn 1998]. The norm of reciprocal-helping has been well documented in face-to-face self-help groups as well [Jacobs and Goodman 1989; Forsyth 1999].

This research suggests that the strong group norms of support and reciprocity, as exhibited in the exchange of messages on the bulletin board, make externally-driven governance unnecessary. This supports the findings the sociability evaluation described; the central position of the message board enables participants to see its purpose as expressed in the members' own messages, making the need for an explicit statement of purpose unnecessary. Interestingly, face-to-face self-help groups are generally self-governing; tend to stress the importance of treating all members fairly and giving everyone an opportunity to express their opinion [Forsyth 1999]. These finding reinforce the similarities between this online heath support community and characteristics of face-to-face self-help groups.

In the next section, we present what a representative sample of the Kneeboard participants shared with us concerning how their membership in the community affects their offline lives and what the Kneeboard means to them—the Kneeboard story in the words of its members.

8. MEMBERS REPORT A POSITIVE INFLUENCE ON THEIR OFFLINE LIVES

The researcher interviewed a sample of Kneeboard members selected from those who posted messages November 11–17, 2001. Interviewees were selected based on their roles in the community, their level of participation, and their

gender. The goal was to provide a view of the Kneeboard that represents a range of membership categories and levels of participation. The ages of those interviewed ranged from 19 to 45. A low level of participation was defined as posting between one and three messages in the week analyzed; medium was defined as posting between four to six messages, and a high level of participation was defined as posting seven or more messages. Table IV presents a summary of the characteristics of persons interviewed.

A series of emails was sent to each person who agreed to be interviewed with questions concerning the Kneeboard. The interviews were conducted online because it facilitated communicating with representatives of the community from across the United States and around the world. Online communication provides the opportunity for interviewees to receive the questions and respond to them at their convenience. It also provides time for them to think about the questions and review and edit their responses. In addition, Kneeboard members are comfortable with and accustomed to online communication.

The interview data was coded multiple times for themes. Each subsequent coding crystallized the thematic categories. Through the interviews, the researcher sought to discover the social and cultural context of the Kneeboard from an insider's perspective. This perspective is the heart of the ethnographic research approach in that it tells the story of the community through the words of its members. The ethnographic research approach is "concerned with people's lived experiences and is well suited for finding the meaning people place on the events, processes and structures of their lives" [van Manen 1977]. This approach accepts and documents multiple realities, thus guarding against the presentations of a stereotype of the community [Fetterman 1998].

When asked what motivated their initial participation on the Kneeboard, interviewees consistently responded with two reasons: to find information on knee injuries and treatment options was the major motivating factor, closely followed by the desire to find others who were dealing with knee injuries. Members explain the effects of their knee injury on their lives, their need for information, and the ways that sharing experiences help them cope.

Anna describes the typical knee experience from her point of view:

> "The "knee experience" is a relatively long term process for otherwise healthy people, which end successfully most of the time. It's also, for many of the board members, the first time they've experienced a major, incapacitating injury, and they a) don't know what to expect, b) are exasperated over the long recovery time, c) depressed about their newly limited mobility, d) scared about the surgery and recovery" (10/17/02)

Betty states that she was:

> "desperate for information and support after my knee injury in November 1999" (7/1/02)

Lauren, a physician indicates that:

> "I had an unusual, rare and serious knee injury which was not common even amongst sports medicine specialists. There was a lot of recent debate about the best management in terms of timing of surgery, type of surgery. I wanted to research the best possible treatment for my injury." (7/15/02)

Table IV. Summary of the Characteristics of the Kneeboard Members Who Were Interviewed

