

**UNDERSTANDING USER INTERACTION PATTERNS
IN HEALTH SOCIAL MEDIA**

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By

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ABSTRACTUnderstanding user interaction patterns in health social media
Katherine Y. Chuang

Internet users are becoming increasingly social in their online information behavior, as shown by a growing trend of social media adoption in the past decade. Social interaction patterns in this new space are governed by the technological affordances in the infrastructure and membership to the community, yet at times also by individual emotional needs for seeking social support. In the consumer health domain, social networking technology and consumer health information needs combine to show that even within the same community, relationships are not expressed in the same manner across various computer mediated communication (CMC) formats. The motivation for this research comes from an increasing need to understand the patterns of social interactions online, especially of e-patients using the Internet as a health resource.

Frequently, e-patients use social networking platforms to teach each other about conditions and treatments (Civan and Pratt, 2007; Wright and Bell, 2003). Social networking sites are predicted to increase in popularity as a way for people to socialize online as an extension of their physical environment. Online community tools include the popular text-based communication formats such as posting status updates, discussion boards and profile pages.

While many previous studies of online support communities identified sociability factors such as types of social support (i.e. informational support, emotional support) exchanged in online support groups and health outcomes, there is a gap in research literature concerning the design of software interface architecture. The central focus of this research investigated the impact of software features on online supportive communication behavior across multiple computer-mediated communication (CMC) formats. This research contributes insights to opportunities for design and implementation of social media technologies for online health support communities; scholarly literature regarding online support communities, and inform policy makers who determine

parameters for both design and management of online health support communities. The outcome of this study can contribute to improving online intervention programs by targeting specific functions of social network sites.

CHAPTER 1: INTRODUCTION TO PROBLEM

An online health support community is only as effective as the social interactions taking place through the technological platform. The means of achieving a well-designed online group communication tool comes from deep understanding of online communication behavior as impacted through the platform infrastructure, which can be gained through human-computer interaction (HCI) research. HCI is concerned with the way users interact with a system and with each other through the system – the extent to which users' comfort level is affected by the user interface and the overall system design. Specifically to the consumer health context, social interactions via technology can indirectly influence patient care, where positive interactions can lead to improved health outcomes. The advantages of exchanging social support through online communication vary along a spectrum of direct and indirect assistance. On one end it provides a sense of community to the user, a helpful environment to meet and discuss issues with people who are compassionate or knowledgeable about their particular situation. On the other end, participation in an online health support groups also increases the opportunities for social resources such as information quality and quantity. While many previous studies have already examined interactions among online peer support group settings of social support types exchanged, their operational definitions of an online community are too general in that they misleadingly consider just a single facet. In contrast each individual plays a certain role (support giver or seeker) and communication format features can impact communication within a community. This study addresses this different perspective of studying online community by using an HCI approach to make distinction between communication behavior and the communication software.

Over the years, an increasing number of users search for online health information. In addition to this metric, reports show that social media has become the most dominant Internet activity, which indicates a growing trend of consumers searching online for health information on social websites to hold discussions with other people. Health professionals are realizing the potential value in utilizing the natural flow of communication through technology in the effort to set up successful online health support groups. From the patient perspective, social support can come from a variety of sources such as one-on-

one buddy pairs, a group, or an existing social network. Informal observations of social interactions through social media indicate variations in social support exchanges among different text-based communication formats. However, little is known about the effects of the communication format design on social interactions.

The aim of this study is to better understand the impact of CMC format on supporting interactions of members of a community. Analyzing the content of user-created messages and resulting social network structure generated insights to better understanding of the impact of social media platforms on e-patient social support exchanges.

1.1 MOTIVATION

The motivation for this research lays in the fundamental uniqueness of each relationship and communication software features. Not all relationships or social roles in a group are identical, nor the means of communication; the balance between interpersonal relationships (i.e. acquaintances, professional, or personal contacts) and computer-mediated communication (CMC) formats (i.e. blogs, discussion boards, profile posts) has an effect on each other. Multiple research techniques were used in this case study to explore the social support interaction patterns that could occur among members of the same community.

This nuanced perspective is important in the specific context of consumer healthcare, where a majority of Internet users reported following medical advice or health information found on the Internet (Fox and Jones, 2009). Many indicated that the Internet played an important role in helping with at least one major life decision in the past 2 years regarding a medical condition or major illness (Fox and Jones, 2009). The same report showed that 28% believed the Internet helped them connect to people when seeking help in decision-making, and 30% said the Internet allowed them to compare options. E-patients also access user-generated or “just-in-time someone-like-me” health information (Fox and Jones, 2009):

- 41% of e-patients have read someone else's commentary or experience about health or medical issues on an online news group, website, or blog.
- 39% used a social networking site (i.e. MySpace, Facebook)

- 12% shared updates about themselves or viewed updates about others

The prevalence of users going online for health information and connecting with others through social media is evidence of a growing trend. The social aspects of healthcare may be supplemented with a virtual space, where people can discuss issues through social media. While physicians can provide expert knowledge about health, patients find around the clock social support to conducive with coping abilities with health concerns. This attention can come from social support, evident by expressions of concern or encouragement shared in support groups both exchanged face-to-face, or virtually through various text-based communication tools.

People interacting through various communication tools seek and provide different types of support from each. The presence of emotional support is influenced by the topic of discussion, the relationship closeness of community members, or the presence of women (Mo et al., 2009; Preece, 1999). Researchers typically find a greater amount of informational support than emotional support in online health forums, yet less opinionated conversations than politics (Himmelboim, 2008). In contrast, profile posts on MySpace and Facebook between friends are likely to show expressions of emotion and keeping each other updated (Thelwall, 2010). It seems as though there might be a pattern that could illuminate users' selection of communication tools and their usage. Existing issues that lead to a need for this study were culled from literature, theory, and practice. This is the first study in recorded history that determines where social support is exchanged across multiple CMC formats of a community using naturalistic data and mixed methods. Previously, the study of roles in social support exchanges was measured across face-to-face networks using surveys and measures perceived support (Boase et al, 2006; Wellman, 1981). In this investigation we focus on recorded transactions of support exchanged online. Results could inform future studies on social support networks and text-based communication tool design, thus leading to improvements in online community participation.

This research study was conducted for deeper understanding of the consumer health domain; communication tool usage indirectly impacted patient outcomes (i.e. positive mood, increased ability to cope with life changes). The communication tools may influence the relationship structure between two

individuals because of its communication properties, public vs. private personas, and other influences on behavior. Identifying broad behavior patterns in social interactions helped to identify types of users and the roles they serve within the community.

This is a timely topic because social media adoption is expected to continue to grow rapidly, leading to an increased demand for medical discourse platforms (Boase et al, 2006; Fox and Jones, 2009). Many support group users are drawn to these interactive e-patient services for the sense of community, in addition to seeking opinions or personalized information to help with making tough healthcare decisions (Adamic et al., 2008; Agichtein et al., 2008; Fox and Purcell, 2010; Leimester et al, 2008; Miller, 2010). Once friendships form, people will have increased interest in staying connected with their social circles, even through online platforms (NielsenWire, 2010).

This study seeks to address issues surrounding the infrastructure delineated by social software and by online support communities. Since not all connections are the same, a person may feel closer to their spouse than a cousin. Since not all CMC formats are the same, a person may feel more comfortable posting personal stories to a blog that friends follow rather than a discussion forum that many strangers read. By understanding support functions participation in online social networks, we can then pinpoint elements in an online communication tool design that exhibit and influence supportive interactions. Knowing what attracts and keeps e-patients actively participating in online communities could provide insight to health experts who look towards social technology as a means for creating communities in online intervention programs.

1.2 RESEARCH OBJECTIVES

The first objective revealed patterns within user created content and user relationships from the health social networking site. Meeting this objective helped to see patterns regarding participation in the MedHelp alcoholism community. The second objective compared three samples to reveal the infrastructure of the system. The main approach of this study is different from related studies in the comparison of CMC formats within a community, rather than comparing across multiple communities.

Meeting both objectives helped us understand the software and best practices to inform theoretical research of user-centered online community design. These objectives are summarized in Table 1.

Table 1. Study Objectives for Modeling User Activity

	Questions	Analysis
Content	What patterns of social support exchanges emerge across each CMC format?	social support types Nurturant and Informational
Relationships	What patterns of social network structure emerge in this online supportive environment?	structure of social networks (people relationships)

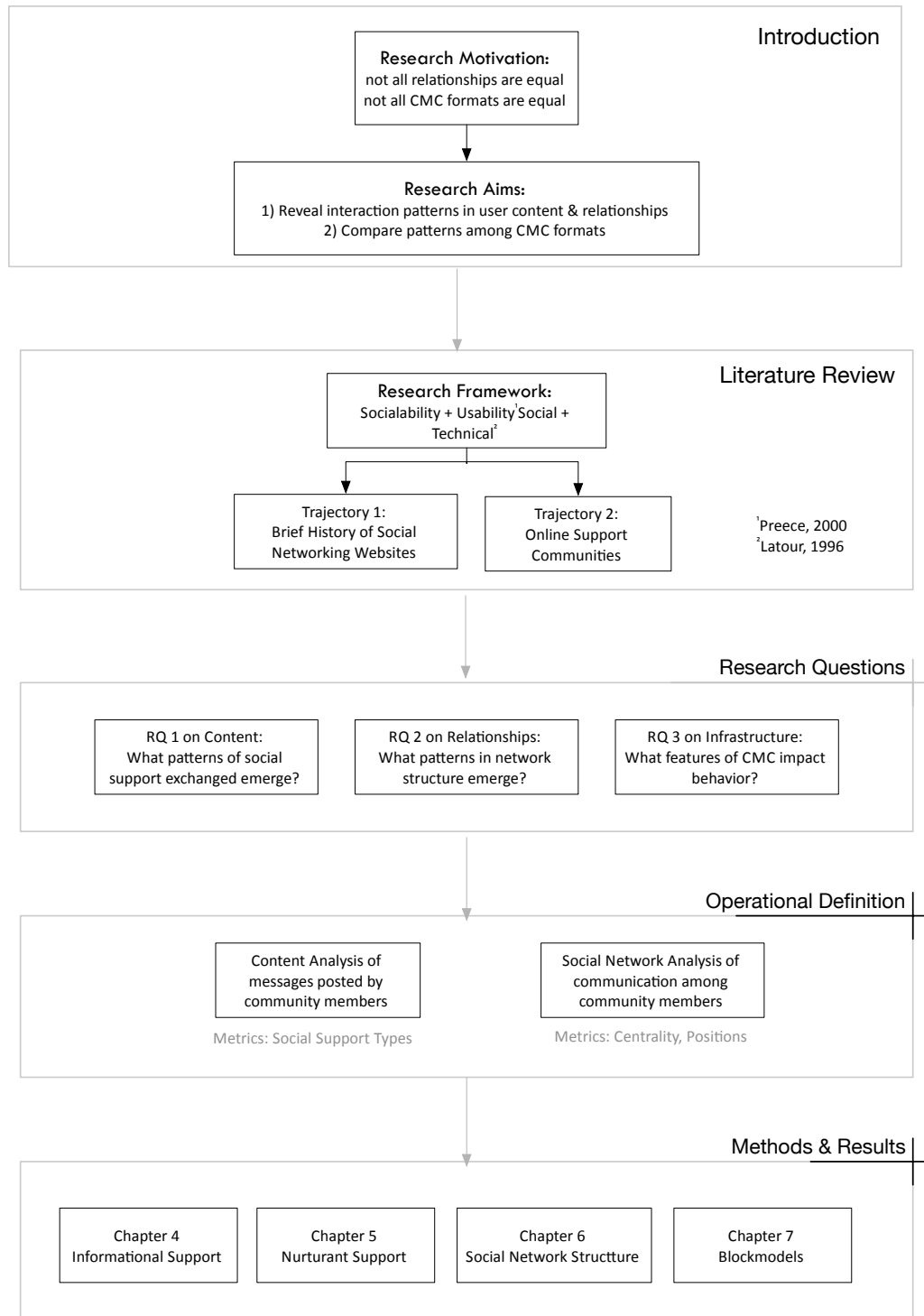
E-patients often prefer seeking out people who share similar experiences for medical advice (Ancker et al., 2009; Civan and Pratt, 2007; Wright and Bell, 2003; Leimeister et al., 2008). Additionally, e-patients turn to the Internet as a resource, building relationships while seeking support (Miller, 2010). Social support is a combination of informational support (i.e. facts, advice, or stories that are educational about similar situations) or emotional support (i.e., encouragement, empathy, validation), to alleviate distress over situations. (i.e. coping with a terminal disease, having children for the first time). A common example, a cancer survivor might dispense advice to a new patient about packing useful items for hospital stays. Social media emphasizes relationships through a networked public space with profile pages and options for public or private messaging (Boyd and Ellison, 2007). Examples include Twitter, Facebook, MySpace and many more health-oriented websites (i.e. MedHelp, PatientsLikeMe.com); each developed a unique culture due to web interface design (Papacharissi, 2009; Preece, 2000). Studying social interactions on this type of website could show us how people exchange social support with each other. For instance, people are more comfortable seeking help from people they have close relationships with (Ellison et al., 2006; Rau et al., 2008), so it is possible that individuals with stronger relationship ties exchange greater support than a pair with weak relationship tie.

The aim of this study was to reveal points where structure of the communication tool features impact social interactions. The results helped to explain how emerging Internet technology applies to a domain as specific as consumer health. The purpose of conducting this study – examining supportive social interactions exchanged among members of a community across multiple text-based communication tools – helped to create a list of suggested design criteria for online support communities.

Figure 1 shows the flow among chapters of this dissertation and how they fit together. The introduction chapter describes the motivation behind the research problem, and aims of the study to frame the rest of the document. Next, the literature review describes the theoretical framework for studying online communities from a socio-technical perspective. Because this a new area, the two trajectories of research topics reviewed include: (1) a historical view of software design patterns for online community type of websites comparing features and accessibility, leading up to social networking sites, and (2) the content exchanged within online health support communities. The two main research questions ask about patterns in social support exchanged within a community across multiple CMC formats and the patterns of network structure (Table 1). In Figure 1, the first two questions (RQ1, RQ2) fit into the broader question (RQ3) of CMC software attributes that impact user behavior. These questions were answered through content analysis and social network analysis to understand both the users' and the content they create. The results from these approaches are presented in chapters 4 through 7 (Informational Support, Nurturant Support, Social Network Structure, and Blockmodels). Finally, the discussion section provides explanation as to why there exist varying patterns among the three CMC formats.

This research is significant in contributing to deeper understanding of interaction patterns in social network structures across different spaces within the same community. Mixed methods approach generated results that support the idea that people choose specific communication tools for a purpose. The advantage of using unobtrusive data gathering techniques to make broad generalization about behaviors of social network structures opened up the opportunity for exploring social roles when interacting in online communication environments. Because the patients participating in an online health support community are solving personal problems, making personal decisions, or seeking information in social

setting, the analyses provide a layer of insight into an individual's role integrated inside an entire network. The analyses also revealed visual patterns of users' communication characteristics, the relationships between users and their social support needs from a support group, on a system that fosters the exchange of social support among e-patients. Examining patient-to-patient peer interactions can also increase recognition of common problems faced by health consumers as they seek or provide help such as recognizing common health symptoms or coping techniques (Civan and Pratt, 2007).



Figure

1. Summary Flowchart of Study

CHAPTER 2: LITERATURE REVIEW

The study of socio-technical systems such as an online community takes into consideration both an understanding of the social context and the historical trajectory of a system as well as the system itself (deSouza and Preece, 2004; Latour, 1992; Preece, 2000). This chapter presents two main sections of literature review for each side of socio-technical framework (Figure 2). The first section of this chapter describes the technology platform supporting the phenomenon, such as text-based communication tools and a comparison of their functions, as an historical perspective showing the evolution of the system features. The second section of this chapter describes social support types found in online patient communities and benefits from participation in online support groups. Together, these two sections form the literature review, which provides a brief history of social networking sites (SNS) and findings from related studies that investigated social support in online communities. The study focused on the communication tools available in social networking site and the social support exchanged across them, which are distinguished as two trajectories: technical and social aspects of online support communities (Latour, 1992). Preece (2000) encourages looking at sociability and usability separately to allow designers to focus on specific issues separately, yet also to study how the two aspects work with each other to understand both the infrastructures separating invisible spaces and actors within the community.

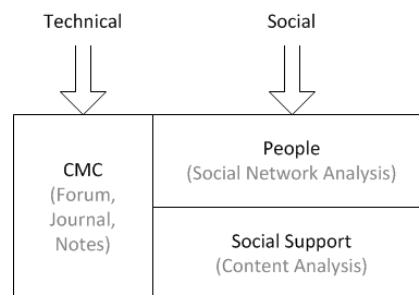


Figure 2 Literature review covers SNS design (left) and online communities (right)

2.1 BRIEF HISTORY OF SOCIAL NETWORKING SITES

Social media in its current modern-day form serves many social purposes ranging from a wide array of personal to business reasons; some specialized in niche topics and services. Available communication tools allow quick and easy publishing of various content types, to allow individuals to meet new connections or to keep in touch and share information easily. For example, the top ranked social media website, Facebook, is an example of friends to staying connected through many tools (i.e. profile posts, private messages), which in turn makes it possible for users to form online communities (i.e. group page discussion). Many popularly known websites for online communities include:

- Social networking, such as MySpace, Facebook, and LinkedIn
- Distributed marketplace retail, such as eBay
- Post-sales support sites
- Collaborative knowledge transfer sites, such as Wikipedia
- Social bookmarking, including sites such as Digg and Delicious

2.1.1 COMPUTER MEDIATED COMMUNICATION SOFTWARE

The evolution of SNS originated with a technology called UseNet, a software that enabled users to share announcements to an entire newsgroup. This was operating as a peer-to-peer network, which lacked centralized servers and did not include dedicated administrator staff (Boyd & Ellison, 2007). In their paper describing the history of SNS, Boyd & Ellison (2007) point out the two branches of software that emerged from UseNet, one type for passive content following and another for active engagement (Figure 3). The former passive content following activity is now referred to as Rich Site Summary (RSS) feeds, typically enabling easy syndication of content and used by readers for following blogs and other newsletter style content that is meant as a one-way dissemination. The latter active engagement type of website are discussion groups supported by bulletin board system (BB). The first version of BB software was originally hosted on personal computers and allowed one user to log in at a time, but later evolved

into online services that incorporated asynchronous chatting such as AOL, ICQ, IRC (Boyd & Ellison, 2007).

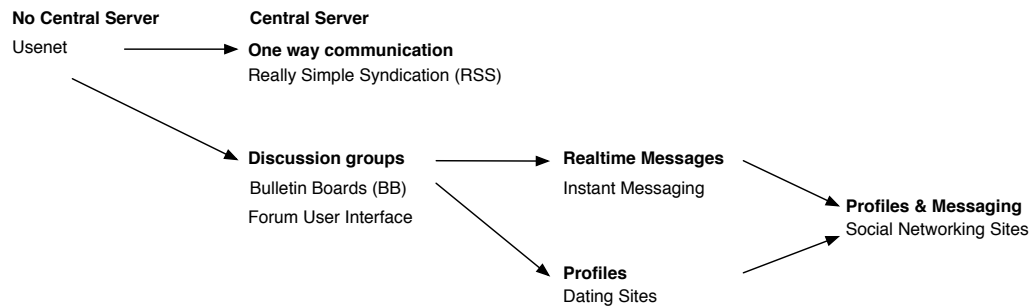


Figure 3. Social networking sites evolved from other social software

A parallel branch of social technology software emerged as well around this time; dating sites and forums (Boyd & Ellison, 2007; Croenen et al, 2006). Dating sites allowed users to create profiles (with photos) and emphasized contacting other users but little knowledge shared. Forums descend from the BBs features with added user-friendly interface and administrative features to manage content and users, in which users share knowledge through discussion threads. Both types of technologies allowed users to contact each other, however did not have features for tracking lists of friends.

At a later stage, realtime messaging and profile sites matured into social networking sites and became popular as a way for people to represent themselves online with a personal profile page: SixDegrees, AsianAvenue, BlackPlanet, MiGente as seen in Figure 4. A similar trend of using profiles also occurred in blogging community platforms such as LiveJournal and Xanga. There were also massive multiplayer online role-playing games (MMPORGs) where users interact both in the augmented reality system and in real life. For example social interaction within group games was set up for tactical purposes. The early 2000s brought major advances to social network sites for making connections with the introduction of features that permit searching for friends and ‘friends of friends’ on Friendster and

suggesting ‘people you may know’ on Facebook; this was further advanced with the feature of finding people with common interests in movies, music, food and the like (Boyd & Ellison, 2007; Lampe et al, 2007).

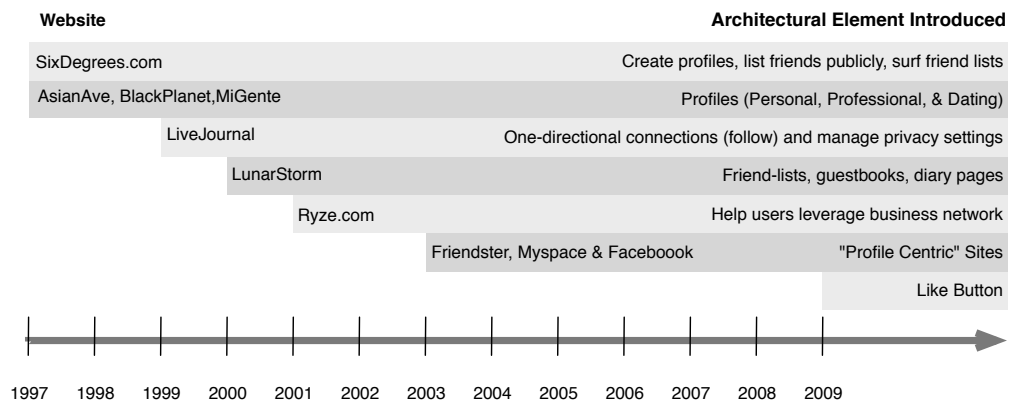


Figure 4. Timeline of social networking sites and their introduced features

Three commonly used social networking sites (LinkedIn, MySpace, and Facebook) were designed with similar features for displaying social contacts and both private and an array of public messaging features. LinkedIn, created in 2003, allowed users to post profiles that essentially truncated professional resumes and interact with contacts through a personal messaging system. LinkedIn users can join groups and post to those discussion boards, as well as post status updates. MySpace was founded in the same year, but focused on the users’ personal rather than professional connections - introducing ability to personalize themes such as customizable layout of profiles, embedding music/videos of favorite music artists, and thus quickly became the most popular website. Additionally, MySpace allowed communication through several formats: private messages, public comments posted to a user’s profile, and bulletins sent out to all connected friends. Public messages on profiles were brief as opposed to prolonged exchanges, such as for keeping in touch and for birthdays (Thelwall & Wilkinson, 2010). Blogs were also a big part of MySpace profiles, with each member automatically getting a blog with their

account. Later additions to MySpace’s functionality include the addition of real-time status updates and news feed showing friend activity. (Boyd and Ellison, 2007; Lampe et al, 2007; Papacharissi, 2009; Thelwall & Wilkinson, 2010)

Facebook membership initially started accepting students exclusively from Harvard University in 2004, and then later expanded to include students from other universities, high schools, businesses, and then finally accepting public membership from everyone. Facebook had limited functionality, profiles allowed users to customize content of a few fields, but not the layout. Users could choose from a few different methods of communication: private messaging, as well as writing on another user’s wall. Wall posts are visible to that user’s friends, but usually not to the general public. Users could easily change their privacy settings to allow different users to see different parts of their profile, based on any existing relationships (the basic privacy settings are “only friends”, “friends of friends”, and “everyone”). Users can post notes that are visible to all of their friends. Users can also comment on or, more recently, “like” the posts of their friends, and conversations often occur within the comment sections among multiple people (Lampe et al, 2007; Thelwall, 2010; Thelwall & Wilkinson, 2010).

		Website Content			
		Text		Multimedia	
Immediate response desired	News Feed Mobile Email	Twitter Instant Message Online auction	Webcam, voice over IP, augmented reality		
Response deferred to later time	Search Engine Product Reviews E-mail, Blog	Forums Blog comments Wiki	Maps, Video and Photo sharing	MySpace Facebook LinkedIn	
		Lurker	Very active	Lurker	Very active
		Participation Level			

Figure 5. Common social website types by communication style of audience

Around this time in web history, discussions comparing different social network websites appeared. Figure 5 shows an example of how the different websites may be classified into quadrants

characterized by the website content (either text or multimedia websites), with different aspects of communication such as participation level and response time for the intended audience (Warfield, 2008). These aspects influence the communication behaviors on social media. In the top left quadrant, the text based formats that require a shorter response time, such as twitter feeds and instant message. The top right quadrant includes high-fidelity multimedia format that requires an immediate response, such as web cam and augmented reality. In the bottom right quadrant, multimedia sites include sharing photos, videos, maps, or even an integrated social networking site that enables sharing of these content. Finally, in the lower left quadrant, use of email, blogs, and forums do not require immediate response and generally text-based. A health support community would be a participator type of website, located in the 'defer' and 'text' quadrant in the lower left, with both freeform and structured communication. In the health domain, patient peer-to-peer communication often happens across broad geographic and time distances, so the communication is typically asynchronous and text-based, such as those in the bottom left quadrant.

Niche community SNS, such as Ning, and Photobucket, Flickr, YouTube, Revver, Delicious, Digg (social news), and Reddit also offer people to network with others who have similar interests and build communities. The latest wave of introduced social interaction features shown in Figure 4 was real-time updates, also known as microblogs. Twitter (2006), Posterous (2009), Tumblr (2007). Mobile devices such as iPhone and Blackberry made these real time updates even more popular; these services are integrated into SNS. Figures 6-8 show the layouts of some of the user interfaces for various websites.

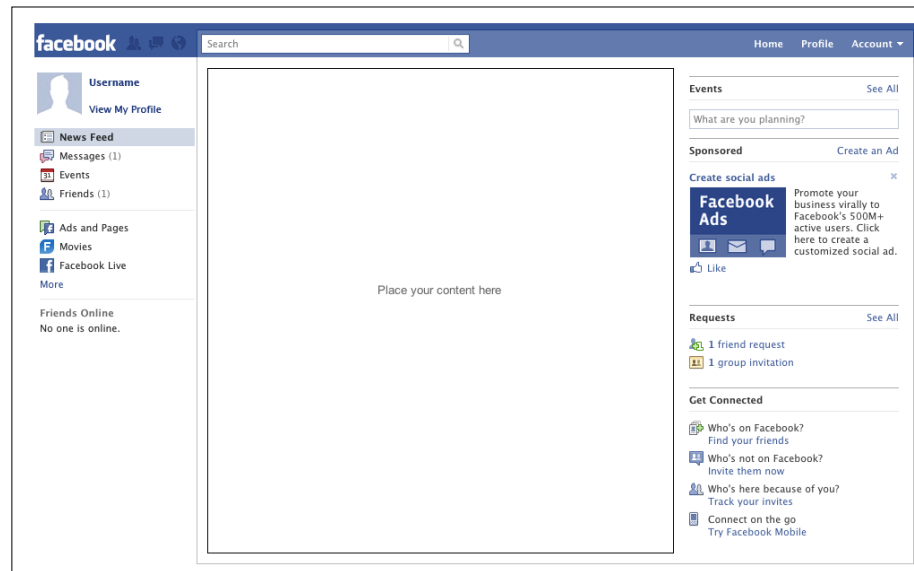


Figure 6 Facebook.com, home page a social networking website

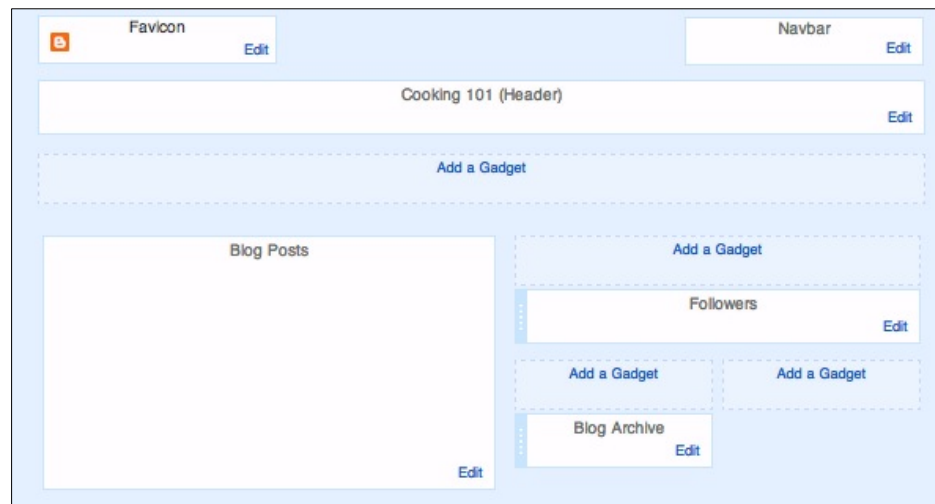


Figure 7 Blogger.com layout wizard for blog

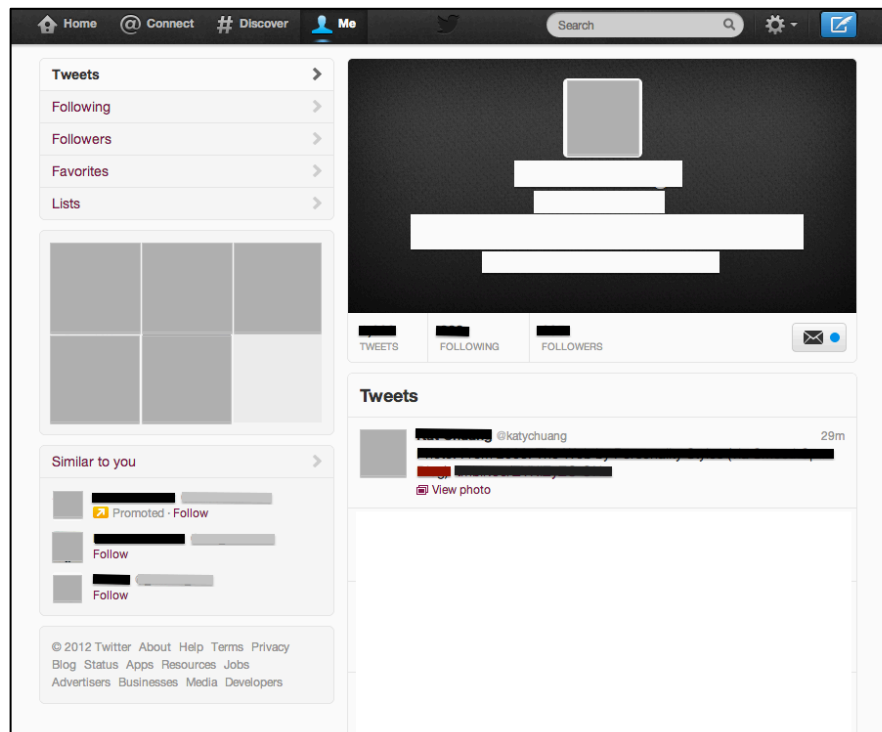


Figure 8 Twitter.com, a status update microblog website

2.1.2 FEATURES IN TEXT-BASED ONLINE COMMUNICATION TOOLS

Users select a communication tool based on the purpose for their communication (e.g., seeking information vs. seeking empathy) as well as relationship strength with recipient; “not all communities are supportive, and not all types of ties provide similar kinds of support but rather vary in characteristics and kinds of support they provide” (Chuang and Yang, 2010; Wellman and Wortley, 1990). Selecting a CMC format because of ideal intimacy with another member of the community is creates a stronger tie, and intimacy is built upon trust (Gilbert and Karahoulios, 2009; McKenna et al, 2002; Radin, 2001). Review of relevant SNS literature shows that the design of sites may impact the behaviors of registered members (Boyd & Ellison, 2007; Lampe et al, 2007; Papacharissi, 2009; Thelwall & Wilkinson, 2010). These

concepts are important considerations for the design of text based computer-mediated communication (CMC) tools.

In contrast to profile posts and blogs, discussion forums are *public, communal space* for finding people to ask questions and fishing for information. Ancker et al (2009) compare a forum and a journal formats; while both enable asynchronous, interactive discussion, forums are mainly used for broadly disseminating content among the community whereas journals targeted towards the few individuals who subscribe to new posts. Croenen et al (2006) suggest a multi dimensional view of SNS websites with three levels. At the basic level, SNS allows people to represent identity and allow people with mutual/compatible interests to find each other. At the second level (dyadic), users can create contacts, make use of the internal messaging system, and write testimonials for identify feedback (i.e. notes format). The final level (group) includes features such as the forum for allowing overlap between areas of knowledge and management of social networking system and community informatics. This framework fits with the approach for this case study that incorporates multiple research techniques.

For instance, a discussion board may be employed in the first steps of information seeking because it is similar to a main public road that gets lots of traffic. The prominence and ease of navigating to the forum space factor into higher traffic through that CMC format. When users desire to exhibit nurturant support to another individual, they may prefer the more intimate nature provided by limited access controls (i.e., privacy settings) that come with the journals format and the notes format. Furthermore, users may be more comfortable in requesting certain support, which may influence their selection of communication tool (Chuang & Yang, 2010). A summary of tool characteristics is displayed in the chart below (Table 2).

Table 2. CMC formats found in MedHelp

CMC	Access	Tags	Other features
Forum	Public – read and write posts and comments	Yes	Select topic, Add to watch list, Show Ticker
Journal	Everyone (read and write comments), Only Me (read and write posts and comments)	Yes	Show Ticker, Add Photo
Notes	Everyone (read and write notes) Friends (read and write notes), Only Me (read notes)	No	Add as friend

On the MedHelp website, each of the three CMC formats have their own attributes. The forum is a public page where any MedHelp user can start a discussion thread and anyone can reply to it. Journal owners can start blog posts and only the public can only respond. Notes are even more restricted than journals, the owners cannot write notes to themselves. In addition to these features, forums and journal posts can be tagged.

Table 3. Publishing features for common CMC formats

Mode	Designed Type	Access	Distribution	Who can post?	Who is displayed prominently?
(microblog)	Broadcast	Private Public	1 to 1 1 to many	Account holder	Author
Social Network Profile Page	Guestbook Testimonial	Private	1 to 1 1 to many	Authorized	Profile
Blogs	Diary	Public Private	1 to many	Main author(s)	Author
Guestbooks	Guestbook	Private Public	Many to 1	Anyone	Host (not guests)
Forum	Forum	Public	Many to Many	Anyone	None. Discuss topic

In addition to message privacy settings, social network site privacy can be set to different levels of access of friends, friends of friends or everyone. For example, Facebook allows custom settings for various elements in an online profile (Figure 11). These settings can strongly influence the writing style of posts, when authors are aware of self-presentation (Raban, 2009).

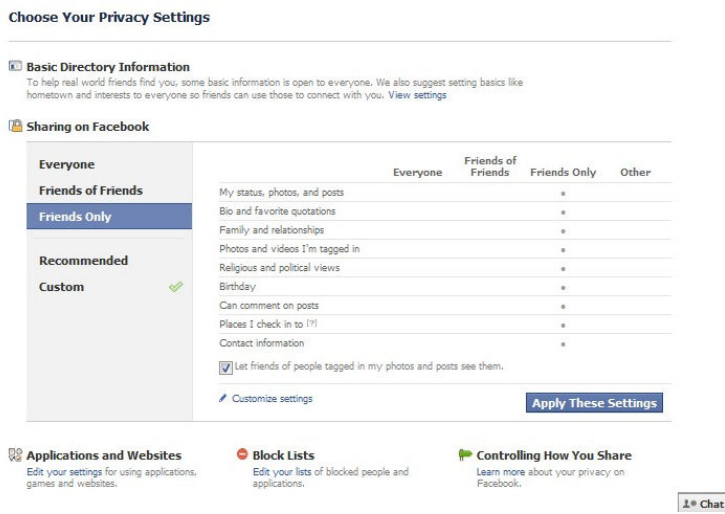


Figure 9. Privacy settings for Facebook social networking site

Selection of a communication channel for posting a message is influenced by whom the writer believes will be able to access the message. For instance, an individual may reduce their emotional expressiveness in a hostile online community, whereas be more vulnerable with friends. Users have multiple channels through which to communicate social support needs, depending on their circumstances.

SNS allow users to represent themselves with an online presence that contains shareable personal info (boyd & Ellison, 2007). In addition to profile information, social network sites (SNS) also includes a 'friending' feature and communication functions. Profile information typically includes: username, personal or biographical information, demographic information, contact information, interests such as favorite books and movies, and uploaded media content (i.e. photos, videos). The friend feature in social network sites is convenient tool to exchange messages and stay in touch. (Ahn et al, 2007). Friends can communicate using several tools, including private and public messaging systems (Thelwall & Wilkinson, 2010). Some communication functions offer more privacy (i.e. private messages) in the sense of less stumble upon traffic and others more visibility (forum or group page posts). Privacy allows for more intimate conversations, which indicate more trust between two users (Radin, 2009) and leads to greater levels of supportive or emotional communication (Leimester et al, 2009; Thelwall, 2010; Online support groups) and information self-disclosure.

Social media allows user creation of multiple media types -- text, photos, videos, audio files, and links -- for easy sharing. The content can be displayed on personal profile pages, journals, or discussion boards. Users can also privately message each other. Other indirect communication functions that allow social feedback include “like”, gifts, pokes, and application invites. This information allows researchers to cluster users based on content (Liu et al, 2008; Thelwall, 2009).



Figure 10. Users can share various text and photo media formats

The visual aspect of the profiles and tool layout on the screen may affect the perception of these tools. For example, a journal displays posts by a single author whereas posts on a profile page contain multiple authors. Communicating online, especially through use of an SNS, provides benefits at varying levels. It encourages “disparate individuals” to connect, communicate, and take action. (Ellison et al, 2009) Especially because identity information from online profiles can assist in developing common ground and facilitate initial interactions.

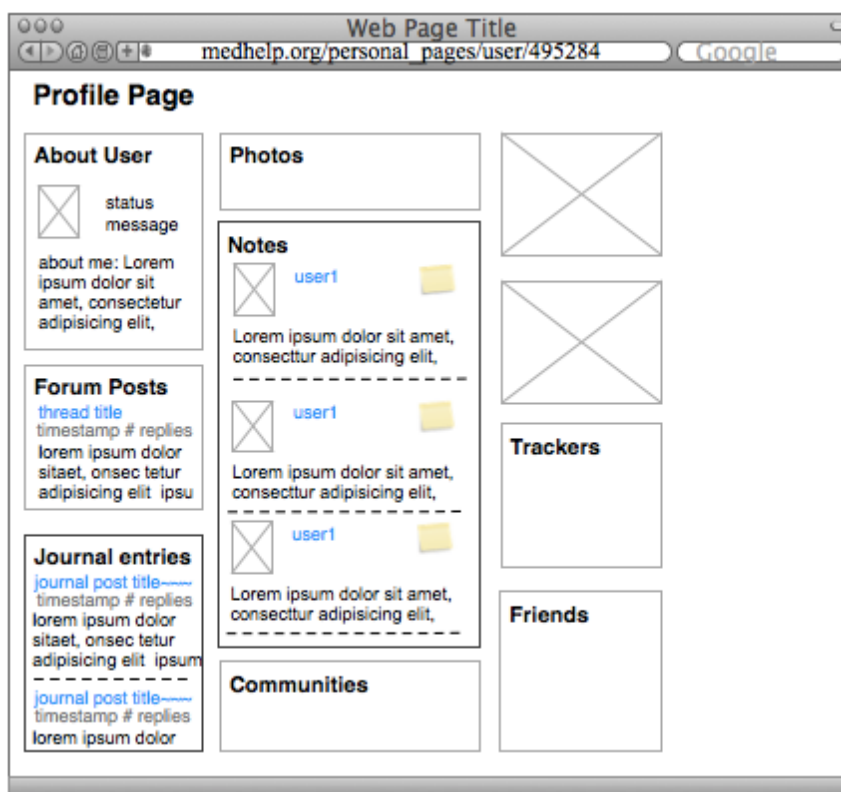


Figure 11. Friends and messages displayed on user's profile page

The online setting affords anonymity, relief from stigma, and connections outside an immediate local network of contacts (Owen et al, 2003; Wright & Bell, 2003). Individuals participate in online communities to help others (i.e answer questions), exchange ideas, and debate around topics of interest (Fox, 2009). In the traditional face-to-face environment, it could be difficult for some patients with rare diseases to get a sense of community, especially when stigma is attached to their condition (Wright & Bell, 2003).

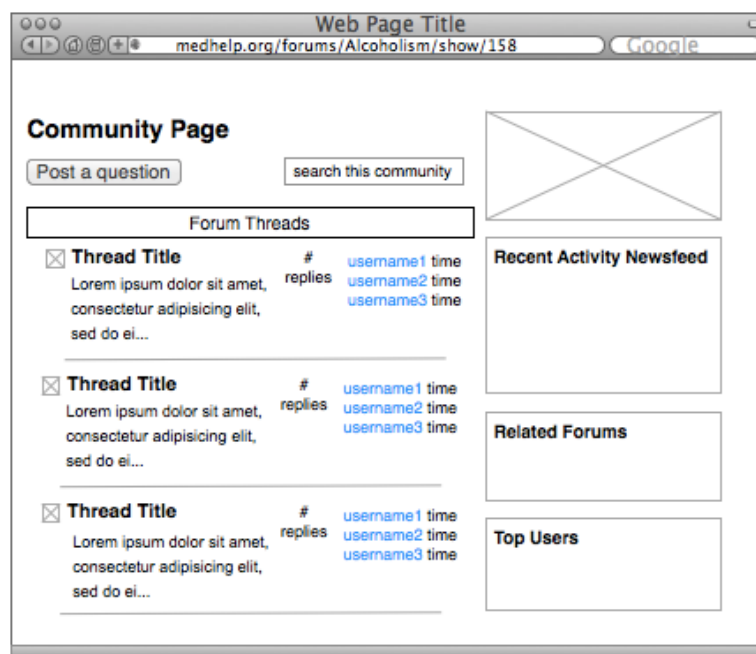


Figure 12. Community activity (messages and updates) displayed on a MedHelp public forum page

Selection of the multiple communication functions within a social network site for relationship maintenance or information seeking depends on the users' comfort level with another member of the community as well as the level of intimacy in the conversation (Chuang & Yang, 2010; Rau et al, 2008).

Social media serves multiple purposes in everyday lives: networking and expanding social circle, for purchasing and selling items, bookmarking and news sharing, collaboration, and also support. These activities can cross multiple domains: general every day, business, news, education, health, etc. Often communities form through these activities. Many researchers study the social interactions among multiple planes (community, interpersonal, individual) (Ellison et al, 2009; Heo and Breuleux, 2009). Medhelp communities have the social tools mentioned in this section, however for this study the focus is on the forum, journal, and notes CMC formats.

2.2 ONLINE HEALTH SUPPORT COMMUNITIES

Social support is typically found exchanged in health oriented communities compared to other types of communities (i.e. sports), but can also be found in in general SNS between friends (Preece, 2000; Thelwall, 2010). Social support research covers a wide range of fields and domains. In earlier research of this field, the concept of social support was generally defined as resources available from friends, family and acquaintances (Bambina, 2007; Cobb, 1976; Faber and Wasserman, 2002; Wellman, 1981). Social Support Types Categorizations of social support types range from simple to more complex (Bambina, 2007; Barbee and Cunningham, 1995; Caplan, 1979; Cutrona and Suhr, 1992; House, 1981). A summary of these categorizations is listed in Table 4 in chronological order.

Table 4. Classifications of Social Support

Caplan (1974)	2 dimensions: objective vs subjective; tangible vs psychological Financial Aid, child care = receiving financial aid Touching, smiling, information = percept of comfort, hope received
House (1981)	<i>Emotional support</i> (i.e., concern) <i>Appraisal support</i> (i.e. affirmation or feedback) <i>Informational support</i> (i.e., advice or suggestions) <i>Instrumental support</i> (i.e., physical assistance)
Cutrona and Suhr (1992)	<i>Informational support</i> <i>Tangible assistance</i> (physical or instrumental help)
“Social Support Behavior Codes framework”	<i>Esteem support</i> <i>Network support</i> (connecting an individual to helping others) <i>Emotional support</i> *Contains 23 subcategories of behaviors under these five types.
Barbee and Cunningham (1995)	(a) <i>Solve behaviors</i> (problem-focused approach) (b) <i>Solace behaviors</i> (emotion-focused approach) (c) <i>Dismiss behaviors</i> (problem focused-avoidance) (d) <i>Dismiss behaviors</i> (problem focused-avoidance) (e) <i>Escape behaviors</i> (emotion-focused avoidance). * Contains 26 subcategories listed under these five types.
“Interactive Coping Behavior Coding System”	
Bambina (2007)	<i>Emotional Support</i> : Understanding/empathy; Encouragement; Affirmation/ validation; Sympathy; Caring/concern <i>Informational Support</i> : Advice; Referral; teaching <i>Companionship</i> : Chatting; Humor/teasing; groupness

2.2.1 SOCIAL SUPPORT TYPES

Though there are numerous variations on the definition of social support, in this study it is defined as a social network's provision of psychological and tangible resources intended to benefit an individual's ability to cope with stress; information leading the subject to believe that he or she is cared for (Chang, 2009b; Cobb, 1976; Cohen, 2004; Coursaris and Liu, 2009; Cutrona and Suhr, 1992). Two primary forms of social support were identified through literature review: (1) resources intended to assist distressed individuals to solve or eliminate programs directly relating to causing distress and (2) emotional understanding to comfort support seekers (Cutrona and Suhr, 1992).

The first type support solves or eliminates situational problems by providing information or tangible support. Information resources include: offering advice, information referral, and insights from personal experiences, or opinions (Cobb, 1976; Cutrona and Suhr, 1992). Instrumental support includes offering financial assistance, services to relieve stress, active participation, or willingness to help. The second form of social support comforts stressed individuals by making the recipient feel cared for without direct efforts to solve problems causing the stress. This form uses verbal or nonverbal communication such as compliments, recognition, or validation, to help a person have a sense of acceptance and belonging with similar people. Other types of positive group interactions include introductions, expressions of gratitude, or congratulations (Chang, 2009b). Social support types can occur alone or in combination (Bambina, 2007; Eichhorn, 2008; McCormack, 2010; Radin, 2001; Winzelberg, 1997; Wright and Bell, 2003).

Table 5. Main Social Support Types

<p>(1) Resources that assist individuals. <u>Informational Support</u> is information relating to treatment or coping with withdrawal symptoms, such as clarifying problem or making suggestions Examples include:</p> <ul style="list-style-type: none"> • Advice: offers ideas and suggests actions; provides detailed information, facts, or news about the situation; or skills needed to deal with situation. • Fact: reassesses the situation and presents facts. • Personal experience: stories about person's experiences. • Opinion: a view or judgment formed about something, not necessarily based on fact or knowledge. • Referral: refers the recipient to some other source of help. <p><u>Instrumental Support</u> is provision of material or financial aid, or services. Examples include:</p> <ul style="list-style-type: none"> • Loan • Perform Direct Task • Express willingness 	<p>(2) Emotional understanding to comfort individuals. <u>Nurturant Support</u> is expressing signs of listening, expressing sympathy, or expressing the importance of relationship. Comforting can help people think more clearly about problems. Examples include:</p> <ul style="list-style-type: none"> • Esteem: positive comments to praise support seekers abilities or to alleviate feelings of guilt. <ul style="list-style-type: none"> ○ Compliment ○ Validation ○ Relief of blame • Network: messages to help support seeker from feeling alone. <ul style="list-style-type: none"> ○ Access ○ Presence ○ Companions • Emotional: providing understanding of situation, express sorrow, provide with hope and confidence. <ul style="list-style-type: none"> ○ Relationship ○ Physical Affection ○ Confidentiality ○ Sympathy, Understanding/Empathy ○ Encouragement ○ Prayer
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Multiple social support types occur in online health support communities, typically more informational than emotional support¹; however the reverse combination can also occur (Braithwaite et al., 1999; Preece, 1999). This could be related to factors related to health condition – stress level, stigma of disease, or chronic conditions – since empathetic communication tends to occur when sharing difficult life experiences (Preece, 1999). Variations in support type levels may also be explained by coding definitions, however overall these studies show that supportive communication is a vital element to health communities. Finally, the very act of providing support is as encouraging to the receiver as actualized support (Haines et al., 2002).

2.2.2 SUPPORT IN ONLINE HEALTH COMMUNITIES

Various aspects of social support in an electronic environment among e-patients have been studied for decades (Allgower et al., 2001; Braithwaite et al., 1999; Chang, 2009b; Civan and Pratt, 2007;

¹ Studies that categorize support types in the Social Support Behavior Codes Framework (Cutrona and Suhr, 1992) found that users are more likely to exchange information than any other type of support, except in the studies by Bambina and Braithwaite.

Coursaris and Liu, 2009; Cunningham et al., 2008; Eichhorn, 2008; Helgeson and Cohen, 1996; King, 1994; Pfiel and Zaphiris, 2007; Swickert et al., 2002). For example, previous investigation found characteristics of the user created messages, such as question type (White, 2000), content of questions (Cunningham et al., 2008; Pfiel and Zaphiris, 2007), and levels of support. Social support positively influences adjustment to living with cancer and other health conditions (Civan and Pratt, 2007; Helgeson and Cohen, 1996; Swickert et al., 2002). However, researchers suggest that the health outcomes improvement may be linked to the perception of available support on part of the online support group participants rather than actualized support (Faber and Wasserman, 2002; Haines et al., 2002; Swickert et al., 2002). The availability of online support groups 24/7 and large membership size with individuals with similar interest in talking about the health condition offer a perception of available support.

Health outcomes from participating in support groups include improved coping with stress (i.e., crisis recovery or relocation), or even disease prevention. These changes were shown in a number of health domains, namely: eating disorders (Eichhorn, 2008; Winzelberg, 1997), HIV/Aids (Coursaris and Liu, 2009), psychosis (Chang, 2009b), breast cancer (Civan and Pratt, 2007; Helgeson and Cohen, 1996), smoking cessation (Burri et al., 2006), and depression (Pfeil and Zaphiris, 2007). Social support is a potentially valuable behavior change technique (Wantland et al., 2010), such as helping alcoholics quit their drinking habits. These outcomes were measured using physical metrics (longevity, mobility, reduction of medicine, quicker recovery), social metrics (less health services used, productivity), and socioemotional metrics (harmony, increased hope, greater satisfaction, less anxiety) (Gottlieb, 1983).

A person's health is related to availability of supportive ties because social relationships impacts health status, health behaviors, and health decision-making. According to the Conceptual Model for the Relationship of Social Networks and Social Support to Health (Glanz et al., 2008), individuals are situated in an environment that includes family and social institutions. An individual's social network provides supportive resources for their physical, mental and social health such as buffers to stress (Cohen, 2004; Wright and Bell, 2003). For instance, healthy adults who were more socially integrated (i.e. married, close friends and family, belonging to social groups) tend to have better health than those who

were not (Cohen, 2004). However, in the case of alcoholism where stigma is attached to this health problem, the anonymous nature of the Internet is an advantage that encourages users' participation with online groups.

CHAPTER 3: OPERATIONAL CONCEPTS: TECHNICAL AND SOCIAL ASPECTS OF AN ONLINE COMMUNITY

The research framework for this study follows the two aspects laid out by socio-tech researchers Bruno Latour (*Technical* and *Social*) and Jenny Preece (*Usability* and *Sociability*), by separating the technology and human factors to study each separately (Latour, 2000; Preece, 1999). In this research the individuals in the online community were studied with multiple techniques and multiple data sets to understand the content of their messages and the relationships they share with each other, in order to contrast from the technology infrastructure made available by the web design. The technology is studied through common web design research method similar to those used in evaluating wireframes to understand the tasks a user can perform through the website. Figure 13 below breaks down the five concepts addressed in this study, two of which belong to social component (individual relationships and the social support exchanged) and three belonging to technical component (the three CMC formats). These elements were measured separately and explained in chapters 4 through 7.

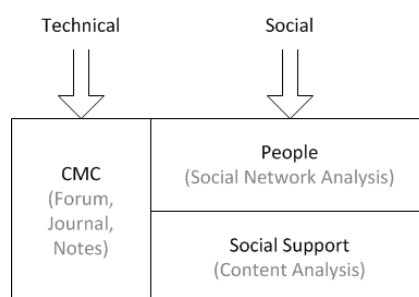


Figure 13 Operational Concepts: Technical and Social aspects of an online community

The intersection of social media and consumer health serves as the context for this study. The proliferation of health social media allows the public to share intimacies of their life with strangers. Individuals access online support groups to interact with others and share information, emotional support, and companionship while overcoming stigma associated with their health conditions (Bambina, 2007; Wright and Bell, 2003). While online support groups formed in previous decades were created on email

lists and discussion boards, more recently adopt social media features that can allow for more flexible types of communication with peers. An individual's coping mechanisms to life problems can vary among different approaches and require different types of social support (Greenglass, 2008; Lazarus and Folkman, 1984). Informational support tends to be a problem-based approach that may be due to an immediate problem such as finding the right doctor or medication for treatment (Dwyer and Cummings, 2001). In contrast, an emotional-based approach of sharing nurturant type of social support does not have the same time-sensitivity limitations and thus the parties could wait for a more intimate, personal environment to feel comfortable sharing expressions of comfort.

Publicly available e-patient messages from the MedHelp Alcoholism Community were used as data for answering the research questions and described in detail in section 3.1. Research methods extracted support type and relationships based on user-generated conversation in the community, to expose interaction patterns among each text-based computer-mediated communication format. By sifting out the support exchanged among users and different communication formats, the investigation indicated which CMC formats were better suited for emotional vs. informational interaction. Although the selected primary research techniques are detached from personal perspective of members in the community, they are sufficient for answering the research questions and provide groundwork for describing the landscape; future work could focus on more participant engaging forms of data collection such as interviews with the members of the community. Finally, the research questions were compared across multiple communication formats. This study attempts to answer these the research questions in this process:

1. What are patterns of informational support exchanged in the community across each CMC format?
2. What are patterns of nurturant support exchanged in the community across each CMC format?
3. What general communication patterns in the social network structure emerged?