Name	Country of Origin	Participation Level	Participation in Kneeboard Clubs	Roles Played—The roles are listed in the order of the number of times the member played that role from highest to lowest.
Peter - Male	U.S.	High	Leader of Boyz Club	encourager, information-giver, information-seeker, initiator
Anna - Female	U.S.	High	Originated Mom's and Pop's Club	encourager, opinion-giver, information-giver, group commentator
Betty - Female	U.S. - lives in Japan	High	Originated the Old Broad's Club	encourager, information-giver, opinion-giver, group commentator, initiator
Barbara - Female	U.S.	High	Participated in clubs	encourager, information-giver, opinion-giver, group commentator
Chris - Male		Moderate	Participated in clubs	information-giver, opinion-giver
James - Male	India	High	Participated in clubs	information-giver, information-seeker, encourager, opinion-giver, group commentator
Mary - Female	U.S.	Was not represented in the messages analyzed	Lightly moderates the Kneeboard	
Holly - Female	U.S.	Moderate	Participated in Mom's & Pop's Club	information-giver, information-seeker, encourager
Susan - Female	U.S.	Low		information-giver, information-seeker, encourager
Sarah - Female		High	Participated in Old Broad's Club	encourager, information-giver, opinion-giver, evaluator/critic, group commentator
Mark - Male	U.S.	High	Originated the WiseA$$ Club	information-giver, encourager, opinion-giver, energizer, gatekeeper, group commentator
Lauren - Female	U.K.	Moderate		encourager, information-seeker, information-giver, standard-setter
Cindy - Female	U.S.	High	Originated the Boyz Club, participates in all clubs	information-giver, opinion-giver
John - Male	Canadian	Low	Manages the Knee Library	information-giver, opinion-giver
Sandy - Female	U.S.	Low		information-giver
Bill - Male	U.S.	Low		information-giver, opinion-giver
Jerry - Male		Low		information-giver, opinion-giver
Luke - Male	New Zealand	Low		information-giver
Jennifer - Female	U.S.	Low		information-giver, opinion-giver, encourager

Bill, a soccer coach, explains that his:

> "Initial motivation was to find out about surgical choices, successes and concerns, before my surgery. Post-op I wanted to find out about recovery issues and compare my own progress with others' so as to reassure myself that I was on course." (6/28/02)

Kneeboard members indicate that their membership in the community improves their offline lives in a number of significant ways. They feel that it helps their relationships with family and friends because the community provides a unique source of support during the knee injury and treatment period. A community member explains:

> "I have a very supportive family, not only my immediately family of husband and two kids, but also parents and a sister in the area. I also had friends at work. More to the point is that while they are supportive (help at home, rearrange life schedules to suddenly fit in surgery, pt etc) it isn't enough. I became totally focused on my knee for several months. It was literally all I thought about. I was thinking about recovery, exercises, the pain, icing, would I ever be normal—all the time. This gets very boring for the other people in your life. I went from being a balanced person with diverse interests to only caring about knee recovery. Then I found bob's acl board and I discovered there were a lot of other people in the same situation. I could ask them questions and get detailed answers on all the different thoughts I was having about my knee—was this normal, do you feel this way, what are you doing in pt, what is this little bump by the incision. Stuff that the os [orthopedic surgeon] and pt [physical therapists] were too busy to answer and the regular (non-acl patients) people in your life had no clue about." (Mary, 5/13/02)

Furthermore, Kneeboard members state that their family members and friends do not really understand how debilitating, painful, and anxiety-provoking a knee injury is. Sandi said:

> "Family is there for you, but they tire quickly of the situation and don't understand that our surgeries can take a year or longer to heal from." (10/20/02)

Mary sums it up this way:

> "... And it helped because I could get out all my frustrations and worries about my knee with other like-minded people and then return to my family and work. I didn't spend as much time obsessing about my knee with my family, because I could do that on the board." (5/13/02)

On the Kneeboard, members find people who understand and help them with information and support through a very difficult period in their lives.

Many community members express that the information they receive on the Kneeboard improves their medical care and treatment. They go to their physicians armed with information about treatment options and discuss them intelligently. They are able to assess the quality of the care they are receiving compared to other Kneeboard members and, in some instances, seek second opinions. Some community members locate doctors in their area based upon recommendations from Kneeboard members. Jennifer said:

> "Initially, the kneeboard was a huge source of information directly from people who have been through this injury. Like I said, I had no idea what was going

> on with this injury, and the physicians don't always have time to sit there and explain every little detail. In addition, I didn't know what questions to ask either." (10/22/02)

Betty's response touched on the focus of the community. She said she describes the Kneeboard to friends as:

> ". . . a great source of information and comfort during a very difficult time. Your activities are limited. You feel cut off from the outside world. Most on the Kneeboard feel the same, have the same questions, fears and elations. No one can understand the trauma of a knee injury until you have gone through it . . . I believe there are core values among the members who have been on the Kneeboard for a long time. They seem to keep the group in tow. By not letting the subject get to far side swept. Most messages are about knees." (7/30/02)

While community members report forming strong relationships and attachments with other Kneeboard members, some report that they do not have enough common ground (outside the knee injury) to establish strong offline relationships. Mark describes his offline meetings with Kneeboard members:

> "The other thing is that even when I met some of the people, there was limited things to talk about once you got past the introductions and knee talk . . . It was an interesting experience and that's about it! " (10/17/02)

The ability to build offline relationships is highly influenced by the geographic dispersion of the online community, some members do keep in touch via email with people they meet on the Kneeboard. Sarah talks about friendships she formed on the Kneeboard:

> "It's been nearly 3 years since the injury and at some point it is time to "move on". I do keep in touch via e-mail with 2 individuals from the kneeboard. These are 2 people I will not likely meet face to face, however through our mutual experience, I feel I know them." (10/17/02)

Kneeboard members report that participation in the community reduces the anxiety, depression, and isolation that often accompanies the long recovery from knee injuries and treatments. Anna describes the way the Kneeboard helps members cope:

> ". . . So, while going through the reconstruction/rehabilitation process, people seek information, advice, encouragement, compare notes on progress, etc. over a fairly long period of time, thus establishing themselves as contributing members of the community, which feels good emotionally at a time when not much else feels good emotionally." (10/17/02)

Membership in the Kneeboard enhances community members' sense of self-esteem by providing the opportunity to help others at a time when activities in their offline lives may be curtailed due to their injury and they may be more dependent on others for support. John, who manages the Knee Library, is a major contributor in the community. He explains how he feels when he helps others:

> "I also enjoy answering questions on topics I am intimately familiar with . . . It makes me happy when, as a result of my efforts, someone is better-prepared to deal with a knee problem." (7/24/02)

Some research indicates that time spent on the Internet might weaken relationships with a person family, friends, and other social commitments [Cummings et al. 2001]. However, members of the Kneeboard felt that membership in the community improves their lives in a number of positive ways: the online community provides useful information which helps them deal with a very debilitating injury, multiple treatment options, a long recovery period, and a variety of healthcare professionals. The online community is a source of comfort, support, humor, and shared experiences. The online community improves relationships with families and friends by providing an outlet during their treatment and recovery where they could vent when they needed to or provide help and assistance to others. Even those who are involved in the community for a short time assess their experience as positive.

We have seen how each aspect of the Kneeboard's structure—technical, dynamic, and social—contributes to the culture of the community. We know that members report that the community is of value to them and has a positive affect on their ability to cope with their knee injury. In the next section, we discuss these findings and present some recommendations.

9. DISCUSSION AND RECOMMENDATIONS

We embarked upon this study with the purpose of providing information, informed by research, which contributes to the ability of online community designers, developers, mangers, and healthcare professionals to find ways to build and maintain thriving online communities that improve the lives of people as they seek to cope with illness, disease, injuries, and health concerns. We used a multilevel analysis guided by the principles of ethnographic research. We asked the questions: What factors contribute to the vitality, longevity, and character of Kneeboard?; What are the norms, values, beliefs, and patterns of behavior and participation on the Kneeboard and how are they expressed?; What is the relationship between the social and technological aspects of the online community?; and, What role does the online community play in the lives of its members? Through a long-term immersion in the community as an observer, analysis of communication patterns and group membership roles, interaction process analysis, an analysis of the Internet site of Bob's ACL WWWBoard, and interviews with community members, we gained a deep understanding of the community, its technical and social spaces, and the relationship between them. The Kneeboard is a very successful online community by every measure: longevity, interactivity (length of message threads), no externally-driven governance, and members' reports of how their participation in the community improved their lives. The question then is: Why is this group so successful?