By answering these questions, it was possible to describe what the social networks look like on a health social network site; for example, who people interacted with and how. It can also offered insights on the impact of social media platforms on e-patient social support exchange.

Table 6. Types of Evaluation Methods for Online Communities

Evaluation Type	Qualitative Data	Quantitative Data
Subjective	Ethnographic Data, Observations (Baym, 1993, 2000; Hine, 2000)	Online surveys (Andrews, Nonnecke, and Preece, 2003).
Objective	Content analysis to categorize user comments, seek to identify patterns and frequencies. (Herring, 1992, 2004)	Usage logs to generate data for statistical analysis (i.e. social network structure) (Wellman and Gulia, 1999a, 1999b)

In effort to show validity of the selected datasets and research techniques, some preliminary research is included in this chapter. This work uses publicly available data from an online health focused SNS, e.g., MedHelp, to study the associations between the social network structures of three different computer mediated communication (CMC) formats in this site. Network approach is used to explain communication patterns within a network and how they can be measured. Wasserman and Faust's (1994) definition for social networks is used, "a finite set of sets of actors and the relation or relations defined on them" (Wasserman and Faust, 1994, p. 20). These methods are sufficient for this study to describe how social media sites are used.

3.1 DATA SELECTION

Data for this study comes from MedHelp.org, the oldest and largest health community on the Internet, with over a million unique visitors each month. According to the website, this community is, "*a place where people who try to help themselves or their loved ones quit drinking can propose questions or offer supports. The community covers topics ranging from health issues, how to quit, reasons to quit, relapse prevention, and friend and family support.*" The Alcoholism community was selected based on its relevance to the research objectives of understanding the social (sociability) and technical (usability) aspects. To investigate *sociability*, the examination revealed patterns and structures based on the content and relationships by extracting social support themes using content analysis and relationship patterns using social network analysis. To investigate *usability*, the examination delineated the infrastructure for

the community by comparing features of the three CMC formats to understand the software architecture's influence on social behavior.

The research process began with data collection with a web crawler, and then cleaning to prepare the data for the two analytic techniques. In the first step, a custom developed web crawler downloaded all publicly available text messages from the MedHelp alcoholism community. This includes all forum threads (i.e. - text, timestamps, and user IDs), journal posts (text, timestamps, and user IDs), and notes. Data downloaded includes basic information from each registered user of the alcoholism community, his/her personal profile page, which contains all of his/her journal posts, and received notes. The data collected includes first available message of the community member in 2006 until September 26, 2009. There are 737 forum threads in total; each received an average of 7.2 comments. Journal posts average at 2.4 posts per profile page, and each journal post received an average of 2.3 comments.

While online support groups possess some similarities to face-to-face groups (i.e. sharing personal experiences, social comparison, and collaborative healthcare decisions making), the outcomes of this study differ from those studying interaction of face-to-face groups (Fjermestad, 2004; Lau and Kwok, 2009). Scholarly literature of online support communities currently does not acknowledge the impact of software features on user behavior, namely: relationship formation and social support exchanges. Understanding the distinctions helped us improve design of successful consumer health support communities, which should facilitate personal experience sharing, support exchanges, and opinions to help with decision making and to help people gauge their progress in coping with situations (deSouza and Preece, 2004; Gurzick et al, 2009; Lau and Kwok, 2009; Otterbacher, 2009; Preece, 2000). While this case study uses objective and quantitative ways of gathering and analyzing data, it does not replace the traditional qualitative methods.

3.2 DEFINITIONS OF OPERATIONAL CONCEPTS

A *community* is a group a people who have a shared purpose or common interest and relationships that crisscross one another (Etzioni and Etzioni, 1999). An *online support community* is a

particular type of community brought together by a technical platform for a shared specific interest (i.e. related health questions), such as to share emotional support or advice (Eysenbach et al., 2004; Leimeister et al., 2008; Preece, 2000). These online support communities may include patients suffering from a variety of health conditions, or their caregivers. Users participate in these support communities for many reasons, such as to find peers with similar experiences and to seek social support.

In this study we viewed communication in the context of *computer-mediated communication* (CMC), which is a text-based format. More specifically our data is collected from a platform known as a *social networking site* (SNS), which contains both communal and personal communication spaces. CMC could be used for communal or personal reasons. Communal CMC is accessible by anyone on the Internet, where new messages are easily noticed. An example of a communal CMC is the MedHelp forum, which is a discussion board for a group to discuss matters, where anyone can post or comment. Personal communication is more restricted area in the sense that limitations are placed on authorship and viewership, along with limited signaling of new content. Examples of personal communication include the MedHelp journal and notes features. The journal is an extension of a user's profile page, diary-like communication tool for recording thoughts. The notes feature is a portion of a user's profile page where "friends" can leave comments, typically used to keep in touch.

The users in the MedHelp Alcoholism community exchanged *social support* (O'Reilly, 1988). Social support can include *informational support*, which is information relating to treatment or coping with withdrawal symptoms, such as clarifying problem or making suggestions. Another strain of social support is *nurturant support*, which is expressing signs of listening, expressing sympathy, or expressing importance of a relationship.

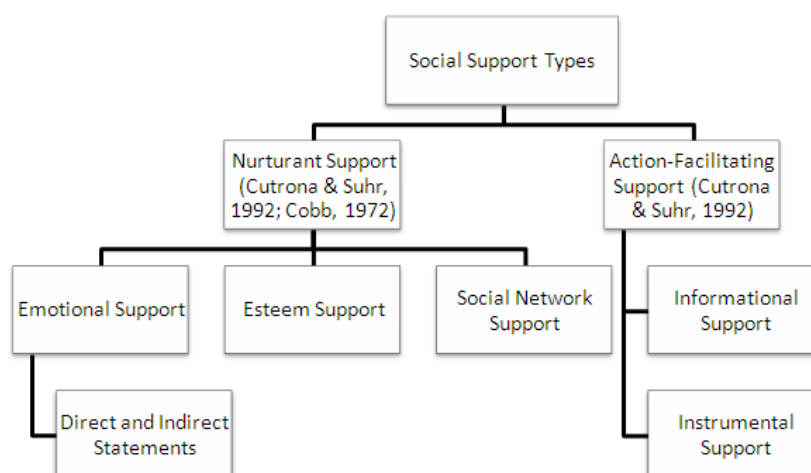


Figure 14 Social Support Types

Informational support includes *advice* (ideas and suggests actions), *facts* (i.e. assessment of the situation), *personal experiences* (i.e. stories), *opinions* (view or judgment formed), or *referral*. Nurturant support includes *esteem* (positive comments), *network* (messages to help support seeker from feeling alone), or *emotional* (expressions of sorrow or providing confidence). These support types were investigated with content analysis techniques (Hsieh and Shannon, 2005; Krippendorff, 2004). In some cases, a message could have multiple types of support occurring.

3.3 ANALYZING MESSAGES POSTED BY COMMUNITY MEMBERS

Content analysis was an appropriate and sufficient approach for finding observations of elements of text-based communication tools that have effect on the exchange of social support, and help illustrate examples where people choose certain communication tools (Riordan and Kreuz, 2010). Content analysis is highly used in social sciences and is an inductive method analogous to seeing trees of a forest (Krippendorff, 2004). With this method, tallying is often used to identify patterns in the data and also to bring contextual meaning to codes. To ensure reliability, another individual researcher conducts content analysis with the same set of operational definitions to show how well the definitions are set using the inter-coder reliability metric. This metric was calculated separately for informational support types and nurturant support types, and described in more detail in chapters four and five.

The purpose of using content analysis was to find common themes in the data to allow identification of communication trends of an individual or group. Elements for analysis include the channel and the message. The channel can allow for analysis of persuasive techniques or stylistic markers in the communication. The message can show trends of communication content or to map related characteristics to messages produced. These advantages of this research method would be useful in understanding the use of a social network site by inferring patterns from user to user communication. By looking for social support types, it would be possible to identify when, where, and how much support is exchanged in the community. In this process, one looks for contextual themes in the data that represent ideas and expressions. Of the multiple content analysis methods, summative content analysis was selected for its purpose in looking context of words used (Hsieh and Shannon, 2005).

Social support occurs everyday as support leading to a general sense of well-being and at critical times. The 3 common elements of social support exchanges are: (1) an interactive process in which (2) particular actions or behaviors, and (3) can have a positive effect on an individual's social, psychological, or physical well-being (Lehto-Järnstedt, 2000). While these traits are important for social support studies, the timeliness of support is not distinguished in the content analysis for this study.

3.4 PRELIMINARY RESULTS – SOCIAL SUPPORT PATTERNS

Generally, the preliminary results from content analysis showed distinct user interaction patterns on each format depending on whether the community member was seeking answers to the questions related to their health condition, or seeking emotional support. Over the course of preliminary analysis, it also became clear that an association existed with the software communication privacy control features (i.e. viewable by friends, public, or self) for each format influenced identifiable user interaction patterns. Given the differences among these three CMC formats, the third research question aims to better understand how user interaction behavior varies across these different CMC formats for users of the same community. The result of this study would help us to answer many practical questions about the design; such as whether the display of messages to audience will impact how often users will post to that format.

Data Collection and Description

A web crawler crawled through the online community to copy publicly available data in the online Alcoholism community from the first message in 2006 until September 19, 2009. This data included the community forum and the list of community members. The community list was used as a reference list to scan each user's profile page for journal entries and notes received from friends using the same time period. Data collected with this process covered a time period of 24 months, where 2611 unique registered users posted at least once in forum ($n_{FP}=737$, $n_{FC}=5317$), journal ($n_{JP}=1083$, $n_{JC}=2440$), or notes ($n_N=9510$) totaling 19,087 messages. This total refers to users that started a forum discussion thread or replied, wrote a journal, replied to a journal, or composed a note (Table 7).

Table 7. Downloaded data from MedHelp Alcoholism Community

	Time Period	# of users	# of posts	# of comments
Forum	24 months	568 start threads 628 comment 887 total participants	737	5317 comments
Journal	24 months	84 authors 674 comment 702 total participants	1083	2440 comments (average 2 per post)
Notes	24 months	205 receive 1529 posting 1645 total	9510	n/a

The most current three month time period of user-created messages (June 19, 2009 to September 19, 2009) was selected to make the analysis of this data feasible. The resulting samples include the discussion forums ($n_F=493$), the user journals ($n_J=423$), and from notes ($n_N=1180$). The forum messages and journal messages were subgrouped into *posts* (i.e. messages that start the thread) and *comments* to the post due to the way these messages are displayed on the user interface. The data sets encompassed 81 forum posts; 412 forum comments, 88 journal posts, and 335 journal comments (Table 8).

Table 8. Sample sizes selected for data analysis (3 months)

Sample	Forums	Journals	Notes
Size	493 messages	423 messages	1180 messages
Posts	81 forum posts	88 journal posts	
Comments	412 forum comments	335 journal comments	

Each message had unique user-related markers along with the published content. The figures below show how messages in each format are formatted on the screen. The forum messages are displayed in a column of boxes on forum page (Figure 15), where each box has a thread title, followed by author and avatar and time stamp, then an excerpt. The right side of the box shows number of comments and how long ago they were created. The journal messages are displayed in a column of boxed on a user's profile page (Figure 16). Each box contains a title, timestamp, and an excerpt. There is no author stamp because these journals are located on a user's profile pages. Notes are also found on each user's profile page (Figure 17). They are shown in a column of boxes, where each box contains the author, timestamp, an avatar, type of note and the note itself. Each user's profile page also contains a list of forum posts the user created. But for an overall view one would have to visit the forum page. This alone shows a communal space and a more personal space.



Figure 15. Forum threads view

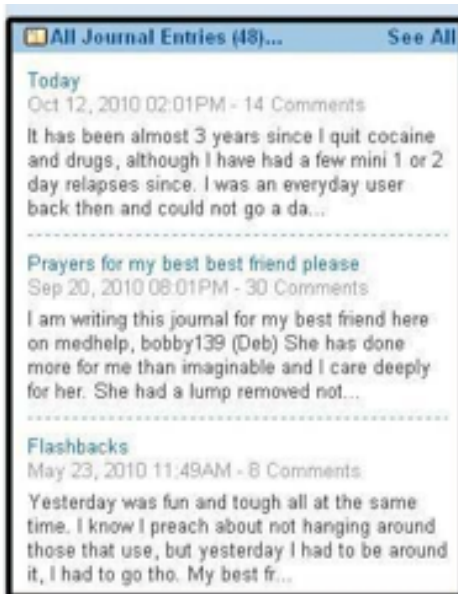


Figure 16. Journal posts view



Figure 17. Notes format view

Users are identified in the community by a combination of username and user number – i.e. *abcdefg(12345)*. The users in the community tend to refer to each other by their username, and may sometimes shorthand it affectionately, for example *ibi* was used as a nickname for the individual *ibizan*. An example of forum comment with use of nickname: *“hi. ya, ibi is correct, excessive alcohol consumption, especially with someone who is chemically dependent, can trigger totally uncharacteristic and sometimes violent outbursts in the kindest of souls. i was never very violent drinking, but my personality did shift. frequently there is a jekyll/hyde scenario, and the drunk side of the equation can be unpredictable. take care, gm”*

Other summary information about the messages in the sample

First this process identified both top level informational and nurturant support in the samples (both those provided and requested) and present these findings first before presenting the analysis specific support types of each. There was a range of message characteristics. While on average, a message contains 2.57 social support types; the maximum was 10 codes per message in a comment message.

Forum posts tend to have less codes, the maximum found was 6 codes. Some messages only offer support (i.e., “Have you tried Naltrexone? It is supposed [sic] to help with the cravings there are other meds that can help with it too. If all else fails, make a picture of tea and pop some popcorn and hang out with him with your “drink”), or only request support (i.e., “Hi, is there a medicine to take to stop the craving for alcoholic drink?”).

The results from this content analysis are presented in the following pages. The notations for each of the samples are (FP) Forum Post; (FC) Forum Comment; (JC) Journal Post; (JC) Journal Comment; (N) Notes.

Table 9. Amount of Informational and Nurturant Supports

	Offered		Requested	
	Nurturant	Informational	Nurturant	Informational
FP	16%	82.7%	44.4%	7.8%
FC	67%	85.2%	6.3%	15.5%
JP	73.9%	92%	36.4%	13.6%
JC	82.1%	51.9%	4.2%	8.4%
N	84.9%	57.5%	1.4%	20%

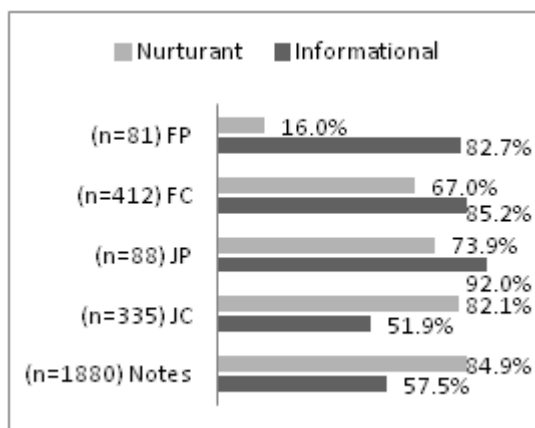


Figure 18. Support Types Offered

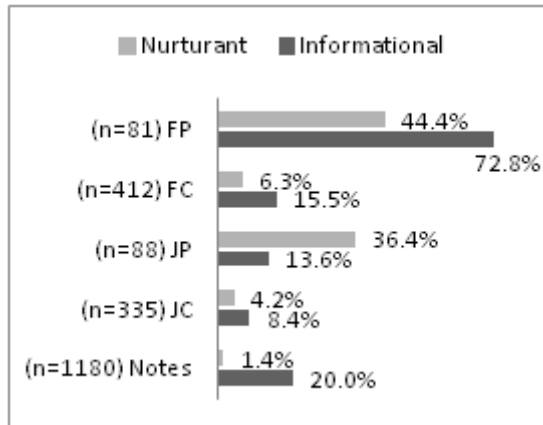


Figure 19. Support Types Requested

Three clusters showed up in the data, shown in Figure 20. The percentage P indicates percentage of messages in a particular sample with the support type s .

$$P = \frac{N_s}{N_{total}}$$

where P = percentage, and N_s equals number of support type s and N_{total} equals total number of messages in that sample.

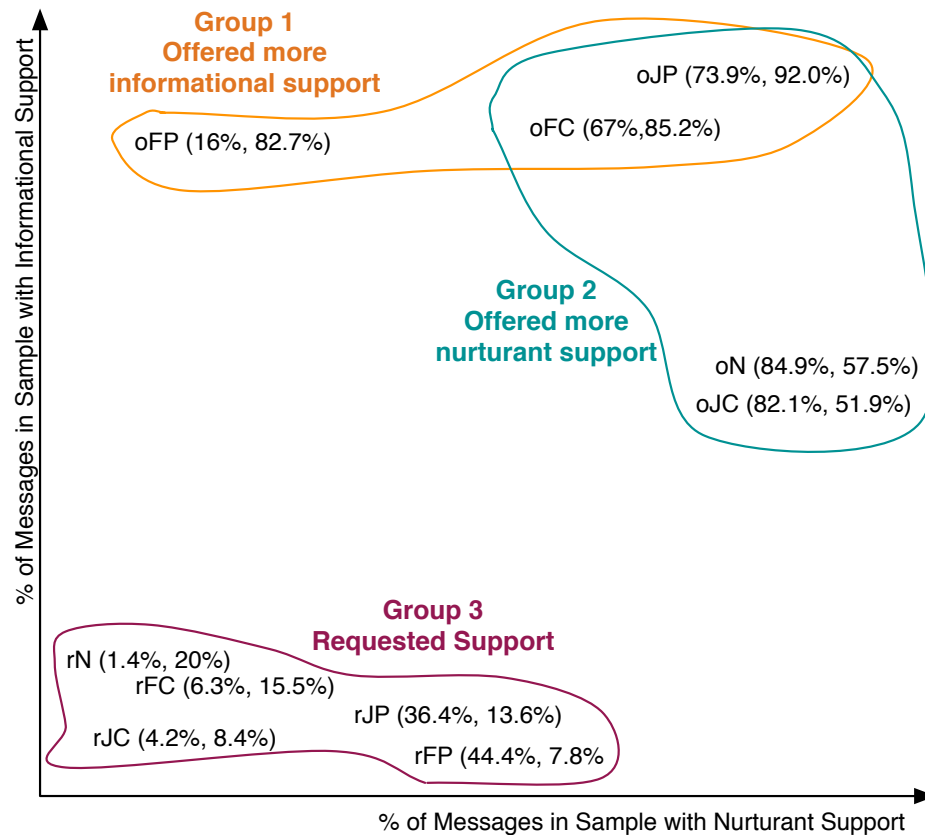
Notations: o = offered support and r = requested support, where oFP = % of FP msgs that offered support.

The results are from three different computer-mediated communication formats plotted onto an XY scale, where X = nurturant support and Y = informational support:

Group 1 – CMC formats where many messages offer informational support (i.e. advice) [Forum Posts, Forum Comments, and Journal Posts]

Group 2 – CMC formats that where many messages offer nurturant support (i.e. encouragement) [Journal Posts, Forum Comments, Notes, Journal comments]

Group 3 – CMC requested information and nurturant supports are relatively low compared to offered supports [Forum Posts, Forum Comments, Journal Posts, Journal Comments, and Notes].



Legend

oFC Offered Support in Forum Comments
 oFP Offered Support in Forum Posts
 oJC Offered Support in Journal Comments
 oJP Offered Support in Journal Posts
 oN Offered Support in Notes

rFC Requested Support in Forum Comments
 rFP Requested Support in Forum Posts
 rJC Requested Support in Journal Comments
 rJP Requested Support in Journal Posts
 rN Requested Support in Notes

Figure 20. Groups of CMC format usage

Based on this initial analysis of informational and nurturant supports, initial patterns of behavior are apparent, where informational support increases with nurturant support. In addition, the increase of nurturant support also means information support drops off. This imbalance prompted more careful analysis into the specific types of nurturant support for each format, but also across multiple formats. For

example, there was link between rJP (36.5% nurturant) and oJC (82.1% nurturant). There was an interesting connection in reverse for notes, where users request information but provide more emotional support. While forums may be seen as Q&A portal for exchanging information, the portion of nurturant support higher than expected in the comments.

This pilot work was expanded into further studies to show informational support patterns, nurturant support patterns, social network structures, and social positions. The rest of this chapter highlights related studies of online health support groups with similar approaches. In the next four chapters, each of the methods (content analysis of informational support, content analysis of nurturant support, social network structure, blockmodels) is described in detail with findings.

3.5 RELATED WORK – SOCIAL SUPPORT PATTERNS

Similar studies also identified themes of social support types and user behavior characteristics in online health support communities. These patterns are listed in the following tables (Table 10-11). From this comparison, we can see that informational support tends to be greater than emotional support, however the type of CMC format presented have more similarity to the forum format than the journal or notes formats. Additionally, it is difficult to compare results, as many studies reporting from SNS are not tailored to a health issue, but rather general SNS such as Facebook, MySpace, LinkedIn, where users may already know each other offline.

Other researchers who also looked for patterns of social support types in online support communities either came up with their own categories of social support types, or used Cutrona and Suhr's framework. Results from their studies are shown in the following tables in regards to informational, instrumental, emotional, network and esteem supports. Typically, online support group members exchanged informational support as they participated in the community. However, in some communities the members are more likely to focus on exchanging emotional support instead (Bambina, 2007; Braithwaite, 1999; Preece, 1999).

Previous studies covered a wide range of health conditions including cancer and other chronic illnesses, but few studied addiction type of health conditions such as alcoholism or smoking (Cunningham, 2008; King, 1994). These few studies created their own categories instead of using the framework suggested by Cutrona and Suhr, because they were more interested in identifying success factors of building an online community rather than investigating the multiple CMC formats. The advantage of using Cutrona and Suhr's framework is that it gives a baseline for comparing results from this MedHelp alcoholism community with other communities. Studies that categorize support types in the Social Support Behavior Codes Framework (Cutrona and Suhr, 1992) found that users are more likely to exchange information than any other type of support, except in the studies led by Bambina (2007) and Braithwaite (1999).

Table 10. Comparison of Social Support Type Findings, percentage of messages

Sample	Informational	Instrumental	Emotional	Network	Esteem
Bambina, 2007 Support OnLine Cancer Forum 84 members. 1149 messages	38.6%	N/A	48.2%	56.7**%	N/A
Braithwaite et al, 1999 "Support Network" 42 users, 1472 messages	31.3%	2.7%	40.0%	7.1%	18.6 %
Civan & Pratt, 2007 Breast Cancer - Community A 163 users, 458 messages	68.3%	3.3%	28.3%	N/A	N/A
Breast Cancer - Community B 78 users, 246 messages	40%	25%	35%	N/A	N/A
Breast Cancer - Community C 77 users, 312 messages	70%	8.3%	13.3%	N/A	N/A
Coursaris & Liu, 2009 HIV/Aids 5000 messages	41.6%	0.8%	16.0%	6.8%	6.4%
5 Eating Disorder msg boards 490 messages	29.7%	11.7%	27.8%	21.2%	9.5

* Specifically Companionship type of network support

Studies that used their own classification of social support types use their own labels for each type. The amount for each type is listed in the rightmost column of Table 11, ranked by frequency. Pfiel and Zaphiris (2007) considered the classification of social support as a nested hierarchy, in the middle column the subtypes are displayed in parentheses. Each of these studies noted the distinction between informational and nurturant support types.

Table 11. Levels of Support

Study	Classification	Results
Preece, 1999 Torn Knee Ligament, 500 msgs, April 1996 – April 1997	Empathetic Hostile Factual Personal narrative messages. Other (i.e. jokes)	44.8% empathetic 32.0% personal narrative 14.4 % factual 5.8% other 0.0% hostile
Cunningham et al, 2008 Alcoholism 10 months 474 Posts (Moderated)	Introductions General encouragement Specific suggestions/what works Success stories Discussion of slips I've felt this as well Questions about how the site works Experiencing urges, future challenges, worries Posting about someone else's problem Why I am changing my drinking, goals Requests for advice/help I'm still here How are you? General day-to-day life events What type of person I am Thoughts about nature of addictions	40.3% Introductions 23.6% General encouragement 17.3% Specific suggestions 17.1% Questions about the site 10.5% Urges, future challenges, worries 9.5% Why I am change, goals 8.4% Success stories 6.8% Discussion of slips 6.8% Requests for advice/help 6.5% How are you? 5.3% I've felt this as well 5.1% I'm still here 4.6% General day-to-day life events 1.3% What type of person I am 0.6% Post about someone else's problem 0.4% Thoughts about addictions
McCormack, 2010 Eating Disorder	Information giving/seeking Encouragement & Esteem Personal Experience Personal Opinion Prayer Network Showing appreciation Inspirational Message Emotional Expression Miscellaneous	52.3% Encourage/Esteem 47.7% Info giving/seeking 40.6% Emotional Expression 42.8% Personal Experience 35.7% Inspirational Message 26.5% Personal Opinion 21.2% Network 16.6% Showing appreciation 10.8% Prayer 2.2% Miscellaneous
Pfiel and Zaphiris, 2007 Depression/Seniors	Self-Disclosure (narration, general feeling, ask for support, similar situation); Light Support (best wishes, encouragement, humor, interest); Deep Support (reassurance, give help, deep emotional support); Community Building (different channel, own activity, activity of others, togetherness, thanks); Medical Facts (medical information, medical question); Technical Issues (problems & suggestions); Slightly Off (3 rd person story, off topic chat)	71.0% Self-Disclosure 61.5% Community Building 42.5% Light Support 38.25% Deep Support 22.5% Slightly Off 14.5% Medical Facts 4.5% Technical Issues

3.6 RELATED WORK - NETWORK STRUCTURE PATTERNS

Similar studies also identified themes of user behavior characteristics in online health support communities using social network analysis techniques (Bambina, 2007; Chang, 2009b; Pfiel and Zaphiris, 2009; Takahashi et al, 2009). This comparison shows that online settings and network analysis techniques can produce overlapping results. The four studies are limited in that they do not cover CMC formats similar to journal or notes (Bambina, 2007; Chang, 2009b; Pfiel and Zaphiris, 2009; Takahashi et al, 2009). Many other studies reporting social network analysis from SNS data are not tailored to a health issue, but rather general SNS, (Facebook, MySpace, LinkedIn) where users may already know each other offline. Four related studies use social network analysis techniques (Table 12) for investigating types of user behaviors. Each produced their own categorization schema to describe behavior types (Table 13). The similarity among all studies is that they identified members who were unidirectional and bidirectional in their support exchanges – some users give and receive support, some take without reciprocation, some provide w/o reciprocation (Bambina, 2007; Chang, 2009b; Pfiel and Zaphiris, 2009; Takahashi et al, 2009). This could be further extrapolated to show different social roles. For example, someone who successfully quit drinking years ago may be more likely to offer support than request.

Table 12. Comparison of Analysis Techniques

Sample	Messages	Social Network Analysis	Software
Bambina, 2007 Support OnLine Cancer Forum 1 st two weeks of March 2000. 84 members.	1149 messages	<ul style="list-style-type: none"> • Network Centralization in and out degree • Actor centrality in and out degree • Blockmodeling 	<ul style="list-style-type: none"> • UCINET 6 • CONCOR
Chang, 2009 PTT.CC – Psychosis 344 users.	558 posts, 168 threads	<ul style="list-style-type: none"> • Size • Density • Cliques • Network centralization 	<ul style="list-style-type: none"> • UCINET 6.96
Pfiel and Zaphiris, 2009 SeniorNet – depression 47 members. 6th Aug 2000 - 14th Feb 2002	400 messages	<ul style="list-style-type: none"> • Density • Inclusiveness • Reciprocity • Cliques 	<ul style="list-style-type: none"> • Cryam NetMiner II, version 2.5.0
Takahashi et al, 2009 Japanese SNS log files Questionnaires 105 participants.	N/A	<ul style="list-style-type: none"> • Centrality: degree, closeness, betweenness 	<ul style="list-style-type: none"> • UCINET 6.1 • Pajek 1.20

Other researchers have also tried to discover patterns in network structure of online communities. First of all, they found different types of users based on their communication patterns. Often, support is exchanged in one direction, where clearly a set of users is more likely to offer support to community members, and others such as newcomers are more likely to seek support from the community (Bambina, 2007; Chang, 2009; Pfiel & Zaphiris, 2009; Takahashi, 2009). With this directional perspective, there exists a bowtie effect where there is a core of users asking for support, another group providing support, and a core set of users doing both. When looking at just the relationships among the members (based on communication), you can also see that there are certain users who act as “gatekeepers” and also users fall into the center of the group or on the periphery. The gatekeeper serves an important role as the connection between central members and the peripheral members who are less active (Bambina, 2007; Garton et al, 1997). As gatekeepers, they are bridges that group small cliques into the larger group (Takahashi, 2009). The peripheral members are considered one step above lurkers in activeness level. Central members are very active and often participate in the community.

Table 13. Comparison of Findings from Related Studies of Social Network Analysis

Study	Support Categories	Findings
Bambina, 2007	Emotional Informational Companionship	Group 1 – actors who give and receive support All 3 types of support Group 2 – takes support w/o reciprocating Predominantly information Group 3 – inactive participants
Chang, 2009	Informational Emotional Thanks Esteem Support Network Support	Overall network is highly centralized Most exchanged support were network and info Group 1 – Support Providers Group 2 – Support Receivers 3 types of Experts: Information, Emotion/Network, combination
Pfiel and Zaphiris, 2009	Emotional Self-Disclosure, Light Support, Deep Support, Community Bldg Factual Technical Issues Medical Facts Slightly Off	Emotional communication – higher density, inclusiveness, and closeness measures Factual communication – loose and few members Self-disclosure addressed to entire community rather than select individuals Deep support is 1-directional (give, don't receive) and results in cliques Light support is reciprocated
Takahashi et al, 2009	N/A	Central users – highly active, have more friends, and positively assess SNS Gatekeepers – some connected to periphery individuals

Most studies of online communities also show a power law distribution of participation, where a small number of users are highly active and large number of users less active but make up a larger percentage of the group.

CHAPTER 4: INFORMATIONAL SUPPORT

The previous chapter presented preliminary results showing the data selected from a three-month period and the difference between informational support and nurturant support. Content analysis was used to find the two different kinds of social support among the five samples (Forum Posts, Forum Comments, Journal Posts, Journal Comments, and Notes), which led to a discovery of three clusters of patterns.

Group 1 included CMC formats where a majority of the messages offer informational support. Group 2 included CMC formats where many messages offer nurturant support. The final Group 3 included all the formats for requesting support of both informational and nurturant. This overview shows more support offered than requested, and that some formats are more likely to house informational support whereas other formats are more likely to house nurturant support. Thus this chapter is a report of results of specific informational support found in messages across the three computer mediated communication formats. First the definitions for each of the subtypes are presented, followed by description of the method for finding these five subtypes, and finally a comparison of the results to similar studies.

4.1 DEFINITIONS OF INFORMATIONAL SUPPORT TYPES

Informational supports are resources that assist individuals by providing tangible support or information to eliminate situational problems. These resources include advice, information referral, insights from personal experience, or opinions.

- *Advice*: offers ideas and suggests actions; provides detailed information, facts, or news about the situation; or skills needed to deal with situation.

An example of advice: *“What should I be doing? Should a person just not think about their dysfunctional family ? Is that how you detach?”*

- *Fact*: reassesses the situation and presents facts.

An example of fact: *“i know u and I have talked bout this b4.....PAWS....Post Acute Withdrawal Syndrome...comes from years of heavy drinking....takes a LONG time for the central nervous system to repair itself...and Tgirl i think u get impatient with this understandably so.....but u will never have*

any contentment in whats left of ur life if u have that just ONE!"

- *Personal experience*: stories about person's experiences.

An example of personal experience: *"I was drinking every night or every other night for over a year. I would drink 6 to 8 beers at night. Never got wasted... It's been over 6 months and I don't feel like I want to drink but I remember whenever I had a few drinks at least I could laugh and enjoy watching tv and minor things like that... Do I have depression? Did alcohol made permanent damage after drinking a 6 pack a day for over a year?"*

- *Opinion*: a view or judgment formed about something, not necessarily based on fact or knowledge.

An example of opinion: *"I like to have a vodka martini followed by 1 beer every nite....(2 drinks) On saturdays and sundays ill have about 6 or 7 drinks (out to dinner or a show with wife) What do you all think? do i have a problem?"*

- *Referral*: refers the recipient to some other source of help.

An example of referral: *"oops its Dr.Edward Hallowell and i think the book i mentioned may be out of print but he has written many on anxiety...Driven to Distraction is a good one!"*

Content analysis can be very helpful in helping to identify common themes in a dataset. A

complementary approach is to use social network analysis to overlap the two analyses to see what kind of relationships is common throughout.

4.2 METHODS

Identification of the informational support types was done using content analysis to find common themes in the messages of where users mentioned advice, fact, personal experience, opinions or referrals. Using the data collected in the preliminary results, the messages in the three-month period with

informational support were further analyzed for this portion of the study, to identify instances of the five specific types. Messages with multiple instances of the same type (i.e. advice) had that type marked once. After the themes were identified, the totals were tabulated.

Once the coding scheme was by the first coder, the second coder performed content analysis with the same coding scheme. Two independent coders separately coded the messages with informational support types to validate the coding scheme. Cohen's Kappa was calculated at $K=0.734$, which shows that the code used for this study is reliable.

4.3 INFORMATIONAL SUPPORT PATTERNS

Five different informational types of information were identified across all the messages. Overall, fact was the most exchanged type of information across all samples. Notes and JC showed similar patterns of behaviors for both offered and requested. JP, FP, and FC showed similar patterns for requested informational support.

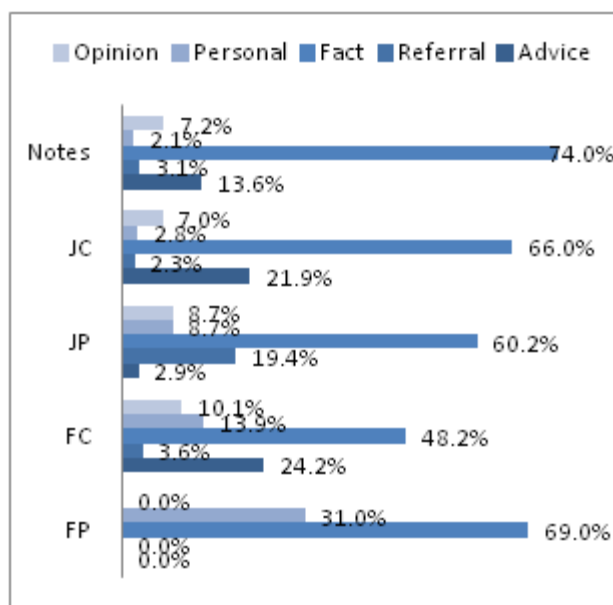


Figure 21. Information Support Types Offered

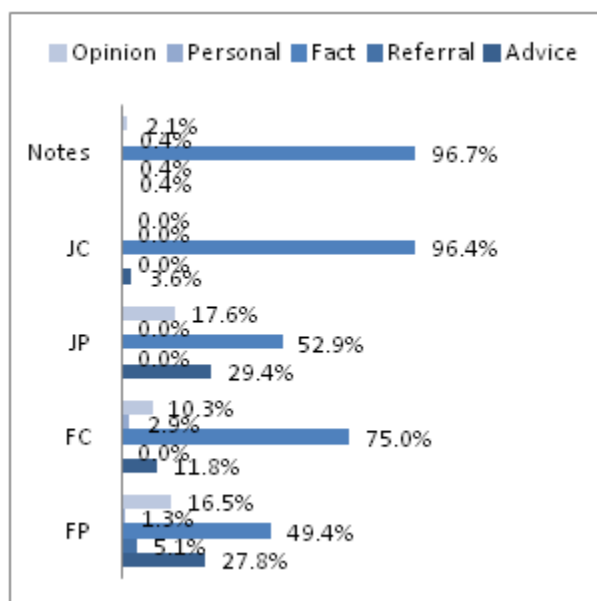


Figure 22. Information Support Types Requested

Notes were different from the other message formats for information sharing. In forum messages and journal posts, users were likely to request information types other than fact; however, in notes users are more likely to exchange facts without stressing stories or information referrals. This is different in the longer messages of journals and forums, which contain the more stories, opinions, and advice.

There was a relationship between offered and requested support, for example, advice is offered in the comments, but not in posts. For all the samples, fact is exchanged in most. Fact occurred very high in notes messages (74.0% offered; 96.7% requested), where as the other information types are less. Advice is offered (13.6%) but not requested as much (0.4%). Similarly, opinion offered (7.2%) more than requested (2.1%). This could be an indication of using notes format for altruistic reasons. Secondly, in the journal messages the high incidence of fact offered in JP (60.2%) suggests that users were documenting their thoughts. In those messages there was a combination of referral (19.4%), personal stories (8.7%) and opinions (8.7%), and a bit of advice (2.9%) offered; yet for requested support there is less for each category fact (52.9%), opinion (17.6%), and advice (29.4%). This may be because they did not expect

responses, unlike JC messages where requested fact is very high (96.4%), and some advice requested (3.6%). JC messages were most likely to offer fact (66.0%) along with some advice (21.9%). JP and JC matched in the exchange of advice and opinion. JP requests opinion and advice in addition to fact, and JC offers these three types more than the other information types. More specifically, JC had high levels of fact for both offered (66.0%) and requested (96.4%); advice offered less (21.9%) and requested (3.6%). Opinion, personal stories, and referrals were not requested at all, however offered in few messages (O: 7.0%, P: 2.8%, R: 2.3%). In JP, fact was exchanged in most messages (60.2% offered; 52.9% requested). Personal experience and referrals not requested at all (0%) but referral was given (19.4%). This pattern suggests that journals might be a place for sharing information. Also some personal experience offered (8.7%). Other types were requested and given. Advice is sought (29.4%) but not offered as much. JP might also be a good place to seek advice, as comments offers advice. We conclude that perhaps the users in journals might have some type of relationship that normally gives each other advice and opinions, such as close friends.

Although forum posts and forum comments also had a relationship, it followed a slightly different pattern. FP messages offered personal stories (31.0%), facts (69.0%), or a combination of these two. FP requested mostly facts (49.4%), advice (27.8%), and opinion (16.5%) and returned in FC (O: 10.1%; P: 13.9%; a: 24.2%). But also lots more personal stories than expected (1.3% requested in posts but 10.1% offered in comments). In more detail we see that the relationship between FP and FC messages is a polite and altruistic exchange, where more is given than requested. In FC, personal experience given (13.9%) but not requested so much (2.9%). Opinion and advice also similarly (10.1%, a: 24.2%) and requested 10.4% and a: 11.8%. Referral not requested at all but was given in some messages (13.9%). Advice was requested in nearly a third of the FP messages (27.8%) and opinions requested half of that (16.5%), but neither type was offered (0%). When starting forum threads, many messages shared facts (69.0%) or personal experiences (31.0%). This might be a strategy to obtain advice, stories, and opinions, for example, because offering opinions may not be helpful in seeking advice from others. JP has the highest

FC similar to JC

A>O/P/R

The only one not following these patterns was FP message that offered fact and personal stories only.

Fact is occurring in all the message formats and also the highest, very likely because the users joined the online community for information, but stay because of the community.

4.3.1.2 Informational Support Requested

The number of messages identified with requested informational support was less than the number of messages that offered informational support. We calculated percentage by dividing by total number of messages with that contain informational support. Table 17 shows the distribution of information types offered in the sample.

Table 16. Ranking of samples by information type offered

	Forums		Journals		Notes
	FP	FC	JP	JC	N
Advice	22	8	5	1	1
Referral	4	0	0	0	1
Fact	39	51	9	27	231
Personal	1	2	0	0	1
Opinion	13	7	3	0	5
Total	79	68	17	28	239

Table 17. Ranking of samples by information type requested

Type	Fact	Opinion	Personal	Referral	Advice
Rank #1	N 96.7%	JP 17.6%	FC 2.9%	FP 5.1%	JP 29.4%
#2	JC 96.4%	FP 16.5%	FP 1.3%	N 0.4%	FP 27.8%
#3	FC 75.0%	FC 10.3%	N 0.4%	JC 0%	FC 11.8%
#4	JP 52.9%	N 2.1%	JC 0%	JP 0%	JC 3.6%
#5	FP 49.4%	JC 0%	JP 0%	FC 0%	N 0.4%

Comparing across samples, all CMC formats request advice quite heavily except notes.

FP, FC, JP
Notes & JC

F > A > O
F

Perhaps notes were not the main source for info seeking, but rather maintaining relationships. The pattern found among FP, FC and JP is that there is a similar combination of advice greater than opinion. There is also no information referrals requested in FC, JP, or JC.

Our results disagree with related studies of the same type concerning the levels of support identified among user generate content (Bambina, 2007; Braithwaite et al, 1999; Coursaris and Liu, 2009; Cunningham et al, 2008; Eichhorn, 2008; McCormack, 2010; Pfiel and Zaphiris, 2007; Preece, 1999). There are several explanations for the variance between our study and other studies shown in Table 18: First, this study collected data from different text-based communication formats (journal, notes) than previous studies (mailing lists, discussion boards). The architectural elements are different and can affect communication. Second, the members of the MedHelp community are allowed to and often communicate with each other across multiple CMC formats instead of just one (i.e. email lists). Features such as the profile page and journals are similar to providing rooms for people to talk about more specific things and have fewer interruptions, and this availability impacts the conversations on the communal areas to be more formal and the other areas to be less so. Third, the space formed from these three different CMC formats leads to increased further use of these tools in the manner it was used. The space influences the early adopters' behavior and then over time, new members will adopt the same behaviors. For example, the first users asked medical questions in the forum, and later when the journal and notes were added, the users were familiar with these formats from other websites (i.e. LiveJournal, Facebook, MySpace, Twitter) and bring those practices into this community.

Table 18. Comparison to results from other studies

Data	Architectural Elements	Patterns
Preece, 1999 Torn Knee Ligament, 500 msgs, April 1996 – April 1997	Email List	Nurturant > Information (no distinctions) P > F
Braithwaite et al, 1999 “Support Network” 42 users, 1472 messages	“Messages were distributed via E-mail through a nationwide computer BBS network.”	31.3% Informational
Klaw et al, 2000 Online Alcoholism support group	Mailing list	Self-disclosure > Information/Advice
Bambina, 2007 Support OnLine Cancer Forum 84 members. 1149 messages (unmoderated)	“an Internet cancer support forum ... a virtual space ... [to exchange] support” Only requires email address. Archives posted online and publicly available	38.6% Informational
Civan & Pratt, 2007 Breast cancer	Bulletin Boards	Board A 68.3% info Board B 40% info Board C 70% info A > R
Pfiel & Zaphiris, 2007 Depression/Seniors	Bulletin Board	P > A > F
Cunningham, et al, 2008 Alcoholism 10 months; 474 Posts (moderated)	Bulletin Board	P > A > F > O
Eichhorn, 2008 5 Eating Disorder msg boards 490 messages	Yahoo Discussion Groups	29.7% Informational
Coursaris & Liu, 2009 HIV/Aids 5000 messages	Bulletin Board	41.6% Informational
McCormack, 2010 Anorexia Bulletin Board	Bulletin Board	A = F = R > P > O

To the e-patient, the interactivity of an online community is different from perusing static information pages because of the added social component. A forum space is similar to a waiting room at the clinic, in that people know it is more public than the doctor’s office. In terms of informational and emotional content exchanged in the community, users were selective in what they write and whom they interact with across the CMC formats. In the forums, it appeared that they treated the space as a Q&A forum, whereas on profile pages and journals the "personal nature" might explain their behavior in exchanging more emotional content. It may be the environment that makes them behave that way, yet it may also be that they want to behave this way and perceive those environments to be proper for that type of conduct.

CHAPTER 5: NURTURANT SUPPORT PATTERNS

Preliminary research from chapter 3 showed the findings from a three-month period and the difference between informational support and nurturant support. Content analysis was used to find the two major kinds of social support (informational and nurturant) among the five samples (Forum Posts, Forum Comments, Journal Posts, Journal Comments, and Notes), which lead to a discovery of three clusters of patterns. Group 1 included CMC formats where a majority of the messages offer informational support. Group 2 included CMC formats where many messages offer nurturant support. The final Group 3 included all the formats for requesting support of both informational and nurturant. This overview shows more support offered than requested, and that some formats more likely to house informational support whereas other formats house nurturant support. The previous chapter (chapter 4) focused on a report of the levels of information support types found in the samples. Thus, in this chapter is a more in-depth report of results of specific nurturant support found in messages across the three computer mediated communication formats. First the definitions for each of the subtypes are presented, followed by description of the method of finding the three subtypes, and finally the results of each in comparison to similar studies.

5.1 DEFINITIONS OF NURTURANT SUPPORT

Nurturant support is emotional understanding that comforts individuals. It can be divided into esteem, network, and emotional.

- *Esteem*: positive comments to praise support seekers abilities or to alleviate feelings of guilt. An example of esteem support: “*Congratulations on your sobriety!*”
- *Network*: messages to help support seeker from feeling alone.

An example of network support: “... *Well, I guess I wasn't much help, but I appreciate the input, and it's good to know you're not alone. Thank you brocknbck. Maybe we can help each other.*”

- *Emotional*: providing understanding of situation, express sorrow, provide with hope and confidence.

An example of emotional support: “*You're going through a rough time....*” or “*Hang in there hon.[sic]*”

Content analysis is helpful in showing themes in content such as frequently occurring words and ideas. Indications of top users can also be found. A complementary research technique to identifying content themes is extricating on relationships between users with social network analysis.

5.2 METHODS

Identification of the nurturant support types was done using content analysis to find common themes in the messages of where users mentioned esteem, network, or emotional supports. Using the data collected in the preliminary results, the messages in the three-month period with nurturant support were further analyzed for this portion of the study, to identify instances of the three specific types. Messages with multiple instances of the same type (i.e. emotional) had that type marked once. After the themes were identified, the totals were tabulated.

Once the coding scheme was by the first coder, the second coder performed content analysis with the same coding scheme. Two independent coders separately coded the messages with informational support types to validate the coding scheme. Cohen's Kappa was calculated at $K=0.719$, which indicates a high agreement between two independent coders and that the code used for this study is reliable.

5.3 NURTURANT SUPPORT PATTERNS

The results for nurturant support in the three CMC tools are separated into offered and requested. Three different nurturant support types were identified across all the messages. Overall, emotional was the most exchanged type across all samples.

5.3.1.1 RESULTS: NURTURANT SUPPORT OFFERED

Table 19 summarizes the number of messages showing nurturant support offered for each sample. After these numbers were tabulated, they were converted into percentages. Figure 23 displays the percentages and from here you can see two types of patterns. Two nurturant support patterns emerged in messages that offered support: EM>NET>EST (Forum Posts, Notes) and EM>EST>NET (Forum Comments, Journal Posts, Journal Comments). We explain these two patterns in this section.

Table 19. Number of messages offering nurturant support

	Forums		Journals		Notes
	FP	FC	JP	JC	N
Esteem	1	53	13	124	220
Network	5	18	2	17	488
Emotional	12	259	61	241	752
Total	18	330	76	382	1460

Emotional (EM) was the most commonly appearing subtype among offered nurturant support. Network and esteem occurred less in comparison. In two sets (journal comments, forum comments), esteem (EST) is greater than network (NET), which is indicated by EST>NET. This pattern may indicate the compassionate nature of users who recognized the perspective of first author, compliments or relieving blame. In addition, journal posts also displayed more esteem than network, which may indicate author's awareness of their audience. Conversely, in the samples that have more network than esteem (Notes, Forum Posts), the strategy might have been increasing communication with emphasis on presence, access, or companionship.

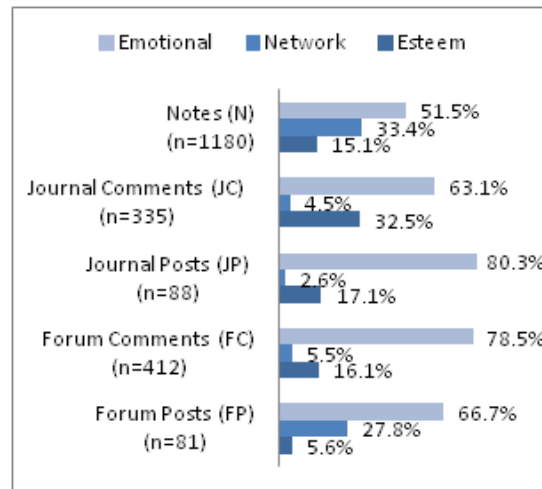


Figure 23. Nurturant Support Offered

The first pattern where network is greater than esteem support might be an indication of the author's informational or emotional state while starting a thread in the forum or creating a note for friend. The emphasis on network more than esteem suggests promoting presence and involvement with the community, which could be a strategic expression for being worthy recipients of social support. The lower amount of esteem support reflects social status of individual members as less important to mention across this medium. The similarity between forum posts and notes may suggest that users post without expectation of a direct response.

In the second pattern where the communication formats had the pattern of more esteem than network support EM>EST>NET (Forum Comments, Journal Posts, Journal Comments), this may suggest that these formats are more suitable for praising and complimenting others. Forum comments contained less explicit mentions of network support, which can convey that the act of replying to a message shows presence rather than replying and also mentioning being present. Similar to Journal Posts and Journal Comments, the act of posting may be as an indicator of network support. Offering emotional and esteem support more than network, might be from an assumption that other members are aware of network

support and need not explicitly stated. It is possible that users were compelled to offer esteem support with increased familiarity with similar experience.

One possibility for pattern differences could be that levels of network or esteem supports correlate with relationship strength. Surprisingly, offered support in journals is different from notes even though their features make them ‘publicly private’. While journals and notes users who communicate with each other might be friends of each other, the longer message format of journals may not be as conducive as notes for maintaining relationships.

5.3.1.2 *NURTURANT SUPPORT REQUESTED*

There were fewer messages identified with requested nurturant support than offered nurturant support. We calculated the percentage by dividing by total number of messages with that contain nurturant support.

Table 20. Number of messages requesting nurturant support

	Forums		Journals		Notes
	FP	FC	JP	JC	N
Esteem	6	8	21	8	2
Network	8	10	0	0	6
Emotional	29	10	23	7	9
Total	43	28	44	15	17

Again for requested nurturant support, emotional support was highest in all sets. Esteem support was also frequently requested among all sets of messages, but most noticeable in journal comments, which may indicate a desire on part of the commenter to help the journal author feel better about them. Journal messages do not show network support, possibly because readers are already known friends. In comparison to other formats, more network support requested in notes and forums than journals.

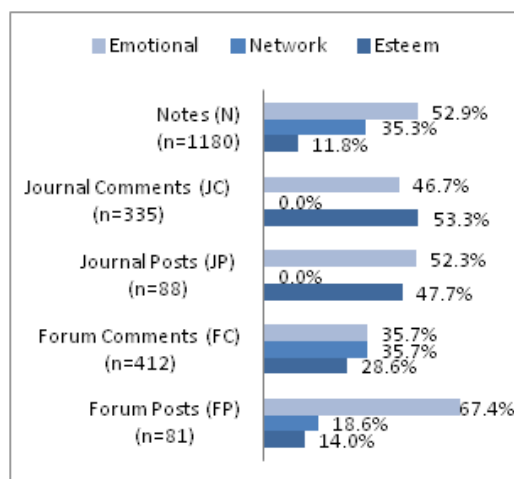


Figure 24. Requested Nurturant Support

The three patterns that emerged among messages that requested nurturant support were:

EM>NET>EST (Forum Posts, Notes); EM=NET>EST (Forum Comments); and EM&EST (Journal Posts, Journal Comments).

The first of these patterns (EM>NET>EST) appears in Forum Posts and Notes. The combination of requested supports is an effect of authors explicitly stating the type of support they seek, such as an emotional release from thinking about the situation. Notes had more messages requesting network than Forum Posts, which might be an emphasis of referring to the friendship between the author and receiver. In the forums, more comment messages offered network support than post messages, which could be an indication that people comment on forum threads because they know there is someone else with similar situation to talk about. The pattern of requested support in notes is most similar to forum posts, where network requested more often than esteem, possibly because of emphasizing their presence in the online community.

In the second pattern, emotional support occurred in the same number of messages as esteem (Forum Comments), a demonstration of authors showing empathy and appreciation. Perhaps members find talking to each other soothing; especially the encouragements and time spent chatting with each

other. While there was less emotion in Forum Comments than Forum Posts, more esteem and network supports were requested. Perhaps it was easier for members to ask for additional types of support after asking emotional support at least once before.

The third pattern of requested nurturant support was observed in Journal Posts and Journal Comments where users are more likely to only request emotional and esteem, rather than network. Because users who write to each other in the journals have a higher likelihood of being “friends” or have a stronger relationship than forum users, they may find it unnecessary to emphasize reminders of network presence, as that might be a purpose more suited for notes. In the case of no network support in a pattern, the architectural features of the tool offer a way out of explicitly stating network support in note content through the “friends” feature shown on the profile page. In journals, the author intends to write for self or friends and usually only friends notice new posts and willing to comment after reading. Findings suggest that privacy control features for each format may have some influence on the social support patterns.

Pattern of Nurturant Support Exchanged

Another portion of the first study identified nurturing social support types in user-created messages across three different text-based communication tools (discussion forums, personal journals, and notes) of an online healthcare social networking site. The content analysis codes came from literature review and were organized into Cutrona and Suhr’s supra-categories, and show similarity to reports from other studies (Coursaris and Liu, 2009; Eichhorn, 2008). The results provide indication of social support present in the MedHelp Alcoholism community most often exchanged by group members from a three-month period. Interestingly, the nurturant support pattern in forum posts and Notes was same for both the offered dimension and requested dimensions where emotional was greater than network and also greater than esteem support (EM>NET>EST). Percentages shown in Figures 23 and 24; the patterns (EM>EST>NET, EM&EST) found among journal messages (journal posts, journal comments) also group these samples together. Forum comments is the only sample where the pattern offered (EM>EST>NET) was different from requested (EM=NET>EST). While the three computer-mediated communication formats of Medhelp have similarities, the differences in architecture appear to impact the support

exchanged. We find that some formats were more conducive to emotional connecting than others, yet overall each was used for different purposes. In this section, results were explained with theories from related research literature.