The community exists as an entity with a ready reservoir of social capital and a culture of general reciprocity [Putnam 2000]. Members may come and go, stay for a short time or a long time, or return periodically to celebrate overcoming their injury, but, the Kneeboard is always there 24 hours a day, 7 days a week. Well-established norms provide a model for interaction within the community that in turn provides a sense of continuity and stability.

The community provides bonding social capital and bridging social capital, linking members to resources within the group and outside the group [Putnam 2000]. In $2^1/_2$-years of observation, we witnessed the lively exchange of information and support in this intergenerational, international community. Many members indicated that they could not find the information resources that existed on the Kneeboard in their local communities. The variety of descriptions about injuries, treatments, and experiences found on the Kneeboard was a key attraction. In addition, even though the community is geographically dispersed, members did recommend physicians to one another, helped locate specialists (e.g., orthopedic surgeons who worked with children with ACL injuries), and recommended places to find knee braces to deal with unusual problems. Members reported that the information they received from the Kneeboard gave them a sense of empowerment that helped them interact more successfully with their healthcare providers.

Members of the Kneeboard reported that participation in the community positively influenced their offline lives in a number of significant ways. We found evidence that strong group norms of support and reciprocity made externally-driven governance unnecessary which is also similar to the way that many face-to-face support groups function. We found that membership patterns in the community and strong subgroup activity are key factors in the stability and vitality of the community.

Finally, the members are very satisfied with the technology that supports the community. Perhaps there is better or different software that the community is unaware of but their attitude to suggestions of change can be summed up in the old saying: *if it isn't broken, don't fix it.* This may cause a dilemma for human-computer interaction specialists, some of whom may argue that if only users knew what they are missing, they would want the newer technology. However, any change should be made with prudence.

Of course, being aware of the research in software support for online communities, we are prompted to reflect on how this community might react and benefit from design techniques of which they are probably unaware. For example, would it be helpful if developers allowed users to filter off certain types of messages so that they could see only the encouraging ones (to meet the need someone might have to be cheered up), or only the ones that discussed particular topics. Identifying encouraging messages on arrival would involve searching for supportive words and phrases. Visualization techniques might also be useful to allow participants to see how much activity there is on the board at any time, peak times and slow times, and who tends to answer particular types of questions [Donath 2002; Erickson et al. 2002; Erickson and Kellogg 2002]. Different types of participants could also be identified so that participants could see who the main opinion-givers are, who is supportive and how many people are lurking. Such techniques would also enable community moderators and managers to see whether it is a balanced community and how the balance changes from time to time. Visualization that allows community members to search for information together could help increase support for social activity [Cosley et al. 2003]. Participants could also be offered different ways of representing themselves, their emotional state, and the content of their messages

through a variety of software techniques. For example, log-in names could be enhanced with graphics and messages coded for content. However, as a medical community, it is likely that most participants will not want to include pictures of themselves or graphics, partly for privacy reasons and partly because such communities do not feel they are needed [Abras 2003; Abras et al. 2004]. An issue for designers is how to best expose participants to this range of possible enhancements without disturbing their day-to-day activity. The dynamics of community can be fragile and controlled studies are likely to be of limited value. Being able to balance the trade-offs of leaving well enough alone verses enhancing with technology needs to be approached carefully.

When we compare our findings to those of previous research in the field, we find some common elements. The study by Gustafson et al. [1994] found that people who used a Web site providing health information and a discussion group reported a higher quality of life and lower use of healthcare services. Our study, found that members of the Kneeboard reported that their participation in the Kneeboard helped them deal with their health concerns more effectively and improved their relationships with medical personnel. The study of participants in Hutchworld, an online community for cancer patients [Farnham et al. 2002], found that use of the online community helped maintain feelings of satisfaction with life and social support and that the asynchronous features were used more often than synchronous ones. Our findings showed that participation in the Kneeboard helped buffer community members from the isolation that often follows knee surgery and that the asynchronous nature of the Kneeboard was one of the factors that facilitated effective support within the community.

In the study by Braithwaite et al. [1999], researchers found that emotional support, information, and esteem support were the most common types of social support offered by community members and that humor was an important part of the exchanges between community members. We found in our study that information, emotional support, and encouragement also dominated the exchanges between community members, and humor played an important role in the community.