Comparing Nurturant Support Patterns with related studies

Similar studies identifying social support in online health support communities found various levels for each nurturant support type (Bambina, 2007; Braithwaite, 2009; Coursaris and Liu, 2009; Cunningham et al, 2008; McCormack, 2010; Pfeil and Zaphiris, 2007; Preece, 1999). These studies collected data from settings using bulletin boards or email lists, which is similar to MedHelp forums. There have not been any documented cases of health support groups incorporating software of alternate computer-mediated communication formats similar to the journal or note formats, nor studies of social support among them. Many studies reporting social network sites data are not tailored to a health issue, but rather general social network sites usage (i.e., Facebook, MySpace, LinkedIn), where users may already know each other offline. Table 21 summarizes results from other studies identifying social support in health communities in bulletin board or email list styles rather than social media features such as profile post messages and journal entries. Most studies found emotional and network support to appear more often than esteem support.

Table 21. Nurturant Support in related studies

Data	Architectural Elements	Patterns
Preece, 1999 Torn Knee Ligament, 500 msgs, 1 year	Email List	Nurturant > Information (no distinctions)
Braithwaite et al, 1999 “Support Network” 42 users, 1472 messages	“Messages were distributed via E-mail through a nationwide computer BBS network.”	EM > EST > NET
Bambina, 2007 Support OnLine Cancer Forum 84 members. 1149 messages (unmoderated)	“an Internet cancer support forum ... a virtual space ... [to exchange] support” Only requires email address. Archives available online.	NET > EM
Meier et al, 2007 10 cancer mailing lists hosted by the Association of Cancer Online Resources (5 months)	Mailing lists	Nurturant > Information (no distinctions)
Pfeil and Zaphiris, 2007 Depression/Seniors	Bulletin Board	NET > EM > EST
Cunningham et al, 2006 Alcoholism 10 months; 474 Posts (moderated)	Bulletin Board	EM > EST
Eichhorn, 2008 5 Eating Disorder msg boards 490 messages	Yahoo Discussion Groups	EM > NET > EST
Coursaris and Liu, 2009 HIV/Aids, 5000 messages	Bulletin Board	EM > NET > EST
McCormack, 2010 Anorexia Bulletin Board	Bulletin Board	EM > NET > EST
Selby et al, 2010 Smoking cessation	Web assisted tobacco intervention, bulletin board	EST > EM

The members of this Alcoholism community favor providing the emotional type of Nurturant support, similar participants of other health support communities (Braithwaite et al, 2009; Coursaris and Liu 2009; Eichhorn 2008; McCormack 2010; Preece, 1999). We also noted a substantial amount of informational support in our data in addition to Nurturant support. Out of all our results, the forum posts sample appears to have most similarity to previous findings from bulletin boards (EM>NET>EST). Notes showed a similar pattern as the forum posts; however, journal messages follow a different pattern with no network support (EST=EMO). This low amount of network support shows that it is not typical to use journals as a place to indicate relationship bond between two users, or that network support needs were met simply by participating in the community without the need for explicitly stating requests or offers of

network support, unlike in notes, where any member can leave a note for a friend and not expect any response. With the journal format, authors are given more control over who can read and comment, so in that format it requires initiation of explicit support request to have any comments. Journal post authors are more likely to post message for self-recording purpose. For example, one author wrote in her journal: *“i doubt if anyone will read this and that is ok as I am writing this more for my benefit then anyone else. ...”* and probably does not expect a reply. In fact, the same post goes on to state, *“I do not need anyone to tell me how lucky I am, how well off i am, or how good i look. I still feel very fragile and needed to just let someone know that might have a word or encouragement or knidness...[sic]”*.

CHAPTER 6: NETWORK STRUCTURE OF COMMUNICATION

In chapters three through five, the results of content analysis on messages from each of the CMC formats show the different levels of support types exchanged to address the first objective revealing peer-to-peer communication patterns. Next, in this chapter, we go deeper into the analysis of peer-to-peer communication by mapping the user relationships from the same health social networking site. Meeting this objective helped us see the impact a CMC format has on interpersonal communication of the users in the MedHelp Alcoholism community.

While content analysis is a solid technique to systematically summarize written communication in a quantitative and unobtrusive way, it becomes a more powerful when combined with other research methods. It describes what is there, but may not reveal the underlying motives for the observed pattern ('what' but not 'why' or 'how'). Additionally, the analysis is limited by availability of material; for example, catastrophic events in the e-patient's life may lead to more active participation in support groups than less dramatic occurrences.

This third portion reports results from social network analysis (SNA) as a complementary research technique, which is a powerful analytical concept measuring interpersonal connections. This technique provides the opportunity to quantifiably measure the complex patterns of online communication (Zaphiris and Pfiel, 2007). Analyzing the structure of social networks enables us to observe supportive relationships in a social network or potentially the user roles in the community. According to researchers who study social structure, social categories are best discovered and analyzed by examining relations between social actors rather than pre-defined attributes such as age and location (Wellman and Berkowitz, 1997). More specifically, Wellman and Berkowitz (1997) explains that this approach allows the capability to derive "maps and typologies" of social structures by inferring wholes to parts, from "structure and relations to categories" and "behaviors to attitudes" (p. 3). For instance, we can study social support as a resource that is interchanged among members of a network to observe ripple effects, rather than just between two parties at one time slice.

SNA metrics describe a user's location within the network structure and resources exchanged between users. Wasserman and Faust (1994) explain relationships among social entities as graphical represents a network using nodes and ties or in a matrix form. *Structural* variables are the quantities that measure the structure or relationships (Glanz et al, 2008; Wasserman and Faust, 1994), whereas *functions* of a social network are resources that can be exchanged between individuals. Some of the structural characteristics are described in this chapter, however a more detailed description and historical overview of these concepts can be found in the seminal work, '*Social Network Analysis*' (Wasserman and Faust, 1994). This chapter begins with some definitions for structural metrics in SNA, and then followed by the description of the method in more detail, and finally followed by a report of findings.

6.1 DEFINITIONS OF STRUCTURAL METRICS

Structural metrics measure characteristics of the social network structure. For example, homogeneity measures the extent to which network members are demographically similar such as age or gender (Faber and Wasserman, 2002; Garton et al, 1997; Wasserman and Faust, 1994). Geographic dispersion refers to the extent to which network members live in close proximity to focal person. Other structural metrics of interest for this study include:

- Reciprocity: Extent to which resources and support are both given and received in a relationship
- Density: Extent to which network members know and interact with each other
- Directionality: Extent to which members of the dyad share equal power and influence
- Centrality: This measure gives a rough indication of the social power of a node based on how well they "connect" the network.
 - Degree: The count of the number of ties to other actors in the network.
 - Betweenness: The extent to which a node lies between other nodes in the network. This measure takes into account the connectivity of the node's neighbors, giving a higher value for nodes which bridge clusters. The measure reflects the number of people who a person is connecting indirectly through their direct links.

- Centralization: The difference between the numbers of links for each node divided by maximum possible sum of differences. A centralized network will have many of its links dispersed around one or a few nodes, while a decentralized network is one in which there is little variation between the numbers of links each node possesses.

In addition to these measures, researchers have also measured the strength of ties between social media users. Weak ties are helpful as they act as conduits for relevant information and particularly helpful during moments of life change such as job seeking or healthcare seeking (Gilbert & Karahalios, 2009; Granovetter, 1972). The next few sections describe the calculation of these metrics and the results from the online community.

6.2 METHODS

The number of active users (nodes) and the number of conversation pairs (edges) were tallied within each of the three CMC format in the three-month period. Self-loops (i.e. when a user replies to themselves) were not part of the tally, in order to keep focus on interpersonal communication.

Three networks were constructed (Forum Activity, Journal Activity, and Notes Activity) to compute structural metrics for the MedHelp community. The nodes in each network represent users while links between two nodes represent the communication relationship between them. In the forum social network, an edge from node A to node B denoted that user A replied to user B in at least one thread of the forum. Similarly, if user A made comments to any of user B's journal posts, there was an edge from node A to node B in the journal social network. In the note social network, an edge from node A to node B represented a note made by user A on user B's personal page. A user participated in one of the three networks:

1. *Forum Network*: If user B replies user A's question, then a directed link is built from user B to user A. Multiple comments from user B to one post or several posts of user A are only counted once. Not all senders and receivers of links are members of Alcoholism community.

2. *Journal Network*: If user B leaves a comment to a journal of user A, then a directed link is built from user B to user A. Multiple comments from user B to one several journal(s) of user A are only counted once. All the senders of links are members of Alcoholism community, but not all the receivers of links are members.

3. *Notes Network*: If user B leaves a note to user A, then a directed link is built from user B to user A. Multiple notes from user B to user A are only counted once. All the senders of links are members of Alcoholism community, but not all the receivers of links are members.

These networks were generated using a Python language script file, which took the raw data samples for each of the three CMC format in the three-month period to tally the number of active users (nodes) and the number of conversation pairs (edges). Self-loops (i.e. when a user replies to themselves) were removed from the tally to keep the focus on interpersonal communication. A python script was written to convert raw data (text files) into lists of paired users that indicate sender and target for a directed graph that displays asymmetrical communication. Each list was transformed into a sociomatrix, where each row indicates a sender, and each column a target for a directed graph. A cell, the intersection between a row and a column, tallies each pair, for example in table; row User1 composed a message that column User2 received. Similarly, the row labeled User2 composed three different messages to column User1 received. These cells are the edges in a graph. The number of rows is equivalent to the number of columns, indicating the number of nodes in a graph. An example of this is shown in table 22.

Table 22. Example of Sociomatrix

	User1	User2	...	Target
User1		1		
User2	3			
...				
Sender				

This process yielded three sociomatrices (forum, journal, notes). The forum sociomatrix contained 111 rows by 111 columns, indicated 111 unique users. In the matrix, there were 181 cells filled in, totaling 2613 edges in the forum graph. The journal sociomatrix contained 134 unique users and 424 unique edges. The notes sociomatrix contained 411 unique users and 292 unique edges. *Graph density* is a commonly analyzed network property and indicates the extent to which network members know and interact with each other based on the number of edges and the number of possible edges. Network density can be described as the ratio of existing ties within the network in contrast to the possible number of ties in the network (de Nooy, Mrvar, & Batageli, 2005; Wasserman & Faust, 1994). Density in a directed network is defined as:

$$\Delta = \frac{L}{g(g-1)}$$

where Δ is the measure of density, L is number of unvalued ties present in the graph and g is the number of nodes in the graph (Wasserman & Faust, 1994, p.129).

The denser a network is, the more interconnected amongst the members and the more direct contact with each other (Garton et al., 1997). If all ties are present within a network (e.g. every person communicates with every other person) the density of the network is $\Delta=1$. If no ties present, the density would be $\Delta=0$. The denser a network, the greater likelihood that the members within this network are connected to each other and the stronger the connectivity of the whole network. A dense category-specific sub-network would thereby indicate that the respective category is used in order to connect to others, whereas a more loosely bound category-specific sub-network would indicate that this category does not lead to strong connection between the members.

The density of a directed social network can be further investigated by looking at the centrality degrees of the specific members (in- and out-degree). According to Wasserman and Faust (1994) the density is proportional to the average degree centrality of all nodes in the network. Thus, both density and average degree centrality can be used as a measure of the density of the complete network.

The densities were quite sparse in these three networks shown in table 23 (F=0.031, J=0.052, N=0.003), congruent with the idea that these users were not friends in real life. Table 23 shows briefly some high level differences among the three formats. Forum network has the fewest number of nodes with greatest number of edges, suggesting the discussion behavior of group communication. Notes network has more nodes but substantially lower graph density, indicating little overlap of ties and supports the one to one communication. Finally, the journal format has the highest density – indicating more interconnectedness, as the users would be communicating directly to each other.

Table 23. Summary of structural metrics in each CMC format

	Forum	Journal	Notes
Nodes	111	134	411
Total Edges	2613	1612	1180
Unique Edges	181	424	292
Graph Density	0.031	0.052	0.003
Maximum Geodesic Distance (Diameter)	5	7	10
Average Geodesic Distance	2.20	2.92	3.93

6.3 RESULTS - STRUCTURAL METRICS

Geodesic distance refers to the shortest path between any two nodes in the graph. The distance from one node to another can be found by inspecting the power matrices. These distances can be arranged in a distance matrix (starting with p=1).

$$d(i, j) = d(j, i) = \max_p x_{ij}^{[p]} > 0$$

The maximum geodesic distance refers to the pair of users farthest from each other who do not have a direct connection. The diameter of a connected graph is the length of the largest geodesic distance between any pair of nodes ($\max d(i, j)$). It can range from minimum of 1 (if graph is complete) to a maximum of g-1. The diameter is important because it quantifies the distance between the farthest two nodes in the graph.

In the forum, a diameter (maximum geodesic distance) of 5 shows that there is a pair of users who have not directly messaged each other, but is related within 5 degrees of separation. This value is smaller than the values in journal and notes, indicating forum users more likely to mingle and come into contact with each other. A diameter of 7 in journal shows that strangers seldom comment on the same messages. A diameter of 10 in notes means that two users even less likely to pen a message outside familiar relations.

The average geodesic distance indicates the shortest path between any two nodes. In each of the three samples, the average geodesic distance is similar. This shows that diversity of a majority of users in messaging each other or reaching out to a greater set of other users. The values for average geodesic distance are similar for the three networks (F=2.20, J=2.92, N=3.93). This suggests that the core users in the community are tighter knit, within 2 to 4 degrees separation.

Individual communication behavior of people in a group can be distinguished between in-degree and out-degree, in-degree measuring the number of incoming links and out-degree measuring the number of outgoing links for a node in the network. *In-degree* and *out-degree* measures the number of incoming links and outgoing links, respectively (Wasserman and Faust, 1994; Zaphiris and Pfiel, 2007). This measures the flow of conversations, for example on a forum thread. The in-degree of any node is defined as:

$$c_{in}(n_i) = \frac{\sum_j x_{ji}}{g - 1}$$

where $c_{in}(n_i)$ is the in-degree for node i , and j ranges from 1 to the total number of nodes g . x_{ji} is 1 when there is a tie from node j to node i and 0 otherwise.

The *out-degree* of any node is defined as:

$$c_{out}(n_i) = \frac{\sum_j x_{ji}}{g - 1}$$

where $c_{out}(n_i)$ is the out-degree for node i , and j ranges from 1 to the total number of nodes g . x_{ji} is 1 when there is a tie from node j to node i and 0 otherwise.

In the forum format 67 users post at least 1 message and 97 receive messages. In the journal format 102 users post at least 1 message and 93 receive at least 1 message. In the notes format we have 365 users posting at least message and 74 receiving at least 1 message. The structural metrics (in-degree, out-degree) summarized in table 24 show these numbers.

Table 24. Total number of active user per CMC

	Out-degree nodes	Pattern	In-Degree nodes
Forum	67	$D_{OF} > D_{IF}$	97
Journal	102	$D_{OJ} > D_{IJ}$	93
Notes	356	$D_{ON} > D_{IN}$	74

In the forum, 67 users write messages to someone (60%), in comparison to the 111 in the entire network. Journal network 102 (76%) users post messages and 356 (86%) users posted notes. Forum users have greater in-degree than out-degree nodes ($D_{OF} > D_{IF}$), which suggests that even if users start forum threads with no expectation of replies, it is still an environment for group conversations. Journal users have greater out-degree than in-degree ($D_{OJ} > D_{IJ}$), which indicates that users comment to existing posts more often than composing their own journal entries. Notes users send more than receive ($D_{ON} > D_{IN}$). People write to many different friends with the notes format, however the analyses do not show much reciprocation, largely because it is not a threaded format.

Table 25. Minimum, Maximum, Average, and Median Degree Measures

	Notes	Journal	Forum
Minimum Degree	1	0	1
Maximum Degree	121	48	85
Average Degree	2.311	10.955	6.865
Median Degree	1.00	9.00	4.00
Minimum In-Degree	0	0	0
Maximum In-Degree	117	36	30
Average In-Degree	1.156	5.578	3.432
Median In-Degree	0.000	3.00	2.00
Minimum Out-Degree	0	0	0
Maximum Out-Degree	12	23	56
Average Out-Degree	1.156	5.578	3.432
Median Out-Degree	1.000	4.00	2.00

Centrality measures for a node within a graph determine its relative importance in the network (i.e. how influential a person is within a social network). An actor with high centrality is involved with many relations, regardless of being the initiator or receiver. This measure is based on the average in- and out-degrees of nodes in the network. The idea is that an actor is central if it can quickly interact with all others. One type of centrality is prestige, where an actor is the recipient of many direct ties but initiates few messages. On the other hand, centrality measures of betweenness, closeness, and eigenvector can better describe the message writing behavior.

Betweenness is the extent to which a node lies between other nodes in the network. This measure takes into account the connectivity of the node's neighbors; giving a higher value for nodes that bridge clusters. The measure reflects the number of people who a person is indirectly connected, indicating that a between actor who might control the flow of information or the exchange of resources, perhaps charging a fee or brokerage commission for transaction services rendered. An actor is central if it lies between other actors' connections. Let $g_{jk}(n_i)$ be the number of geodesics linking n_j and n_k that contain n_i and g_{jk} be the number of geodesics linking n_j and n_k

$$C_B(n_i) = \sum_j \frac{g_{jk}(n_i)}{g_{jk}}$$

$$C'_B(n_i) = \frac{C_B(n_i)}{(g-1)(g-2)/2}$$

Table 26. Average Betweenness

	Forum	Journal	Notes
Average Betweenness Centrality	134.649	210.055	935.090

In the three networks, it was typical to find one node connected to all the other nodes, and the other nodes not acting as a bridge. The average betweenness for notes ($C_{BN} = 935.090$) was much higher than for forum ($C_{BF} = 134.649$) and journal ($C_{BJ} = 210.055$). This shows that a bridge node in notes format is likely to have more diverse set of friends among different subgroups, whereas the forum and journals clusters seem diluted in comparison.

Eigenvector centrality measures the influence of a node in a network. It assigns a relative score to each node based on the concept that connections to high-scoring nodes contribute more to the score of the node in question than equal connections to low-scoring nodes. In summary, a person is prestigious if prestigious people endorse him. A typical node in forum or journal has more influence than a typical user in notes. This is consistent with the idea that forum and journal are better formats for group conversations on a topic, and notes for one on one relationship maintenance.

$$\lambda v = Av$$

where A is the adjacency matrix of the graph, λ is a constant (the eigenvalue), and v is the eigenvector. The equation lends itself to the interpretation that a node that has a high eigenvector score is one that is adjacent to higher scoring nodes.

$$C_E(n_i) = v_n = \frac{1}{\lambda_{max}(A)} \sum_{j=1}^g a_{jn} v_j$$

where $v=(v_1, \dots, v_n)^T$ referring to an eigenvector for the maximum eigenvalue, $\lambda_{\max}(A)$ of the adjacency matrix A .

Table 27. Average Eigenvector Centrality

	Forum	Journal	Notes
Average Eigenvector Centrality	0.009	0.009	0.002

Closeness can be regarded as a measure of how long it takes to spread information from a node x to all other nodes sequentially, which is modeled by the use of shortest paths. An actor that is close to many others can quickly interact and communicate with them without going through many intermediaries. This measure can be used for each actor or for the entire group. For an actor,

$$C'_c(n_i) = \frac{g - 1}{[\sum_{j=1}^g d(n_i, n_j)]}$$

For the group, this measure is multiplied

$$C_c(n_i) = \frac{\sum_{i=1}^g [C'_c(n^*) - C'_c(n_i)]}{\frac{[(g - g)(g - 1)]}{(2g - 3)}}$$

Of the three CMC formats, notes had much higher closeness centrality (0.086) than forum (0.004) and journal (0.003). This shows that notes users in contact with a greater number of users, which is consistent with the measures of average betweenness centrality that says forum graph does not have as many bridge nodes as notes.

Table 28. Average Closeness Centrality

	Forum	Journal	Notes
Average Closeness Centrality	0.004	0.003	0.086

The centrality measures (degree, betweenness, eigenvector, and closeness) show that users in forum format with less bridging nodes in the network are able to take advantage of the ability to reach out to a wider group of people and hold group conversations. The notes format is on the other end of the spectrum; with less overlapping connections because the conversations tend to be one to one. Some users in notes act as bridges in the network by composing messages to a wide group of different friends. The in-degree and out-degree metrics show that forum users tend to be on the receiving end of messages whereas journal and notes users tend to be sending messages to a smaller audience.

In conclusion, this view of the three networks shows that the forum CMC format is better for individuals who want to reach a wider audience. The notes CMC format provides for less overlapping of user connections. It makes sense because of the messages written from one person to another person as one direction instead of threaded format. Journal format network has properties of both, with metrics showing that users have group conversations and less diverse friends. With these in mind, the next sections show specifically the results for each CMC format in relation to information support type exchanged.

6.3.1 INFORMATIONAL VS NURTURANT EXCHANGES

The social network analysis measures were re-calculated once again for two separate subsets for comparison: informational and nurturant networks. Each message in the three-month period was reviewed for either informational or nurturant support for building six networks. If it had informational support, the author was added as a node to the informational network. Similarly, if the message contained nurturant support the user was added as a node to the nurturant network. Some messages contain both types of support, thus some users belong to both networks. Forum messages were more likely to contain informational support rather than nurturant support. The reverse is true for journal and notes, where more messages contain nurturant support and a higher percentage of users belonging to the nurturant network.

Table 29. Number of messages containing the support types in each CMC

Unit = Msgs	Total	Both	Info	Nurt
Forum	493	248	435	327
Journal	423	185	270	349
Notes	1180	567	775	1007

The informational network consists of users who composed messages containing informational support. Similarly, the nurturant network consists of users who composed messages containing nurturant support. The forum format contains 435 users (88.2%) in the informational network and 327 users (75.2%) in the nurturant network. The journal format contains 270 users (63.8%) in the informational network and 349 users (82.5%) in the nurturant network. The notes format had 775 users (65.7%) in the informational network and 1007 users (85.3%) in the nurturant network.

Table 30. Number of users who composed messages with support types in each CMC

Unit = Users	Total	Both	Info	Nurt
Forum	128	82	127	91
Journal	134	82	94	126
Notes	411	194	231	304

Edges, or pairs of senders and targets, were extracted from six samples (forum-informational, journal-informational, notes-informational, forum-nurturant, journal-nurturant, and notes-nurturant) using a custom Python script. For informational support exchanges, 1957, 843, and 776 edges were found for the forum, journal, and notes formats respectively. The nurturant support exchanges yielded another distribution of edges were found – 1490, 998, and 1007 for the same respective formats. Table 31 summarizes the number of edges found in each CMC format.

Table 31. Number of edges in each network

	Forum	Journal	Notes
Informational	1957	843	776
Nurturant	1490	998	1007

Each of these edges were used in the construction of sociomatrices, for calculating structural and positional metrics of the social network. The results for the three CMC formats are presented by structural metrics with informational network first, then nurturant network. Later, the results from positional analysis are shown for each of the six networks.

6.3.1.1 INFORMATIONAL NETWORKS

The informational network comprised of users who submitted messages to the community in any of the three formats, with informational support type of content. This could include advice, fact, information referral, opinion, or personal experience. Three sociomatrices

were created for informational support networks using the same process as before for each of the three CMC formats. The forum sociomatrix contained 102 rows by 102 columns, indicated 102 unique users. In the matrix, there were 303 cells filled in, totaling 1957 edges in the forum graph. The journal sociomatrix contained 65 unique users and 258 unique edges. The notes sociomatrix contained 285 unique users and 305 unique edges. Forum users were more likely to have more discussion with each other as conversations rather than relationship maintenance because of low proportion of unique edges. Graph density is the extent to which network members know and interact with each other, taken from the number of edges and the number of possible edges. The densities are quite sparse in journal and notes ($J=0.06$, $N=0.003$), yet similar to densities in combined networks. This suggests something related to informational support in the two formats. The graph density for forum is much higher here than combined network, so this format is more likely to be used by the community as a place for sharing and discussing information.

Table 32. Summary of structural metrics (informational network)

	Forum (I)	Journal (I)	Notes (I)
Nodes	102	65	285
Total Edges	1957	843	776
Unique Edges	303	258	305
Graph Density	0.29	0.06	0.003
Maximum Geodesic Distance (Diameter)	4	5	11
Average Geodesic Distance	2.21	2.81	4.66

In the forum, a diameter of 4 for geodesic distance shows the farthest pair of users who have not directly messaged each other within 4 degrees related. A diameter of 5 in journal shows that strangers less likely to overlap on the same messages. A diameter of 11 in notes means that users are less likely to message without a pre-existing friendships.. The average geodesic distance indicates the shortest path between any two nodes. In each of the three samples, the average geodesic distance is similar. This shows that diversity of a majority of users in messaging each other or reaching out to a greater set of other users.

The informational network is composed of most users that post in Forum, a fraction of users writing in journals or commenting on journals, and about half that post notes. The resulting informational network looks different than the combined one. In the forum format 58 users post at least 1 message and 91 receive messages. In the journal format 60 users post at least 1 message and 51 receive at least 1 message. In the notes format 237 users post at least 1 message and 56 receive at least 1 message.

Table 33. Number of active users in each CMC, in and out degrees

	Out-degree nodes	Pattern	In-Degree nodes
Forum	58	$D_{OF} < D_{IF}$	91
Journal	60	$D_{OJ} > D_{IJ}$	51
Notes	237	$D_{ON} > D_{IN}$	56

In the forum, 58 users of the 111 users write messages to someone (52). Journal network 60 users post messages (44%) and 237 (57%) users posted notes. Similar to the last sample, the pattern here of $D_{OF} < D_{IF}$ suggests that forum users may have a greater in-degree than out-degree nodes due to starting forum threads without expectation of replies. The patterns in journal ($D_{OJ} > D_{IJ}$) and notes ($D_{ON} > D_{IN}$) suggest that users may be more likely to reach out to friends to exchange information.

Other structural metrics displayed in table 34. show forum users were more likely to exchange information with somebody, similar to the journals format, as shown by the minimum degree value of 1 rather than 0. The information and nutrient networks were separate groups of individuals participating in the forum, shown by the maximum degree size is small here compared to the combined. There isn't much overlap between the two groups, which indicates fewer bridges for different sub groups and potentially a sign of cliques.

Table 34. Degrees for Informational Network

	Forum(I)	Journal(I)	Notes(I)
Minimum Degree	1	1	0
Maximum Degree	72	29	58
Average Degree	5.941	7.938	2.125
Median Degree	4.000	4.000	1.000
Minimum In-Degree	0	0	0
Maximum In-Degree	23	19	58
Average In-Degree	2.971	3.969	1.070
Median In-Degree	2.000	2.000	0.000
Minimum Out-Degree	0	0	0
Maximum Out-Degree	51	21	6
Average Out-Degree	2.971	3.969	1.070
Mean Out-Degree	1.00	2.000	1.000

The average betweenness for the CMC formats in the informational network differs slightly from the combined network. The betweenness centrality measure for notes (682.975) was much higher than for forum (124.804) and journal (118.862). Again this shows that bridge nodes in notes format likely to exchange informational support with a wider group of friends than forum or journal. This may be an indication that a one to one communication format instead of broadcast format or blog format is easier for informational exchange to multiple people because it's more direct. In comparison to the combined network, the journal format here has the lowest betweenness centrality instead of forum format.

Table 35. Average Betweenness Centrality for Informational Network

	Forum (I)	Journal (I)	Notes (I)
Average Betweenness Centrality	124.804	118.862	682.975

The eigenvector centrality measures in the informational support network are similar to the combined network. A typical node in forum (0.010) or journal (0.015) has more influence than a typical user in notes (0.004). This is consistent with the idea that forum and journal as better formats for group conversations on a topic with its threaded presentation (posts and comments), and notes for one on one conversation such as relationship maintenance.

Table 36. Average Eigenvector Centrality for Informational Network

	Forum (I)	Journal (I)	Notes (I)
Average Eigenvector Centrality	0.010	0.015	0.004

Again, of the three CMC formats, notes had much higher closeness centrality (0.125) than forum (0.005) and journal (0.006). This shows notes users in contact with a greater number of users, which is consistent with the measures of average betweenness centrality, which said the forum graph does not have as many bridge nodes as notes. Here the difference between notes and the other two formats is more apparent. Notes users may be in contact with each other to exchange information, such as updates on a health condition or treatment plan.

Table 37. Average Closeness Centrality for Informational Network

	Forum (I)	Journal (I)	Notes (I)
Average Closeness Centrality	0.005	0.006	0.125

In the informational network, the centrality measures (degree, betweenness, eigenvector, and closeness) show that users in forum format able to take advantage of the ability to reach out to a wider group of people and hold group conversations. The notes format is on the other end of the spectrum, where users are less likely to have overlapping connections because the conversations tend to be one to one. It is apparent once again that some users in notes act as bridges in the network by writing to a wider group of different friends. The in-degree and out-degree metrics show that forum users tend to be on the receiving end of messages whereas journal and notes users tend to be sending messages to a smaller audience. Here is very apparent that more notes users ask for information from one other as well as have fewer overlapping conversations because the format encourages one on one messages. It could indicate

that they have specific questions to directly ask someone who is not a stranger. Perhaps asking question demonstrates a sign of showing concern.

6.3.1.2 NURTURANT NETWORKS

The nurturant network comprised of users who submitted messages to the community in any of the three formats, with nurturant support type of content. This could include esteem, emotional, or network types. Three sociomatrices were created for informational support networks using the same process as with the combined networks and informational networks. The forum sociomatrix contained 77 rows by 77 columns, which indicated 77 unique users. In the matrix, there were 254 cells filled in, totaling 1490 edges in the forum graph. The journal sociomatrix contained 104 unique users and 539 unique edges. The notes sociomatrix contained 365 unique nodes with 410 unique edges. Graph density in the nurturant network show to be somewhat even and sparse (f: 0.04, j: 0.05; n: 0.003). This could suggest users not reaching out to many different people. The graph density for forum is much higher, so this format is more likely to be used by the community as a place for sharing and discussing information.

Table 38. Summary of structural metrics in each CMC format (nurturant network)

	Forum	Journal	Notes
Nodes	77	104	365
Total Edges	1490	865	1007
Unique Edges	254	539	410
Graph Density	0.04	0.05	0.003
Maximum Geodesic Distance (Diameter)	5	5	10
Average Geodesic Distance	2.26	2.77	3.94

In the forum, a diameter of 5 shows that there is a pair of users who have not directly messaged each other, but within 5 degrees is related. A diameter of 5 in journal shows that strangers are just as likely to overlap on the same messages. A diameter of 10 in notes means that two users who are not

friends even less likely to message each other. In each of the three samples, the average geodesic distance is somewhat similar, but with the notes having an increased shortest path. This shows that diversity of a majority of users in messaging each other or reaching out to a greater set of other users.

The nurturant network is composed of about half of the users that posted in Forum, a majority of users who wrote in journals or commented on journals, and a majority of those that posted notes. The resulting nurturant network looks different than the combined one. In the forum format 60 users post at least 1 message and 62 receive messages. In the journal format 95 users post at least 1 message and 87 receive at least 1 message. In the notes format 311 users post at least 1 message and 64 receive at least 1 message.

Table 39. Total number of active users in nurturant network

	Out-degree nodes	Pattern	In-Degree nodes
Forum	60	$D_{OF} < D_{IF}$	62
Journal	95	$D_{OJ} > D_{IJ}$	87
Notes	311	$D_{ON} > D_{IN}$	64

In the forum, 60 users of the 111 users write messages to someone (54%). Journal network 95 users post messages (44%) and 311 (57%) users posted notes. Again, the forum users having a greater in-degree than out-degree nodes ($D_{OF} < D_{IF}$) could be due to starting forum threads without expectation of replies. The structural metrics (in-degree, out-degree) displayed in table 39 summarize the number of active degree metrics in the nurturant networks. The journal and notes formats having more out-degree than in-degree could be a result of users wanting to reach out and provide informational support to friends. Since this pattern is similar to the informational networks, perhaps feeling connect with someone else increases the exchange of information.

Table 40. Degrees in nurturant network

	Forum (N)	Journal (N)	Notes (N)
Minimum Degree	1	1	0
Maximum Degree	51	44	99
Average Degree	6.597	10.569	2.234
Median Degree	4.000	9.000	1.000
Minimum In-Degree	0	0	0
Maximum In-Degree	33	35	98
Average In-Degree	3.299	5.284	1.123
Median In-Degree	2.000	3.500	0.000
Minimum Out-Degree	0	0	0
Maximum Out-Degree	34	25	11
Average Out-Degree	3.299	5.284	1.123
Median Out-Degree	2.000	3.500	1.000

The average betweenness for notes (837.649) was much higher than for forum (98.208) and journal (181.451). This shows that a bridge node in notes format is likely to have more diverse set of friends among different subgroups. Journal and forum have less bridges, possibly because the lack of clique. Less neighbors, less bridges, indirect communication is less and therefore minimal number of connecting groups because of the lower number of bridges.

Table 41. Average Betweenness Centrality in nurturant network

	Forum (N)	Journal (N)	Notes (N)
Average Betweenness Centrality	98.208	181.451	837.649

A typical node in forum (0.013) or journal (0.010) has more influence than a typical user in notes (0.003). This is consistent with the idea that forum and journal conducive to group conversations on a topic, and notes for one on one relationship maintenance. These results are similar to the informational network.

Table 42. Average Eigenvector Centrality in nurturant network

	Forum (N)	Journal (N)	Notes (N)
Average Eigenvector Centrality	0.013	0.010	0.003

Of the three CMC formats, notes had much higher closeness centrality (0.076) than forum (0.006) and journal (0.004) even though the closeness centrality numbers here are higher than in the combined network. These numbers show notes users in contact with a greater number of users, which is consistent with the measures of average betweenness centrality that says forum graph does not have as many bridge nodes as notes.

Table 43. Average Closeness Centrality in nurturant network

	Forum (N)	Journal (N)	Notes (N)
Average Closeness Centrality	0.006	0.004	0.076

In these nurturant networks, centrality measures (degree, betweenness, eigenvector, and closeness) show that users in forum format able to take advantage of the ability to reach out to a wider group of people and hold group conversations. The notes format is on the other end of the spectrum, where users less likely to have overlapping connections because the conversations tend to be one to one. Some users in notes act as bridges in the network by composing messages to a wide group of different friends. The in-degree and out-degree metrics show that forum users tend to be on the receiving end of messages whereas journal and notes users tend to be sending messages to a smaller audience.

CHAPTER 7: BLOCKMODELS

E-patient social networks were studied to understand how social structure and relationships act to promote or influence health and health behavior (Luke & Harris, 2007). This research area has included numerous descriptive studies of social support networks in various populations, such as the chronically ill, depressed, homeless, or elderly. Another area of research is on how social networks influence health behavior with focus on social position and the topics of substance use and other risky behaviors. Ennett & Bauman (1993) used previously defined terminology to describe three major social positions that may be associated with health behavior: clique member, liaison, and isolate. Isolates are identified as having little or no interaction with peers and having higher odds of being a current smoker. Clique members, or groups of adolescents that spend more time with each other than with others, and liaisons, who interact with others but not a specific group, both had lower smoking rates (Luke & Harris, 2007).

This final portion of this study incorporates the blockmodeling research technique for clearer understanding of how community interactions may be points of social influence. This technique overlaps with the previous chapter covering structural metrics of social networks, by viewing data from six lenses (forum information, journal informational, notes informational, forum nurturant, journal nurturant, notes nurturant). On the other hand, this chapter contrasts from the structural metrics because positional analysis is based on whom each individual communicates with regularly rather than summarize activeness in the community. Structural metrics can show which actors are important, but understanding their position in the network gives a better understanding of how much influence they can provide a network. This chapter presents the results of positional analysis using a mathematical measure '*structural equivalence*' to find *social positions* within a group. In the following sub sections, the definitions will be given, followed by the approach for producing blockmodels, and finally the results are presented at the end of the chapter.

7.1 DEFINITIONS: POSITIONAL METRICS

Positional metrics can refer to a person's social position in a group; a concept that comes from sociology describing the sets of actors with similar ties to others. An overlapping concept is *social role* (systems of ties between actors or positions), which can be found using *structural equivalence* (Garton et al, 1997; Granovetter, 1972; Wasserman and Faust, 1994). This metric refers to the extent to which nodes have a common set of linkages to other nodes in the system. However, nodes in the same cluster do not need to have any ties to each other to be considered structurally equivalent. This perspective of looking for social positions using the structural equivalence measure is a type 'positional analysis'.

Structural equivalence is a valuable measure for analyzing online support group data because not all relationships are created equal, and categorize individuals into social roles helps us to better understand factors in exchanging social support (Gilbert and Karahalios, 2008). There were very few studies that use positional analysis to study online social networks. In fact, previous research studying communication patterns of online communities limit measurement to distance between various actors such as centrality and density and location measures such as in degrees and out degrees (Chang, 2009b; Pfiel and Zaphiris, 2009). The position of users in a social network has only been studied in a face-to-face environment (Wellman, 1981).

Two nodes in a network structure can be considered equivalent, or in the same social position, when they have the same ties or communicate with the same nodes. *Position* is the collection of individuals similarly embedded in networks of relations (actors in similar social activity, ties or interactions) and represented as a block in a blockmodel. This position represents a pattern of relations between two clusters, which can be encoded in a reduced matrix and ease the identification of active clusters as different from the inactive clusters.

7.2 DEFINITIONS: FUNCTIONS OF SOCIAL NETWORKS

Functions of social networks refer to the resources exchanged between users, such as social support exchanges. Treating social support occurrences as a variable that may occur in a network rather

than change the focus of this study to the social network as the subject and social support as the object of study (Walker et al, 1993). In addition to this perspective, researchers have measured the following concepts as variables:

- Social capital: Resources characterized by norms of reciprocity and social trust
- Social influence: Process by which thoughts and actions are changed by actions of others
- Social undermining: Process by which others express negative affect or criticism or hinder one's attainment of goals
- Companionship: Sharing leisure or other activities with network members
- Social support: Aid and assistance exchanged through social relationships and interpersonal transactions

This study measures the final concept in the list, the transfer of social support, or the aid exchanged through interpersonal interactions in an online community. Understanding how it is transferred through multiple CMC formats could help reveal insights to how the user interface design impacts interpersonal communication.

When measuring relationships among actors, the network approach can be used to consider (1) supportive ties anywhere in the network, (2) content, strength and symmetry of ties within a network, (3) structure of social support, and (4) characteristics of either network or components of the network (Levy and Pescosolido, 2002). Additionally, this approach is able to reveal much about a social support network (Levy and Pescosolido, 2002):

- Tie strength: quantify social support
- Reciprocity: 'shared' support (i.e. symmetry)
- Transitivity: indicates how resources are shared among 3 people.
- Compare different types of ties (i.e. financial vs. emotional supports)
- Density: indicates how number of ties helps or hinders resources to transfer.
- Positional analysis: shows roles and positions based on actor's structural similarities and patterns of relations in multiple relational networks (Wasserman and Faust, 1994).

This portion of the study is based on the final approach in the list to measure user activity based on the actor's patterns of communication with multiple individuals in the network.

7.3 METHODS

Blockmodeling, a process of identifying social positions within a social network by representing them in a matrix format, is used to analyze social roles in a group. A block is a section of the matrix indicating a partition of individuals from the network who have similar ties to others in the network. A block can indicate one of a few types of positions (Burt, 1976; Marsden, 1989) depending on the number of 'choices' available and the number present in the block.

The procedure for constructing blockmodels begins with finding the structural equivalence among nodes of a network. The first step is calculating the Euclidean distance, which measures the distance between actors i and j using their vectors of ties (each row and column) excluding self-ties and the pair's mutual ties ($k \neq i \neq j$):

$$d_{ij} = \sqrt{\sum_{k=1}^{g-2} [(x_{ik} - x_{jk})^2 + (x_{ki} - x_{kj})^2]}$$

These distances were calculated for each pair, and then sorted into predefined number of partitions. Related studies suggest selecting an arbitrary number of partitions, none of the studies showed a consistent pattern in its selection (Bambina, 2007; Burt, 1980; Brieger, 1976; White et al, 1976).

Typically the number of clusters selected is a power of 2 (i.e. 2, 4, 8) because the CONCOR algorithm uses a binary tree structure to group similarity clusters. CONCOR, which is the abbreviated name for CONvergence of iterated CORrelations, is one of the earliest approaches to partitioning actors into positions (White et al, 1976; Brieger et al, 1975). This procedure refers to the observation that repeated calculation of correlations between rows of a matrix eventually results in a correlation matrix consisting of only +1's and -1's where these correlations of +1 and -1 occur in a pattern such that the correlating items may be partitioned into two subsets where all correlations between items assigned to the same subset equal to +1 and all correlations between items in different subsets equal to -1. The CONCOR

procedure starts with a sociomatrix and first computes correlations among the rows and/or the columns of the matrix. These correlations arranged in a correlation matrix C_1 are one possible measure of structural equivalence. Each correlation matrix has its rows or columns computed for correlation, with this process repeating for several iterations until values of all correlations in the matrix equal to either +1 or -1.

Once clustered into partitions, the nodes are encoded in a matrix, with values either a fractional value for a *density table* (a matrix with blocks of densities, fractional values between the range of 0 to 1) or a binary value in an *image graph* (a matrix coded with 0 or 1). The difference between these two types of matrices is the value presented; the advantage of using an image matrix is that it provides a simpler view, whereas a density table allows a more custom selection of nodes present in a reduced graph based on the density criterion (δ). This δ value indicates the proportion of ties present from the actors in the row position to the actors in the column position (Table 44).

Table 44. Example of a Density Table

	Partition1	Partition2	...	Target
Partition1	0.4	0.3	...	0.1
Partition2	0.2	0.2	...	0.7
...
Sender	0.5	0.0	...	0.6

In the density table, each row indicates a sender partition, which is a cluster of users, and each column a target partition for a directed reduced graph. A cell indicates the pair between a row and a column with a value for the distance between those two positions. For example in table; rowPartition1 has a density of 0.3 to columnPartition2. The number of rows is equivalent to the number of columns, indicating the number of nodes in a network. The image matrix contains the same values as the density table, but converted to a 0 or 1 scale depending on the density criterion. The standard density threshold is

$\delta = 0.5$ (indicated by a 1 value in the image matrix for density values 0.5 to 1.0), however one can select a different threshold (Arabie et al, 1978).

Table 45. Example of an Image Matrix

	Partition1	Partition2	...	Target
Partition1	1	0	...	0
Partition2	0	0	...	0
...
Sender	0	0	...	0

The social network data rarely contains (perfectly) structurally equivalent actors, however block models attempt to provide a grouping of social positions. By using the threshold density, the observed block would be coded as one block if is greater than or equal to the threshold (δ) or coded as zeroblock when less than the threshold. Interpreting the blockmodels can be done for both density table and image matrix, such as with the use of reduced graphs to represent positions. The advantage of using image matrices is to show the type of position each node belongs to, whereas the advantage of using a density table can additionally show the strength of relationship ties between position blocks.

Matrices can also be represented graphically in a *reduced graph* indicated by nodes and ties, to highlight the typology of positions (Burt, 1976; Marsden, 1989). These typologies can be identified as *Transmitters*, *Receivers*, or *Ordinary* nodes (Wasserman and Faust, 1994). Positions can also be labeled as *Primary*, *Broker/Liaisons*, or *syncopates*, or *isolates* (Burt, 1976; Marsden, 1989). In the results of a reduced graph, nodes can be referred to as *Transmitters*, *Receivers*, *Carriers*, or *Isolates*.

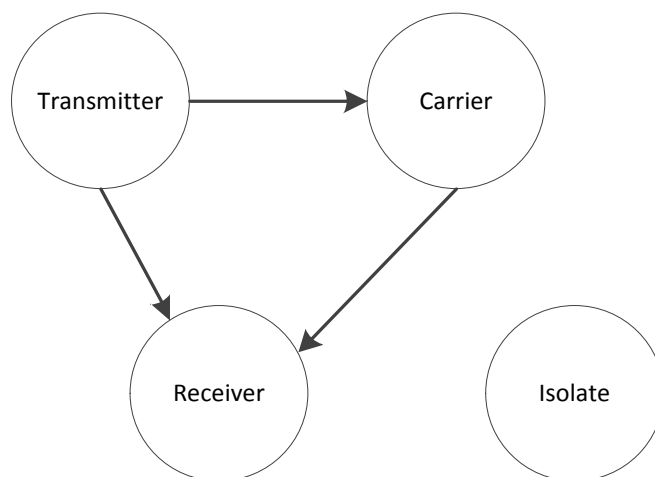


Figure 25. Example of a reduced graph

The definitions for each of the social positions (isolates, transmitters, receivers, carriers) come from Wasserman and Faust (1994):

- Isolates: nodes with neither indegree nor outdegree
- Transmitters: nodes with only outdegree
- Receivers: nodes with only indegree
- Carriers: nodes with both indegree and outdegree.

Configurations of ties between partition nodes can indicate the type of communication happening between multiple social positions (table 46). These configurations provide a guideline for the interpretations of blockmodels for this study.

Table 46. Configurations of ties between social positions

Tie	Meaning
Self loop	A single cohesive subgroup and an isolated position
One tie between positions	Transmitting end is providing support Receiving end is requesting support
Self loop for each position	Two subgroups
Two ties from node: self loop and regular tie	Distinguishes between an “active” position and a “passive position”
Two ties to node: self loop and regular tie	Resembles a core-periphery system. The position of more indegrees has been around longer than the other position.

7.4 RESULTS: POSITIONAL ANALYSIS (BLOCKMODELS)

The following six subsections in this chapter report the results of blockmodeling for each of the six networks (forum informational, forum nurturant, journal informational, journal nurturant, notes informational, notes nurturant). Table 41 displays the total number of nodes for each network, and the number of nodes in each type of block position (indicated by a c for cluster number) for 4 partition clusters, meaning the total number of nodes partitioned into 4 blocks. Table 42 shows the same type of data for 8 partition clusters. Fewer users participate in the core (transmit, receivers, carriers) of the network than in the periphery (isolates) for the forum format and the reverse for the other CMC formats.

In the reduced graphs, the social roles are labeled as *Transmitters*, *Receivers*, *Carriers*, or *Isolates*. These roles were selected based on literature review of related studies (Burt, 1976; Ennett & Bauman, 1993; Marsden, 1989; Wasserman and Faust, 1994). *Transmitters* are members in a cluster that provides support to other members. Examples include answering questions or offering encouragement. *Receivers* are members in a cluster that receive support from other members. This could indicate questions that were asked for information about treatment. This could also indicate that messages they posted had traits where users responded to offer social support. *Carriers* are members in a cluster, positioned to receive and offer support. These could indicate individuals who went from new members to veterans, or this group could have members who keep discussions going as self-selected moderators.

Lastly, the isolates social role is not very well integrated with the rest of the community. The isolates cluster indicates a social role that is marked by users who tend to post to very few members or do not indicate a need for social support. For example, journal users may have users who write daily entries but do not have anyone commenting on entries. Additionally, in the notes format, some users may post notes to individuals who do not return the gesture. These four social positions summarized in table 47 and 48 show the distribution of social positions among the networks.

Table 47. Summary of Blockmodel positions (4-partitions)

Network	Total	Isolates	Transmit	Receiver	Carriers
Forum, Informational	102	29 (c3)	21 (c1)	51 (c4)	1 (c2)
Journal, Informational	62	47 (c4)	4 (c1)	6 (c3)	5 (c2)
Notes, Informational	40	24 (c2, c4)	2 (c3)	14 (c1)	0
Forum, Nurturant	77	44 (c4)	21 (c3)	9 (c1)	3 (c2)
Journal, Nurturant	102	75 (c4)	10 (c1)	13 (c2)	4 (c3)
Notes, Nurturant	52	32 (c4)	18 (c1, c2)	3 (c3)	0

Table 48. Summary of Blockmodel positions (8-partitions)

Network	Total	Isolates	Transmit	Receiver	Carriers
Forum, Informational	102	11 (c2)	26 (c5,c7)	63 (c1,c4,c8)	2 (c3,c6)
Journal, Informational	62	35 (c8)	9 (c2, c4)	7 (c3, c5)	10 (c1,c6,c7)
Notes, Informational	40	19 (c3, c8)	4 (c2,c4,c5)	17 (c1,c6,c7)	0
Forum, Nurturant	77	24 (c7, c8)	18 (c1)	29 (c2, c4, c5)	6 (c3, c6)
Journal, Nurturant	102	29 (c5)	52 (c1,c3, c8)	18 (c4, c6, c7)	3 (c2)
Notes, Nurturant	52	20 (c8)	29 (c1, c3, c5, c7)	1 (c6)	2 (c2, c4)

Each user in the six networks was clustered into four and eight partitions to compare the two selections and reported as image graphs. The interesting finding from this overview is that the journal format has self-loops in nurturant network. Another interesting finding is that the notes format has no carrier position, which is consistent with the design of the CMC format. The rows in each image graph in the following subsections represent the senders and the columns represent target nodes.

7.4.1.1 FORUM INFORMATIONAL NETWORK

The forum informational network encompasses 102 active users over a three-month period. When clustered into the four-partition model in the image matrix in Figure 26, two clusters edges show as active but in a chain direction (cluster 1 to 2, cluster 2 to 4), while in the eight-partition image matrix in figure 27, eight edges appeared. By viewing these two image matrices sizes side by side, we can see that the distribution of many users in the blocks posting messages (transmitters and carriers) to a small subset (receivers) or do not post to the community at all (isolates).

	1	2	3	4
1	0	1	0	0
2	0	0	0	1
3	0	0	0	0
4	0	0	0	0

Figure 26. 4 cluster image matrix (FI)

	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	1	0	0	1	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	1	0	0	0	0	0
6	1	0	1	0	0	0	0	1
7	0	0	1	0	0	1	0	0
8	0	0	0	0	0	0	0	0

Figure 27. 8 cluster image matrix (FI)

In the four-partition model, the users in cluster 3 and 4 are most likely to be recipients of messages. In contrast, users in cluster 1 tend to be composing messages. Cluster 2 contains one user (#308916), who is a carrier. This shows that many users posting messages to a “guru” user in the carrier

position seeking social support and in turn this user has provided numerous amounts of support to many other users in the forum.

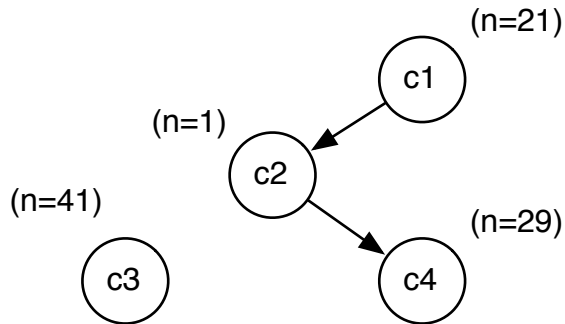


Figure 28. 4 cluster reduced graph (Forum, Informational)

In the eight-partition model, the users in cluster 1, 2, 4, 8 are most likely targets of communication. In contrast, users in cluster 5, 7 tend to be writing messages. Cluster 3, 6 each contains one user each (#455167, #308916), both of whom are carriers that both provide and receive social support.

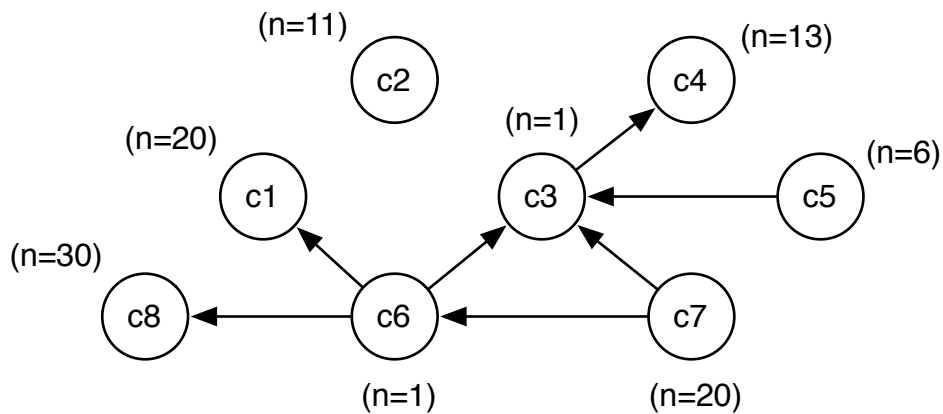


Figure 29. 8 cluster reduced graph (Forum, Informational)

In the eight-partition model, there are two highly active solo nodes (cluster 3, 6) clustering one individual that communicates with different groups depending on receiving or sending messages. In a discussion forum, the active gatekeeping nodes such as carriers help keep the conversation going for the entire community. The clusters that are transmitters (i.e. clusters 5, 7) may be highly selective about topics they want to contribute to, since the forum is a public space. There are more individuals in receiving position than transmitters, which make sense because the conversation in a group is one-to-many. The conversations usually also go one direction too, to exchange information. Interestingly, the most active user (#308916) in both partitions was grouped individually because it is a carrier node that both receives and sends messages. This user in cluster 6 is a gatekeeping node for connecting communication between different clusters.

7.4.1.2 JOURNAL INFORMATIONAL NETWORK

The journal information network contained 62 active users for the three month time period. In both the four-partition and eight-partition models, a tight circle of communication appeared. In the four-partition model three edges are active, with one group of users composing a majority of the messages, another that is mostly on the receiving end, and another that engages in back and forth exchanges (cluster 2). In the eight-partition model, twelve edges remain active, also with the triangular model, of a group transmitting to two groups.