The studies by Cummings et al. [2002] and Turner et al. [2001] found that those who had lower levels of real world support turned to online support groups and that they reported the most benefit from the online support group. In comparison, Kneeboard members generally reported that they had good real world support, but found that the Kneeboard provided an important adjunct to that support during the long rehabilitation period by providing a ready audience for listening to all the gory details of the surgery/recovery and empathizing with their knee trials and tribulations.

The long-term study by Fussell and Setlock [2003] revealed that the ways in which chat is configured facilitate informal conversation in much the same way as physical proximity and that the sharing of virtual food, images and music, and excursions to other Web sites helped to build interpersonal relationships among community members. Our findings also suggest that many ways that people interact in face-to-face situations are replicated in the online environment. For example, we found that group membership roles and behavioral interaction on the Kneeboard were similar to those found in face-to-face

groups [Maloney-Krichmar 2003, Maloney-Krichmar and Preece 2002]. In addition, Kneeboard members also shared virtual food, the most common being virtual M & Ms offered as a form of sympathy or encouragement. As researchers continue their investigation into the dynamics of online social interaction, each new study adds valuable contributions and confirmation of findings to this ongoing discussion of how to build and manage successful online communities so they meet the needs of their members. We believe that what we learned in our study can help to raise awareness of important issues to be considered in other online health communities. In summary, this study revealed the following observations:

—While it is possible that netiquette policies may be needed early in the life of some online communities, the Kneeboard has existed very successfully for over eight years without them and with a minimal amount of moderating. Therefore, we recommend that effort focus on supporting the development of strong group norms without rules and policies that may inhibit participation. Effective moderation of inappropriate behavior may be a productive way to assure that positive behaviors serve as examples of appropriate interaction in the community. Alternatively, user data could be collected and fed back to the community as a self-assessment tool as Kelly et al. [2002] suggest. In addition, moderators and mangers should assume a low profile so that self-moderating can develop as a community norm.

—The prominent display of the message index appears to strongly draw participants into the community. Links to discussion forums seem to be too easily overlooked. Therefore, we recommend that designers find ways to achieve this by providing windows onto discussion boards.

—An important usability finding is that the service should be reliable and available 24 hours a day, 7 days a week. While this may be disappointing news for developers, it suggests that highly usable, reliable software is more important than software with a lot of features.

—The study demonstrates strong community development (i.e., reciprocity, similarity with face-to-face support communities, self-government, subgroup formation) despite there being little differentiation of the community space provided by the software.

—Since our research revealed that the existence of subgroups had a positive effect on the community, even though the software was not designed to support subgroups, we suggest that designers look for ways of supporting subgroup formation. However, it is likely that these subgroups should not have physical barriers that separate them strongly from the rest of the community activity.

—One surprise from out study was the lack of design support for sociability. For example, most developers recommend a strong statement of purpose (e.g., Kim [2000]; Preece [2000]), yet this community does not have that. However it has branding information that enables those with knee injuries to quickly determine what the community is about. We recommend that there should be branding of some sort, a statement of purpose, windows on to message

indexes, and/or a combination of these features to present the purpose of the community.

—The Kneeboard had an extensive library of research and journal articles related to knee injuries embedded in the Web site. Participants report that the information they gain on the Kneeboard is one of the primary reasons they participate in the community. The information provided in the online library supplements the information from fellow community members and provided a way for checking on the validity of information they received. Therefore, we recommend that designers and developers of online health support communities incorporate credible and trustworthy informational resources into the online community environment.

—Participants report that the online community provides an outlet for strong emotional needs they experience during the course of their recovery. Thus, it improves their offline lives by reducing the demands on real world caregivers and friends. We recommend that this information be made widely known to the medical profession so that they can consider using the Internet to provide better patient support. Of course, this effort must include teaching patients to be wise Internet consumers and online community participants.

The Internet has great potential for improving the lives of people with health concerns, but we must take great care to shape the techno-socio environment so that it enables and promotes the exchange of trustworthy information, shared experiences, and social support within the context of community.

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