	1	2	3	4
1	0	1	1	0
2	0	0	1	0
3	0	0	0	0
4	0	0	0	0

Figure 30. 4 cluster image matrix (JI)

	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	1	0
2	1	0	0	0	0	1	1	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	1	1	1	0
5	0	0	0	0	0	0	0	0
6	1	0	1	0	1	0	0	0
7	0	0	0	0	1	1	0	0
8	0	0	0	0	0	0	0	0

Figure 31. 8 cluster image matrix (JI)

In the four-partition blockmodel, the image matrix (Figure 30) and the corresponding reduced graph (Figure 31) both show core members interacting with each other from different positions. It is likely that cluster 1 includes the most “sociable” or “helpful” users in this format, who write messages that are seen by two types of social positions: the ones who are also providing social support, and the cluster 3 who is recipient of all messages. Cluster 4 contains most of the users in the network, who are considered periphery members because their ties do not cross over with the core members.

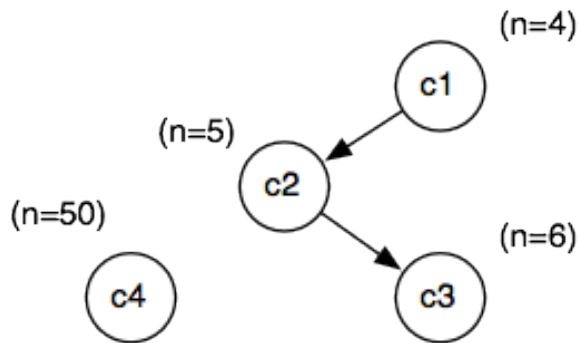


Figure 32. 4 clusters reduced graph (Journal, Informational)

In the eight partition model, the most active user in cluster 7 (#535822) is a carrier that likes to stay ‘in the loop’ by communicating with multiple groups. The journal network is more densely interrelated than the forum network, which is consistent with the idea that friends read each other’s journals and use that space for conversations. The triangular pattern suggests that a user that comments on a friend’s journal will very likely comment on multiple friends’ journals. And the same group of ‘friends’ will comment on the same journals. The transmitter nodes in cluster 2 and cluster 4 are likely to be initiators of blog posts that lead to few discussions. The carrier nodes in cluster 1, cluster 5, cluster 6, and cluster 7 are likely individuals who are comfortable extending discussions of topics. Multiple carrier nodes suggest different topic specialties.

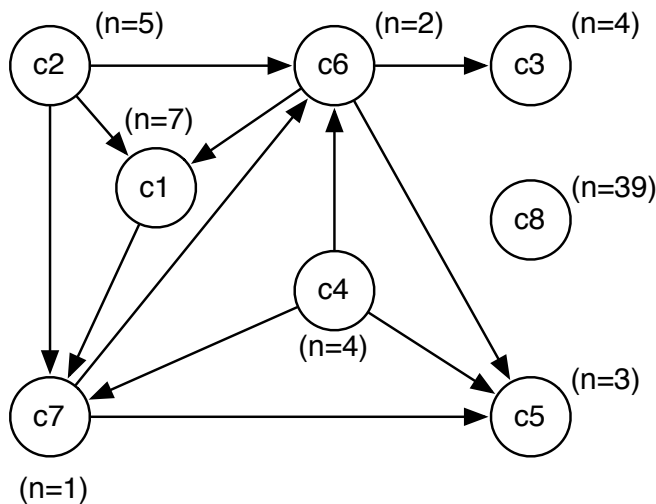


Figure 33.8 clusters reduced graph (Journal, Informational)

7.4.1.3 NOTES INFORMATIONAL NETWORK

The notes informational network contained 40 active users in a three-month period that posted notes to at least two friends. When clustered into the four-partition model, there is only one active cluster

(cluster 3) as a transmitter, which only contained only two individuals. In the eight-partition model, the same pattern of non-interlaced communication is also evident. Nodes were either in a receiving or transmitting position, not both. There were no carriers. The lack of cross-communication supports the idea that friends usually post a note in a one-to-one manner, since the CMC format does not allow threading of comments to a note.

	1	2	3	4
1	0	0	0	0
2	0	0	0	0
3	1	0	0	0
4	0	0	0	0

Figure 34. 4 cluster image matrix (NI)

	1	2	3	4	5	6	7	8
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	0	0
4	1	0	0	0	0	0	0	0
5	0	0	0	0	0	1	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Figure 35. 8 cluster image matrix (NI)

In contrast to the journal and forum informational networks in the previous two sections, clusters in this notes informational network tend pair up with another group in a one-way communication with an equal amount of receiver and transmitter nodes. There are also a higher proportion of isolate clusters in both the 4-partition model (clusters 2, 4) and the 8-cluster model (cluster 3, 8). This ‘paired’ communication patterns show that users transmit information to a specific neighboring cluster. This communication tends to be unidirectional, suggesting the ‘checking in’ type of behavior that friends use to maintain an intimate relationship.

The four partitions show that a couple of users in cluster 3 post notes to users in cluster 1. This indicates that cluster 3 users are more likely to check in with their friends. Recipients of notes do not

necessarily compose a note back to the user in reply. The users in clusters 2 and clusters 4 likely do not receive nor post notes as a form of communication.

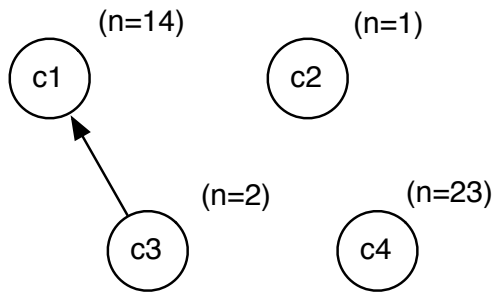


Figure 36. 4 clusters reduced graph (Notes, Informational)

Similarly, in the eight-partition blockmodel, users also tend to be grouped into the social role of either providing or seeking support, or neither. This evidence supports the idea of users maintaining relationships with periodic check-ins. Perhaps there are several parallel relationships of clusters that correspond with time, where depending on the year users started communicating, they end up as part of a subgroup in the community with more communication with their cohorts. Regardless, these pairs of clusters continue to support the idea that notes format is a one-to-one communication mechanism and does not generate discussions because of the lack of threading.

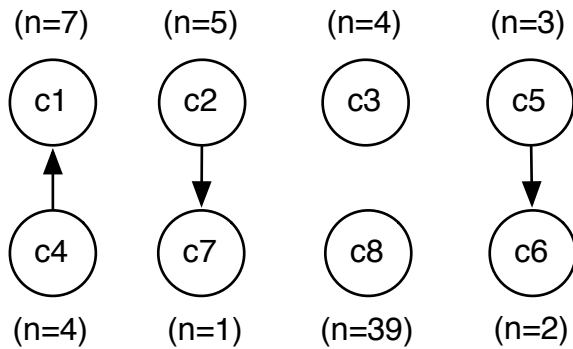


Figure 37. 8 clusters reduced graphs (Notes, Informational)

7.4.1.4 FORUM NURTURANT NETWORK

The forum nurturant network contained 102 actors in the three-month period. When clustered into a four-partition model, two edges remain in a chain pattern. Cluster 3 is a transmitter node connected to the carrier node (cluster 1), which is connected to the receiver (cluster 2). When clustered into an eight-partition model, seven edges remain. Three clusters are receivers (cluster 2, 4, 5), two are carriers (cluster 3, 6) and one transmitter (cluster 1) and two isolates (cluster 7, 8).

	1	2	3	4
1	0	1	0	0
2	0	0	0	0
3	1	0	0	0
4	0	0	0	0

Figure 38. 4 clusters image matrix (FN)

	1	2	3	4	5	6	7	8
1	0	1	1	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	1	0	1	1	1	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	1	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Figure 39. 8 clusters image matrix (FN)

Three clusters in the four-partition blockmodel contain core users of the network. These users interact with each other in a pattern similar to the forum informational network. It is a chain pattern, with many users seeking support from a few “guru” users and in turn these gurus provide social support to other community members. This pattern suggests that the forum is fitting for allowing communication of different knowledge, where not everyone knows everything. Perhaps the users in cluster 1 are likely to answer threads and start discussions that way instead of cluster 3 who are writing posts in order to seek information. A bulk of the users is in the periphery in cluster 4, which overlaps with the idea that few users are active in a discussion board.

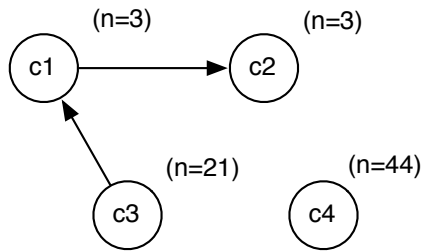


Figure 40. 4 clusters reduced graph (Forum, Nurturant)

The network clusters in this forum nurturant network have similar pattern to the forum informational network in the chaining sequence. In the eight-partition model, cluster 3 (#308916) is a single node and a cornerstone in much of the interaction with other clusters, suggesting that this user is the “guru” and very active in moderating communication in the forum. The direction of communication suggests that similarly here, that some nodes are may be selective about topics they want to talk about but also the pattern of communication fits the idea that the CMC is a one-to-many space.

Along with the idea that users here tend to provide support rather than ask for support, the triangular pattern of out-degrees suggest that users are comfortable with reaching out to strangers with this CMC. A cluster that is a carrier is more likely to be commenting to journal posts than a receiver, who would be the one writing in their journals about something that generates comments. This finding for the eight-partition blockmodel is consistent with the idea that people who start a thread in the forum are seeking nurturant support in addition to information about treating alcoholism.

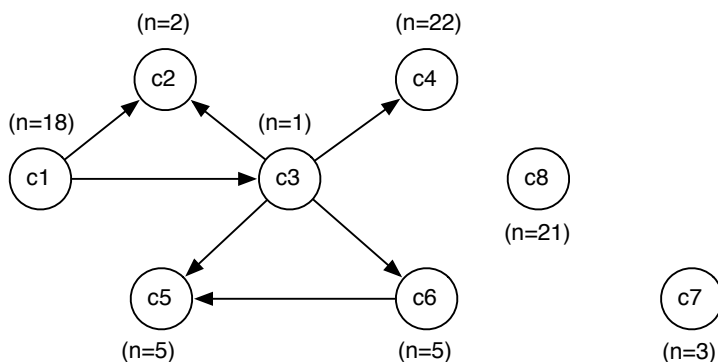


Figure 41. 8 clusters reduced graph (Forum, Nurturant)

7.4.1.5 JOURNAL NURTURANT NETWORK

The journal nurturant network has 62 active users during the three month time period. There are fewer crossovers among nodes in this network compared to the forum nurturant network. The results here are similar to the journal informational network in a more triangular structure. In the four-partition model, there is one transmitter (cluster 1), one receiver (cluster 3), and one carrier (cluster 2). In the eight-partition model, there are seven edges that link the clusters. There is one carrier (cluster 2), three receivers (clusters 4, 6,7) and three transmitters (2, 3, 8). Cluster two contains nodes that are linked to itself. In the 4-partition model there are 4 individuals in this cluster. In the 8-partition model, the self-loop cluster (cluster 2) contains 3 individuals. In the 8-partition model, cluster 6 is a solo cluster (#377493).

	1	2	3	4
1	0	1	0	0
2	0	1	1	0
3	0	0	0	0
4	0	0	0	0

Figure 42. 4 clusters image matrix (JN)

	1	2	3	4	5	6	7	8
1	0	1	0	0	0	0	0	0
2	0	1	0	1	0	0	1	0
3	0	1	0	0	0	0	1	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	1	0	0

Figure 43. 8 clusters image matrix (JN)

In the journal nurturant network, there is something different, where the users in cluster two have a self-loop. This suggests users who write journal posts that lead to conversations, and in turn participate in these threads. Additionally, these users may have strong friendships in the community, and use the journal format to stay in contact. A large number of members in the community are in cluster 4 for this four-partition blockmodel, which shows that few users have frequent exchanges of nurturant social support on this CMC format.

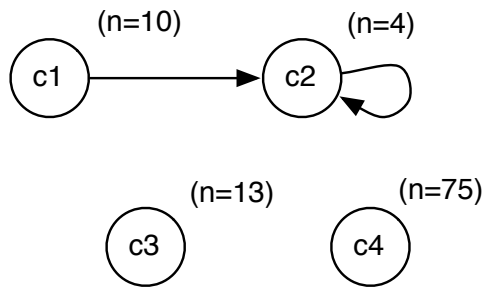


Figure 44. 4 clusters reduced graph (Journal, Nurturant)

The journal nurturant network blockmodels support the idea that journals are for friends who have conversations in small groups. The reduced graph in figure 44 demonstrates that cross-group links stay in small groups. There is not much ‘reaching out’ to random members of the entire network. Cluster 2 is a very active cluster and a carrier of conversation between multiple clusters. Perhaps they take one type of nurturant support from cluster 1, another type of nurturant support from cluster 3, and spread other types of nurturant support to users in cluster 4 or cluster 7.

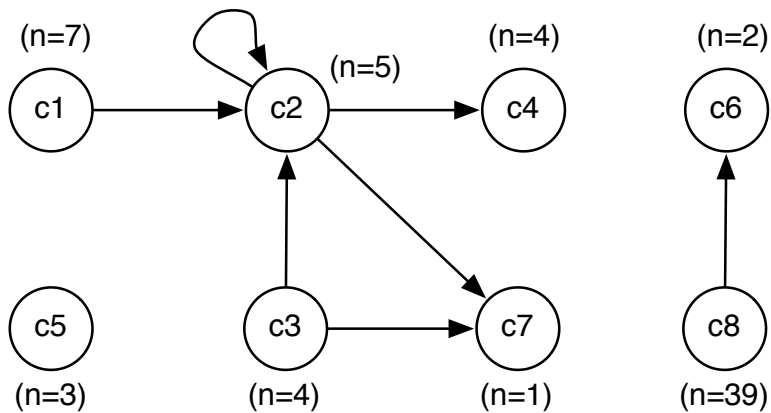


Figure 45. 8 clusters reduced graph (Journal, Nurturant)

7.4.1.6 NOTES NURTURANT NETWORK

52 nodes in the notes nurturant network across the three-month period posted to at least two different friends' walls. When grouped in the four partition model, two edges appear to show two different transmitting nodes (cluster 1, 2) connected to receiving node (cluster 3). The solo cluster (cluster 2) is #455167. Conversely, when grouped into the eight-partition model, this same user becomes a transmitter.

	1	2	3	4
1	0	0	1	0
2	0	0	1	0
3	0	0	0	0
4	0	0	0	0

Figure 46. 4 clusters image matrix (NN)

	1	2	3	4	5	6	7	8
1	0	1	0	1	0	0	0	0
2	0	0	0	1	0	0	0	0
3	0	0	0	1	0	0	0	0
4	0	0	0	0	0	1	0	0
5	0	0	0	0	0	1	0	0
6	0	0	0	0	0	0	0	0
7	0	1	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0

Figure 47. 8 clusters image matrix (NN)

The four-partition reduced graph shows how two clusters are transmitters and one cluster is the receiver. This may indicate that users are extending communication from other formats to this one to personally thank users who were helpful. Another possibility is that these clusters are users who prefer using the notes format over the notes and journals because they want to provide specifically nurturant support.

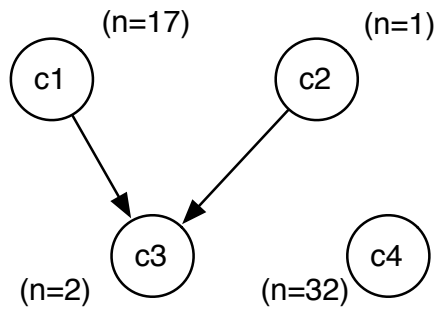


Figure 48. 4 clusters reduced graph (Notes, Nurturant)

It is evident from cluster 4 of the four-partition blockmodel that many users are not part of the core group, because they are not composing messages to specific members of clusters 1 through 3. Additionally, these users may be infrequent or new users who are in the process of forming friendships with other members of the community.

In the eight-partition model, seven edges appear to show two receivers (cluster 4, 6), five transmitters (cluster 1, 3, 4, 5, 7), and one carrier (cluster 2). Solo clusters include cluster 2 (#95284), cluster 4 (#960021), and cluster 6 (#455167). This nurturant network is different from the nurturant informational network. When viewed as a whole, it most of the users post to a specific group or receive notes from users of limited clusters. This supports the idea that friends are likely to communicate through the notes format. There are more carrier nodes in this network compared to the notes informational network, which can suggest that the clusters tend to spread out emotional expressions.

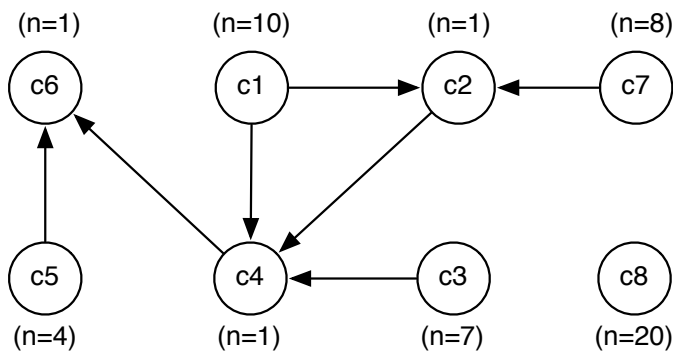


Figure 49. 8 clusters reduced graph (Notes, Nurturant)

7.4.2 SUMMARY OF SOCIAL POSITIONS

The blockmodeling technique resulted in several social positions appearing in the networks (transmitter, receiver, carrier, isolates). There were different numbers of each of these positions in each of the networks that can support the understanding of the design of CMC formats. These positions were investigated from both four-partition clusters and 8-partition clusters, which show that each CMC format is geared for different types of communication.

In the forum format, both the informational and nurturant networks for both partition sizes show carrier positions being in the middle of many transmitters and receivers. As the gatekeeping position, these individuals become “gurus” of the community, who interact with a lot of different users. These gurus can be identified because the conversation format is geared towards a group discussion format. Users tend to be in the carrier position when they communicate with different clusters, potentially reaching out to new users to show support. Additionally, the evidence of the carrier position acting as a gatekeeper potentially suggests that a certain difficulty faced by new users as they grasp new information about treating alcoholism and in navigating different threads of conversations. Other features of the 8-partition reduced graphs for the informational network (figure 29) and nurturant network (figure 41) show varying amounts of in degree and out degree linkages. The informational network shows cluster 3 with many different inbound links, which indicates information coming from various sources; cluster 6 and cluster 7 show information shared with various other clusters. In the nurturant network (figure 41), cluster 3 shares nurturant support outwards to other groups and clusters 2 and 5 receiving only up to 2 different sources of nurturant support. This is an interesting finding, as the informational support is only coming together for one cluster whereas in the nurturant networks multiple clusters give support to the same cluster, perhaps it is acceptable to repeat a certain nurturant support type in a thread. Informational support may not need to be repeated in a thread, though a “guru” user may choose to answer the same question multiple times.

The social positions found for journal format for nurturant networks show clusters of “self looping” conversations (figure 44-45). These self-loops indicate some isolation or clique behavior. In

the 4-partition network (figure 44), cluster 1 is a group of periphery users and cluster 2 is an active core group of users. It also indicates that individuals in cluster 2 have been part of the community longer than the other clusters. In the 8-partition network, the core and periphery structure is also evident (figure 45). Cluster 2 is an active, core cluster indicated by the self-loop and in bound links. It is also a more active cluster than the other clusters that receive nurturant support. In both partition sized networks, some users are “sociable” or “helpful” in transmitting positions that write messages seen by two other social roles. This type of social role keeps replies to journal posts (probably due to existing friendship) and doesn’t expect a response back. Other types of roles are people who write journal entries (transmitters) and those who comment on it in ways that don’t lead to more comments (isolates).

In the notes format, the carrier position does not exist for both 4-partition clusters and 8-partition clusters. This lack of carriers is likely related to the architectural elements of this format, which restricts group conversations. Only transmitter and receiver positions in the networks were constructed, suggesting the ‘checking in’ type of behavior that friends use to keep in touch with each other in order to maintain a relationship. These links do not cross one another, which perhaps indicates a the circumstance of pairing up users, where some clusters are likely to write messages to find out how friends are progressing. These different pairs of transmitter-receiver cluster relationships may correspond with time, where depending on the year users started communicating, they end up as part of a subgroup in the community with more communication with their cohorts. Regardless, these pairs of clusters continue to support the idea that notes does not generate discussions because the format does not allow for threads of responses. The blockmodeling technique shows different social roles in each of the CMC formats, represented by image matrices and also by reduced graphs.

CHAPTER 8: DISCUSSION

Online support communities supplement people's existing offline social networks by providing an outlet for participation in a group setting with similar peers. While a plethora of health information exists on portals such as WebMD, support groups offer socialization with peers who converse in laymen terms. This kind of communication is more easily digestible to patients than speaking with a doctor and more conducive for benefits, such as receiving advice for dealing with a problem, referrals to resources, and emotional support. Each of the three CMC format studied contributed to the overall exchange of social support however each format exhibited different characteristics in the interaction patterns.

8.1 GAPS IN PREVIOUS RESEARCH

Many of the studies found during the course of literature review show that while many previous studies also examined social support types exchanged online, their operational definitions of an online community are misleading as it does not separate the social factors from technical factors. Because not every relationship or communication format is the same, looking at each factor more closely gave a better picture to understand the impact of within a community. This study fills a gap in research by using an HCI approach to make distinction between user communication behavior and the communication software. Additionally, this study also examines how support types vary depending on social positions within an online support group to further illustrate how design impacts communication behaviors. Furthermore, no other study has compared multiple CMC formats within an online health community to see the impact of technology on the exchange of social support.

8.2 FINDINGS

Internet users join online health support communities (like those available on MedHelp.org) even while a plethora of alcohol and other health information is available on the Internet from vetted information sources. These e-patients were looking for the social component (peer support), most likely because they were not health professionals and want to be in a place where they can use laymen terms to share insights with each other as opposed to purely health information sites (e.g. WebMD), where users may experience difficulty in understanding the large quantity of information available. Weak ties are

helpful in times where individuals want to make a life change, such as abstaining from substance abuse (Granovetter, 1972). The added social components in support communities – where e-patients can have their questions answered, and hear other e-patients’ experiences – provide more easily digestible information, for example advice about applying new lifestyle changes.

Chapters 4-7 reported results of the social support exchange patterns and of the social network structure, demonstrating unique characteristics of each of the three CMC formats. Common themes appeared in across the data samples and answer the study objectives: (1) Patterns of social support exchanges emerged across each CMC format, and (2) Patterns of social network structure emerged in this online supportive environment. The study findings that address these objectives are summarized.

8.2.1 CONTENT: PATTERNS OF SOCIAL SUPPORT EXCHANGED IN THE COMMUNITY ACROSS EACH CMC FORMAT

The patterns of social support exchanged in the community varied for each CMC format, as well as for the offered supports and requested supports. Each CMC format had slightly different social support exchange patterns. Forums were used for asking and sharing information with a wider audience. Journal comments were similar to notes with smaller groups of individuals interacting, which might be an indication that journal readers consider the author as a friend. Notes were not the main source for seeking information, but rather for maintaining relationships. It appears that users joined the community seeking information but very likely stayed after getting the information they need because of the community that provided a sense of belongingness.

Offered informational support consisted of three main exchange patterns (advice > opinions > other types). Journal comments were similar to notes, in that most messages offered advice, with opinions a close second. The next highest were personal experiences or information referrals (personal experience > others). These are less formal means of communication because users know each other and because they tend to be one on one interactive formats. Another pattern found among offered support was journal comments and forum comments similarly having mostly advice, and then approximately equivalent

number of messages offering opinion, personal experience, or referrals (advice > opinion = personal experience = referrals). Surprisingly, journal posts were not similar to forum comments. JP offered more referral (R>O/P>A) than FC, which had more advice (A>O/P/R).

As for requested informational supports, there were primarily two patterns. One, forum posts, forum comments, and journal posts were similar with more facts then advice, then opinions. (facts > advice > opinions). Notes and journal comments almost exclusively ask for facts (facts > other types). Perhaps this is in part due to relationship maintenance activities. Requested nurturant support was slightly different as it includes three main patterns. The three patterns that emerged among messages that requested nurturant support were: EM>NET>EST (Forum Posts, Notes); EM=NET>EST (Forum Comments); and EM&EST (Journal Posts, Journal Comments).

8.2.2 RELATIONSHIPS: PATTERNS OF SOCIAL NETWORK STRUCTURE EMERGED IN THIS ONLINE SUPPORTIVE ENVIRONMENT

Any two randomly selected members posting in the forum will likely be found on a threaded discussion than users in the journal or notes format. This might be why the indegree is higher for this format than the other formats. Additionally, in the forum, users were likely to have greater in degree than out degree links, which suggests this one to be a good format for hearing from a wider range of people rather than requiring gatekeeping bridge nodes to connect disparate clusters. It seems unnecessary for any users to act as gatekeepers since a majority of the group message a diverse set of recipients. When it comes to exchanging informational support, forum users are more likely to have influence on other users than in journal or notes. It might be because each user is more directly connected to other users because the format encourages group conversations. Positional analysis showed forum users more likely to be in carrier position than receiver or transmitter positions. This shows that information can flow in this forum because a node in a carrier position not only receives support but also is likely to provide support to users in another position. Furthermore, the blockmodels for the forum networks show that active gatekeeping social position helps to keep conversation going, but may be selective of topics they want to contribute to.

It's a one to many conversations in a chaining sequence, reaching out to strangers. Lastly, the forum is a good format for greater diversity of conversation partners and topics than journal or notes.

Users in the notes format are less likely to message a stranger, as evidenced by the high geodesic distance for combined and separate networks. The out degree was much higher as well, which indicates more value on the act of posting a note as a sign of showing support rather than on the content. Additionally, the large betweenness and eigenvector values suggest more bridge nodes because the users are likely to stay within an invisible boundary for small cliques, just like friends are likely to speak with each other rather than strangers. Notes users are less likely to overlap among the graph, which is consistent with the social support patterns of writing one on one note. Users who author notes are likely to exchange information as well, quite possibly more personal information that is specific rather than generic alcoholism related information. This is consistent with the pattern where in notes format users ask for facts rather than advice or opinions. Positional analysis shows no carrier position in either informational or nurturant networks. This is because the format only allows post of one way without grouping messages into threads.

Writing in journals is intended to simulate a diary writing activity, so the structural metrics were consistent with this purpose. The geodesic distance was fairly low (5) for each network so that shows strangers less likely to message each other than with notes. The out-degree is higher than in degree, so this shows that perhaps users who comment on journals tend to be friends with the author. The centrality metrics are also fairly low, so there is a smaller audience following each journal. This is consistent with the idea that only friends would be interested in reading and commenting someone's journal. The eigenvector shows that journal users have more influence than users in notes, and also that this format is better for group conversations. Positional analysis shows that journal users tend to be 'self-sustaining', in the sense that in the informational network, there are isolates and in the nurturant network, certain users were likely to message someone in the same position. In the notes format, users were more likely to have higher out-degree as well as limited number of unique degrees, which indicates the conduciveness of this format to reach out to friends for activities relating to relationship maintenance.

Users either communicate with a few neighboring nodes that could be friends (i.e. triangular structures in journal informational network) or within their social position group(s) as notated by the self-loops (i.e. journal nurturant network). These observations supports the idea that a journal is for self-expression, to record one thoughts and not intended to reach out to others, but rather a place where others are welcome to comment upon entries. In comparison, the journal format shows weaker relationships between users of the community because of the sparse connections between actors. Block models for this format indicates that this characteristic is due to small friendship group formation. In the notes format, the betweenness measure is higher yet centrality is lower, which shows that a bridge node in notes format is likely to have more diverse set of friends among different subgroups, whereas the forum and journals clusters are quite diluted. The notes users are less likely to have overlapping connections with diverse actors because the conversations tend to be written directly from one user to another user.

8.3 WHAT FEATURES OF CMC FORMAT IMPACT BEHAVIOR?

Although offline support is often available from friends and family, e-patients and their caregivers participate in online support groups for the supplementary exposure to specific types of nurturant support. We found different types of nurturing support in the MedHelp alcoholism community that following various patterns across the multiple computer-mediated communication formats. Four explanations may help identify why the amount of support types vary: (1) the purpose of communication affects which format people use to convey and seek different types of needs; (2) the public and private spheres where communication is mediated by amount of information one wants to expose; (3) the usability and user experience of each format; and (4) the social conventions for particular norms of acceptable behavior.

8.3.1 COMMUNICATING WITH INTENT

The MedHelp communities have several communication formats, three of which were described in this study. Findings show that each format is used for a different purpose. For example, group style communication is good for a public arena for spreading information and getting more eyes on it (i.e.

email list and bulletin boards). However for tailored communication of a more focused topic or between two individuals, the other formats were more suitable because they can appear to be more private.

People have different needs for participating in an online community, for example some members sought information, while others sought compassion and intimacy (Chuang and Yang, 2010; Rau et al, 2008). In addition, patients may go through waves of information needs as they learn more about a topic and shift through various worsening or recovery phases of a health condition (Radin, 2000). Patients are more likely to search for help online if illnesses have limited number of standard treatment options or stigma attached to their illness (Lau & Kwok, 2009). Posting to the forum may be a different purpose than journal or notes, for example, one might disclose personal information as a strategy for finding tailored information or to document experiences.

Social media technology makes it easy to share and seek information from peers. Often, visitors of online health communities search for people who have experienced similar situations to hear stories and practical advice (Chang, 2009a; Overberg et al, 2010; Wright and Bell, 2003). Internet users may also want to stay in touch with close friends and family (Gilbert and Karahoulios, 2009; Kovic et al, 2008). People use different communication tools for different purposes; for example some online community members seek information from the support group, while others seek compassion and intimacy through conversations (Chuang and Yang, 2010; Rau et al, 2008). This distinction is possibly the result of numerous waves of information needs when recovering from alcoholism (Radin, 2001). Presenting information need(s) to the community may be a way to initiate presence and involvement as a new member, but also for older members to welcome new members. While information is often explicitly stated within messages, sometimes participation is motivated by other reasons such as relationship maintenance (Ahn et al, 2007; Thelwall et al, 2010). In fact, results from notes support previous findings of MySpace profile wall posts, which mostly contained short messages to fulfill two purposes: making initial contact and keeping in touch (Thelwall, 2010). Because it is so easy to publish information with

social media technology, blogs can be used as a way to share knowledge and skills and indirectly be a manner to keep in touch with friends and family (Kovic et al, 2008).

While the purpose of communication varies across CMC formats, it is not the same as the purpose of the community of exchanging support. In this case, both the purpose of communication through notes and forum posts (i.e. reaching out to others with emotional and network supports) and purpose of community (i.e. connecting with other patients) overlap. For example, access to other patients' stories on the Internet can be reassuring (Overberg et al, 2010). In addition, social media makes it easier to obtain social feedback and reviews. People with uncertainty about medical answers find confidence from social feedback (Lau and Coiera, 2008). Health issues trigger anxiety and questions, however, online communication with familiar folk can be soothing as it might enhance the quality of relationships and improve the psychological well-being of support seekers (Bessiere et al, 2010; Takahashi et al, 2009). For example, most blogs allow readers to leave comments and, in this way, generate both conversation and encourage collaboration (Kovic et al, 2008). Users of online support communities often communicate in one-on-one situations or in small groups of 3-5 individuals (Takahashi et al., 2009).

The individual coping strategies may also affect the type of social support exchanged. Psychology theory shows that some people use emotional coping strategies and others use problem-based strategies (Weiten and Lloyd, 2008). This distinction could relate to the pattern of social support types exchanged across each CMC format. People using problem-focused strategies try to deal with the cause of their problem. They do this by finding out information on the problem and learning new skills to manage the problem. Problem-focused coping is aimed at changing or eliminating the source of the stress. On the other hand, emotion-focused strategies involve releasing pent-up emotions, distractions, and managing hostile feelings, meditating or using systematic relaxation procedures. Emotion-focused coping is oriented toward managing the emotions that accompany the perception of stress. Looking for problem-based solutions can be related to wanting to build a network of weak ties, something like a forum. Emotional-based coping may be related to building strong ties, like nurturant support exchanged through journal and notes formats.

8.3.2 PRIVACY AFFORDANCE IN NETWORKED SPACES

Over time, new members of a community may adopt the same behaviors of the early-adopters. For example, the first users asked medical questions in the forum, and later when the journal and notes were added, the users were familiar with these formats from other websites (i.e. LiveJournal, Facebook, MySpace, twitter) and bring those practices into this community. Most SNS users communicate one-on-one or within small groups (Takahashi et al, 2009). User behavior with notes has similarity to journal comments, and forum comments are similar to journal comments. However, forum posts stand out as having different pattern than other formats. Because privacy can be controlled through notes and journals, the content can contain more personal experience and emotional content than the public forum. It is possible that the users did not find it necessary to use privacy controls in the more personal areas because it seems more private.

The offline world can provide a model for the origin of these differences in social interactions as well. For example, speaking with a doctor inside the doctor's office is more confidential than chatting with someone in a waiting room or at the bus stop. In fact, there are social conventions for relationship maintenance such as checking in regularly (Rau et al, 2008).

8.3.3 USABILITY AND USER EXPERIENCE

While the CMC format authorship and readership features can influence different behavior patterns, the display on the user interface is also a factor affecting how individuals perceive expected use of the tool. For example, in a physical setting, it is easy for one to perceive the relative privacy of the space. However, in an online environment, the amount of privacy is not as transparent. In this case, perhaps the MedHelp users do not assess the online setting as they would a physical face-to-face setting. In light of the content observed through this community (i.e. blackouts, possible violent episodes, etc.), the online setting diminishes amount of stigma that would be present in face-to-face support.

The three formats in this study (forum, journal, notes) were different from the settings of the other studies (email lists and discussion boards). Even among these three contain some deviations in

accessibility. Forums are more easily accessible from the main page where update notifications are signals indicating an invitation to access to the space. This content promotion encourages discovery of updates to a users' social network, which helps to generate new conversations (Farzan et al, 2009). The journals were explained by the forum to be similar to writing in "diaries" to thoughts and feelings. In a way when the writer presents their content it doesn't necessarily have to be for requesting information. Instead, by authoring a journal post they can initiate discussion without use of questions and also be the owner of the discussion. Journals by design are moderated because a journal belongs to a user and they can limit visibility of their posts as well delete comments to that post. The notes format is one to one communication so people tend not to use if for seeking response.

These three CMC formats (forum, journal, notes) are common among social media platforms (Boyd and Ellison, 2007). This study uses MedHelp, which is different from other study settings in similar studies that use email lists because email lists do not contain profile information and are not linked to a profile page. It is a different way of representing your identity and having a "front door" to your identity, and allowing others to find common ground for conversation (Lampe et al, 2007). SNS compared to other social software tend to focus more on relationships (especially the "friends" listed on a profile page) and interpersonal communication with the plethora of messaging features. And lastly it is different because members can post public notes to each other on topics that branch off from the main community.

8.3.4 SOCIAL CONVENTIONS, COMMUNITY OF PRACTICE

Another reason for different social support patterns in the various computer-mediated communication formats may be explained by communication theory at an individual level, which separates communication into those targeted to the public (i.e. mass media, advertisements) or private interpersonal communication (i.e. email). In recent years, studies of online communication show that social media mimics physical spaces by providing online spaces for communication but instead used to exchange private information. An example of a public space is an urban space, which has characteristics

that allow public gatherings to happen in a neutral space, similar to an online forum that provide a grassroots setting (Oldenburg, 1989; Putnam, 1995). The space experience comes from relations with others (Humphreys, 2007; Lofland and Lofland, 2006). In these neutral spaces, the core group's main activity is informal conversation. Public spaces such as parks are communal and have certain purposes of use compared to a private space such as a home. Communication tools can be designed with a spectrum of privacy options, however the distinction between the traditionally public and private spheres is blurred in online communication (Clegg Smith, 2004; Papacharissi, 2009). We believe that because privacy can be controlled through notes and journals, we can distinguish these as private spheres, which are more personal, and the forum as a public sphere, where conversations are exchanged in a community setting. While the sphere may be a factor that influences behavior on each format, results indicate that the CMC format has attributes that impact behavior patterns. For example, notes has support levels similar to forum posts, where as forum comments have support levels similar to journal posts and journal comments. It is possible that people were unaware of online privacy issues or do not find it necessary to control privacy settings or learn about their implications.

8.4 EMERGING ISSUES FOR PRACTICE

In the course of identifying support types in user-generated content, there were traces of users mentioning their health outcomes (i.e. days sober) or of collaboration with each other. Although bulletin boards have less than expected effect on behavior change such as smoking cessation, it is often an integral component in web intervention programs by allowing participants to communicate with each other and thus exchange experiential knowledge (Stoddard et al, 2010). It is not suggested as a primary information source as only certain individuals voluntarily actively participate and often result a small core set of active users. Participation is also linked to other factors such as an e-patient's phase of quitting (i.e. former smokers have higher participation than those pre-quitting), and speed of responses to posts.

Social media allows direct connection between information consumption and contribution on part of the consumer (Eysenbach et al, 2008). Social networking enables and facilitates collaboration and collaborative filtering processes among weak ties (Granovetter, 1972). For example, it enables users to

check in what their peers or others with a predefined relationship (“friends”, “colleagues”, “fellow patients” etc.); enables automated selection of “relevant” information (based on what peers online activity); enables reputation and trust management, accountability and quality control, and fosters viral dissemination of information and applications (it is this “viral marketing” aspect that makes Web 2.0 applications so attractive to venture capitalists and public health practitioners alike). Moreover, social networking is a potentially powerful tool to engage users, in that it provides “social” incentives to enter, update, and manage personal information that encourages socializing with new individuals (Farzan et al, 2009). Teenagers spend hours keeping their Facebook profile current, constantly updating their status, a generation of users who may possibly turn their attention and energy to similar tools for health (Eysenbach, 2008).

Some areas of future work could be practiced. For example, if hospital management considers creating programs to encourage or organize face-to-face discussions among their patient population, several areas can be considered. Investigations can be made into cost effective measures that address a variety of needs, covering health behaviors, psychological therapy, e-learning and most importantly, confidentiality. Some of the concepts raised in this study could be applied to recommendations for hospital management of patients’ experience in receiving treatment. In regards to patient reported outcomes, efforts can be made to measure health behavior changes in online support groups. For more formalized psychological therapy practices, there can be designated tracks to cover both emotional and problem based coping of health conditions. There can also be efforts made to remove feelings of stigmas attached to the health condition. Confidentiality is also important; any online tools should address the distinction between public and private messages. And finally, collaboration and e-learning among patients can occur in peer support groups, especially because interventions for behavior change have increased success with daily check-ins and paired friendships. This study is a starting point for identifying patient experiences, from which future work can inform many aspects of hospital management.

8.5 DESIGN GUIDELINES FOR CREATING ONLINE SUPPORT COMMUNITIES

CMCs can be designed such that user behavior is considered when constructing targeted social spaces. The analyses revealed visual patterns of users' communication characteristics as well as the relationships among them in an online support community. This study showed that CMC formats either are conducive to offering more informational support, offering more nurturant support, and some that are conducive to both forms. Forums are a good format for encouraging new friendships, because it has a higher volume of traffic participating. From there, users could be channeled into journals and notes format to maintain relationships. This works because the forum is a more informational area, and great for disseminating information. The journals and notes areas are great for nurturant support because this type of support is more likely to be exchanged among friends. Once friendships form, people will have increased interest in staying connected with their social circles, even through online platforms (NielsenWire, 2010). Results show that it may be easier for members to ask for additional types of support after asking for emotional support at least once before; encouraging users to submit a request for emotional support early on can trigger more support seeking activity.

To adhere to more structured paradigms of online communities – there can be designated spaces to focus on either emotional or problem-based coping of health conditions. For instance one area can focus on collecting statistics of treatments prescribed for specific symptoms; another area can focus on the coping of new treatments. Encouraging multiple demographical groups to be represented in a group may be beneficial for enhancing the value of weak ties, however it may be easier to recruit members by matching them with small groups that have a greater number of shared characteristics.

The user interface design can also be improved in a number of ways. The forum is like a public space like a cafeteria – placing a buffet of available discussion topics on the landing page would let a person browse for one that piques their interest. The journals format is akin to a waiting room, where the people who are hanging out there are collectively waiting for something similar. It could be a visit at the clinic or even the waiting for legal paperwork at a local government office. The note format is like the

final zone of public intimacy, where two individuals can focus on their relationship to each other while exchanging information. Many support group users are drawn to interactivity for the sense of community, in order to help with making tough healthcare decisions.

Findings suggest that privacy control features for each format may have some influence on the social support patterns. Additionally, features such as the profile page and journals are similar to providing rooms for people to talk about more specific things and have fewer interruptions, and this availability impacts the conversations on the communal areas to be more formal and the other areas to be less so. Finally, with forum and journal formats being conducive to group conversations because of the threaded layout, the notes are more fit for relationship maintenance.

8.6 LIMITATIONS

The results cannot be generalized because this study setting is narrowly defined to an alcoholism community. Alcoholism comes with several attributes that make it unique. The setting here, an online support community, is also a narrow definition of a social media website. MedHelp has particular software features for computer-mediated communication that other websites may not have. Alcoholism as a health condition has its own characteristics that can influence attitudes and behaviors. Our hope is to extend more work on each of these to better understand impact of technology on human interactions. There were a few limitations in this work. Future work can identify patterns at the message level rather than patterns for each sample to better understand the construction of each message. This study did not account for member's support profile, such as whether they are more likely to provide or request support; nor their health outcomes. Future work that identified whether support was given explicitly to a recipient could be useful. Future work would need to gain further permission to collect health record information of patients who participate in these online groups to measure health outcomes.

CHAPTER 9: CONTRIBUTIONS & FUTURE WORK

The objective of this study was to investigate user behavior in an online community with the socio-technical framework, which resulted in the perspective that user behavior in public virtual spaces parallels human behavior in physical spaces. The results in chapters 3 through 7 illustrate the parallels, where the forum is a public space like a cafeteria, a journal like a waiting room, and notes like a patient room. More research to understand at a deeper level how social support is communicated among computer-mediated communication formats in these groups would be particularly useful to those interested in designing, providing, using, or evaluating online support as an alternative to face-to-face support. Knowing how to develop and sustain an online community is important; attracting returning users necessitates displaying a certain level of active users from peer families and visible signs of their activity. Potential benefits of SNS participation for e-patients include peer support (availability of opportunity to receive and offer support), which can be an empowering experience in a customizable setting (i.e. limited identity information reveals or restricted number of friends). Not only that, a personalized space could help patients open up about their health issues. This could be beneficial to the area of preventive medicine.

Design patterns for SNS to increase knowledge sharing among the group include creating clear group boundaries (i.e. application for membership to the community), tracking content to organize it (i.e. tagging messages), and grasping perspectives (boundary objects to increase insight among different parties). Future work could be practiced for improving the methods used in this study, such as efforts in the content analysis coding scheme to make results more reproducible for comparisons of multiple data samples. For example, there could be key phrases in indicate each social support type.

Previous research on social support in the CMC formats showed that Journal and Notes have similar patterns of exchanging informational support. Thus, future work can focus more on the identifying user relationships to understand how a person's role on a group can influence the content of their communication or even the strength of their network ties. Future work can include a wider array of research techniques, particularly qualitative methods such as ethnography or interviews. Another

direction for future work is to explore theories on personas at an individual level. For example, the theory of faceted social identity in sociology states that people behave differently to different groups. Users communicate with different categories of relationships online. Users present aspects of their identities depending on their intended audience and social support needs. For example, close friends may serve as sources of emotional support, with a format closer aligned with e-mail format since it appears more personal and “private” than social network sites and users are more likely to experience more comfort in using that platform to communicate with close relations (Farnham and Churchill, 2011). Some users may also be motivated to keep in touch with others whereas others want to share information (Chuang and Yang, 2010; Kovic et al, 2008; Rau et al, 2008). Age can also be a factor in online activity, as younger generations are likely to be spending time on SNS to maintain relationships than older generations. There are specific groups tailored for older generations of adults to encourage older people to foster relationships in a support group setting (Pfiel and Zaphiris, 2007; Pfiel and Zaphiris, 2009).

Future work beyond this thesis shall include deeper analysis into online health social networking. For example, more specific support types could be identified, in relation to the social positions. One branch of future research could focus on the depth analysis of the social support types exchanged across each CMC format and their timeliness. Another branch of future work could continue analyzing user relationships through social network analysis to better understand the phenomenon of social networking in this space. Future work that identifies patterns at the message level rather than patterns for each sample would help with understanding the construction of each message. This study did not account for the individual characteristics such as each member’s support profile, such as whether he or she are more likely to provide or request support. Future work that identified whether support was given explicitly to a recipient could be useful.

Future studies could also provide more discussion points such as, linking social support and social relationship findings with the different stages of alcohol recovery. In addition, it is important to identify functions of social support (i.e. resources exchanged in the process of being helpful), and as well as the etiquette of behavior in online space to elucidate social norms of the group. Information needs per

individual member may be different at each stage of alcoholism recovery, and future work can find the correlation between social support exchanges for each stage. More work can be done to compare social networking sites with different health communities. For example, a comparison of alcohol recovery with smoking cessation, or a non-health community to see if the CMC format has similar impact on peer-to-peer interaction. Internet users are not only using social media to stay in touch with their circles of friends and express their opinions, e-patients and caregivers are also actively using social media to look for helpful health information and seeking support from their peers. As this trend continues, it will be important to research and evaluate software architecture to understand the environment for data storage on servers as well as presenting the data on user interface of a social media website.

Yet another research angle for studying patient communities is taking into consideration shared patient data, which are mostly quantitative data points (i.e. blood pressure) rather than qualitative data such as stories and advice (Frost and Massagli, 2008; Wicks et al, 2010). Participants often look for similar patients (by medical ailment in common, hobby, or other thoughts) to make their connections. Websites such as PatientsLikeMe “promote data-centered patient conversations”. This might be a good direction, as there are many lurkers in support communities (Cutrona and Suhr, 1992), who feel that reading community messages is enough to feel sense of belonging to the collective intelligence. The influence of interpersonal association on personal health records could lead to improved health outcomes as people become more aware of their day-to-day behaviors.

Studying the research questions presented in this document helped us better understand how the communication tool impacts online communication and how individuals behave in an online setting. These insights are potentially useful for designing online intervention programs that are more effective in helping with behavior changes. People are drawn to online health support communities because of the availability of tailored information and also the opportunities to meet peers who share similar experience(s). Emotional support is an important component to interactions within support groups; however it varies in exchange across different social media communication formats for reasons such as demographics, and formats of communication tools. Users may prefer to ask basic informational

questions in the forum because they would rather have any answer than only the specific answer. Furthermore, users may prefer using the journals to disclose specific information that only a select few people. Deeper understandings of these associations are helpful towards designing health related Internet applications. This in turn can contribute to applications such as online intervention programs.

We found two general patterns in offered nurturant support and three general patterns in requested nurturant support. Offered nurturant support is typically emotional support such as encouragement, then either esteem (i.e. validation) or network (i.e. reminders of presence) supports. Requested support was also typically emotional support, but with more network than esteem support. There was no mention of network support in the journal posts or comments. We attempted to link theories with results to explain the supportive behaviors. Theoretical perspectives include: (1) purpose of communication, where people use different platforms differently to convey different types of information; and (2) public and private spheres of communication influence the users' behavior. Further research could provide more insight into this phenomenon.

This research offers a novel message regarding the impact computer-mediated communication format has on user interaction patterns in online support communities. It is not clear how people seek or provide social support in an online format, so we explored how the social media platform facilitates social support exchange. Social media has more computer-mediated communication features than previously studied software platforms for online communities in that it gives the user a bit more control over whom they share information with by offering multiple formats for private and public messaging. This research also examines the issue of space preference for privacy and the kinds of support in each format, of disclosing information to specific people. We studied how users use social media for nurturant support to have a better understanding of how computer-mediated communication formats can encourage a specific type of social support. For example, alcoholism, smoking cessation, or cancer survivors may need more nurturant support in coping with stress. Other types of health intervention such as weight loss may need more informational support for behavior changes. Therefore, the design and utility of social media would be tailored to the particular purpose of the community it serves.

The aim of this study as part of a multi-part study was to investigate the social support exchanged across different software features of a health social networking site. We identified different types of information exchanged as social support, with a different pattern on each CMC format. While e-patients can seek information from validated health information websites (i.e. WebMD), they also participate in support groups for social type of information to help with coping with chronic health conditions.

Identifying themes of social support across the three text-based CMC formats showed that each format was used differently. Forums were used for asking and sharing information with a wider audience. Journal comments were similar to notes with smaller groups of individuals interacting, which might be an indication that journal readers consider the author as a friend. Notes were not the main source for seeking information, but rather for maintaining relationships. Users joined the community seeking information however very likely remain active because of the community social connections presented.

This work contributes to knowledge about the use of multiple CMC formats with a mixed method approach to cross-examine the data. It is different from previous studies in its use of quantitative techniques to understand online health support community behavior from an objective approach. This study was conducted with the hope that the method of social network analysis could help us better model the collaborative peer-to-peer information seeking process, specifically the social support and social structure for online alcoholism support groups.

Multiple aspects of an online community were investigated in this study in addition to the content and member relationships. These variables do not tell the whole story, as the policies and purpose of the community can also be evaluated. Empirical data from online community could either confirm hypothesis drawn from literature on F2F groups or shows something new about group behavior. The significance of this work is that it could help with designing specific online communities such as online intervention programs.

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APPENDIX A: SOCIAL POSITIONS

4 clusters reduced graph (Forum, Informational)

Cluster	1	2	3	4
# of actors	21	1	29	41

8 clusters reduced graph (Forum, Informational)

Cluster	1	2	3	4	5	6	7	8
# of actors	21	11	1	13	6	1	20	30

4 clusters reduced graph (Journal, Informational)

Cluster	1	2	3	4
# of actors	4	5	6	50

8 clusters reduced graph (Journal, Informational)

Cluster	1	2	3	4	5	6	7	8
# of actors	7	5	4	4	3	2	1	39

4 clusters reduced graph (Notes, Informational)

Cluster	1	2	3	4
# of actors	14	1	2	23

8 clusters reduced graph (Notes, Informational)

Cluster	1	2	3	4	5	6	7	8
# of actors	14	1	2	1	2	1	2	17

4 clusters reduced graph (Forum, Nurturant)

Cluster	1	2	3	4
# of actors	3	9	21	44

8 clusters reduced graph (Forum, Nurturant)

Cluster	1	2	3	4	5	6	7	8
# of actors	18	2	1	22	5	5	3	21

4 clusters reduced graph (Journal, Nurturant)

Cluster	1	2	3	4
# of actors	10	4	13	75

8 clusters reduced graph (Journal, Nurturant)

Cluster	1	2	3	4	5	6	7	8
# of actors	13	3	5	9	29	1	8	34

4 clusters reduced graph (Notes, Nurturant)

Cluster	1	2	3	4
# of actors	17	1	2	32

8 clusters reduced graph (Notes, Nurturant)

Cluster	1	2	3	4	5	6	7	8
# of actors	10	1	7	1	4	1	8	20

APPENDIX B: PUBLICATIONS OF THIS WORK

Journals

K. Chuang and C. C. Yang, "Interaction Patterns of Nurturant Support Exchanged in Online Health Social Networking" *Journal of Medical Internet Research* 2012; 14(3):e54. PMID: 22555303
doi:10.2196/jmir.1824 URL: <http://www.jmir.org/2012/3/e54/>

K. Chuang and C. C. Yang, "Informational Support Exchanges on Different Computer-mediated Communication Formats in a Social Media Community of Alcoholism" *Journal of American Society for Information Science & Technology* (forthcoming)

Conference Papers

K. Chuang and C. C. Yang, "How Do E-Patients Connect Online? A Study of Social Support Roles in Health Social Networking." *Conference for Social Computing, Behavioral Modeling and Prediction (SBP 2013)*, Washington, DC. volume 7812. p:193-200. doi: 10.1007/978-3-642-37210-0_21

K. Chuang and C. C. Yang, "A Study of Informational Support Exchanges in MedHelp Alcoholism Community." *Conference for Social Computing, Behavioral Modeling and Prediction (SBP 2012)*, University of Maryland, College Park. volume 7227. p:9-17. doi:10.1007/978-3-642-29047-3_2 (Top 5 student paper)

K. Chuang, "A comparative study of supportive interactions between e-patients across communication functions of a social network site," Proceedings of AMIA Doctoral Consortium 2010, Washington DC, November 13-17, 2010

K. Chuang and C. C. Yang, "Helping You to Help Me: Exploring Supportive Interaction in Online Health Community," Proceedings of ASIS&T 2010, Pittsburgh, PA, October 22-27, 2010.

K. Chuang and C. C. Yang, "Social Support in Online Healthcare Social Network," Proceedings of iConference, Urbana-Champaign, IL, February 3-6, 2010.

A Study of Social Positions In an Online Alcoholism Community, **Katherine Chuang**, Christopher C. Yang, *International Conference on Social Computing, Behavioral-Cultural Modeling, & Prediction (SBP 2013)*

Social Support in Online Healthcare Social Networking, **Katherine Chuang**, Christopher C. Yang, Research Day 2010

VITA

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EDUCATION

- Ph.D., Information Science & Technology, Drexel University, 2013
- MLIS, University of California, Los Angeles, 2007
- B.S., Computer Science, CSULA, 2005

EXPERIENCE

- 2013-Present: Product, Research & Development, Soostone, Inc, New York, NY
- 2011-2013: Analyst, Department of Epidemiology & Biostatistics, Memorial Sloan-Kettering Cancer Center, New York, NY
- 2010-2010: Technologist (volunteer), Library, The Academy of Natural Sciences, Philadelphia, PA
- 2007-2011: Graduate Research Assistant, The iSchool at Drexel University, Philadelphia, PA
- 2005-2007: Graduate Student Researcher, Office of Educational Technology, UCLA, Los Angeles, CA

GRANTS

- Student Travel to The Conference for American Medical Informatics Association, Doctoral Consortium.
- Student Support Grant to The Social Computing, Behavioral Modeling, & Prediction Conference 2013.
- Drexel Green Grant Recipient 2011
- Minority and Diversity Grant to The Social Computing, Behavioral Modeling, & Prediction Conference 2012.

