Communications of the Association for Information Systems

Volume 34 Article 26

1-2014

A Multilevel Investigation of Participation Within Virtual Health Communities

Nima Kordzadeh
Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio, kordnima@isu.edu

Charles Zhechao Liu
Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

Yoris A. Au
Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

Jan Guynes Clark
Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

Communications of the Association for Information Systems

CAIS

A Multilevel Investigation of Participation Within Virtual Health Communities

Nima Kordzadeh

Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

nima.kordzadeh@utsa.edu

Charles Zhechao Liu

Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

Yoris A. Au

Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

Jan Guynes Clark

Department of Information Systems and Cyber Security, College of Business, The University of Texas at San Antonio

Abstract:

Virtual health communities are a major channel through which health consumers share health-related knowledge and/or exchange social support with their peers. These virtual environments can be a form of, or a potential component of, integrated Patient-centered e-Health (PCEH) applications, which represent emerging healthcare information systems that emphasize the role of patients and revolve around providing patient-focus, patient-activity, and patient-empowerment services. Because of the collaborative nature of virtual health communities, user participation is a critical factor for community growth and prosperity. In this study, we examine user participation at the individual and group (thread) levels. At the individual level, we investigate the impact of reciprocity and homophily (similarity of user characteristics such as age, gender, and tenure) on user participation within virtual health communities. At the thread level, we study the role of highly active users (power users) as thread initiators as well as the role of thread initiators' participation on the overall thread vibrancy. To do so, we analyzed 2,176 threads initiated by 130 users and 1,947 messages exchanged between these users and their peers. Our results support short-term reciprocity, but refute the positive relationship associated with long-term reciprocity. Among homophily hypotheses, our results support gender homophily, but not age or tenure homophily. At the thread level our findings suggest that a discussion thread is vibrant if the thread initiator is a power user or participates actively within the thread. These findings have important implications for future research and practice in PCEH applications.

Keywords: virtual health communities, online social networks, user participation, reciprocity, homophily, power users, thread vibrancy

Editor's Note: The article was handled by the Department Editor for Special Section on Patient-centered e-Health

Volume 34, Article 26, pp. 493-512, January 2014

I. INTRODUCTION

Over the past decade, information technology has transformed the role of patients in healthcare from passive to active involvement [Lewis, Chang, and Friedman, 2005]. A major driver for this transformation was the emergence of e-health services and technologies. Eysenbach [2001, paragraph 4] defines e-health as "health services and information delivered or enhanced through the Internet and related technologies." E-health is utilized to shift healthcare services and processes from provider-oriented to patient-centered [Lewis et al., 2005; Wilson, Wang, and Sheetz, 2014] and has led to the development and adoption of a new generation of health information technologies referred to as Patient-centered e-Health (PCEH).

As opposed to the traditional healthcare applications in which health providers were the pivotal actors and the sole decision makers, PCEH systems emphasize the role of individual participants [Lewis et al., 2005]. PCEH encompasses a wide range of technologies from personal health records (PHRs) [Greenhalgh, Hinder, Stramer, Bratan, and Russell, 2010], and telehealth applications for diagnosing and controlling diseases, to the Internet-based patient communication tools [Wilson et al., 2014]. The primary characteristics that all PCEH applications have in common include patient-focus, patient-activity, and patient-empowerment [Wilson, 2009]. Hence, the main mission of PCEH is to enhance patients' authority and control over their healthcare by allowing them to meaningfully participate in providing and/or consuming health information relevant to them.

Based on the definition, characteristics, and mission of PCEH applications, online social networks dedicated to health-related topics can be regarded as a form of, or a potential component of, integrated PCEH applications. Over the past few years, patients and caregivers have increasingly relied on these online social networks to find and share health-related information [Lau and Kwok, 2009]. This information may pertain to such areas as the symptoms and treatments of a specific disease or more detailed information related to healthcare practitioners or facilities. A national survey by the Pew Research Center reveals that one in four Internet users who suffer from diseases such as high blood pressure, diabetes, heart conditions, lung conditions, or cancer go online to find information related to their health issues [Fox, 2011a], and even a larger percentage (about 80 percent) go online to find health information in general [Fox, 2011b].

In line with this trend, numerous socially-integrated websites dedicated to health-related topics have been developed [Demiris, 2006]. These websites provide collaboration platforms such as blogs and online discussion groups for healthcare participants to interact with other people with similar health-related issues or to find and share health information [Kordzadeh and Warren, 2012; Oh and Lee, 2012]. Following the general conceptualization of virtual communities that "A virtual community can be seen as a group in which individuals come together around a shared purpose, interest, or goal" [Koh, Kim, Butler, and Bock, 2007, p. 70], we refer to these websites as "virtual health communities." WebMD.com and DailyStrength.org are among the most popular virtual health communities in the United States today.

Virtual health communities vary on population and community dynamics. Some communities constitute discussion threads on a wide range of topics with a vibrant group of users, while other communities serve a relatively stable group of users with a highly focused set of topics. Despite these variations, extant research has shown that the sustainable growth of a virtual community depends critically on user participation [Koh et al., 2007; Ling, Beenen, Ludford, Wang, Chang Li, Rashid, et al., 2005]. Given the prominent role of users (patients) in virtual health communities, we expect the role of user participation to be more salient in driving the success of these communities. Thus, in this study we examine user participation in virtual health communities.

Participation in virtual communities includes posting comments, questions, pictures, videos, etc., by a user as well as viewing/reading these objects posted by other users within a community [Butler, 2001; Koh et al., 2007]. Within the context of virtual health communities, individual participation refers to exchanging social support in the form of support-seeking and support-providing messages and comments [Griffiths, Calear, Banfield, and Tam, 2009]. The communication mechanisms include blogs, discussion boards, private messaging services, and also chat services. In this study, we seek to understand user participation at both the individual and group (thread) levels. At the individual level, we focus on the dyadic exchange relationship and examine two primary constructs that may influence user participation: reciprocity and homophily (similarity of user characteristics such as age, gender, and tenure).

Reciprocity is one of the most prominent drivers that motivates members of a community to share their knowledge [Chiu, Hsu, and Wang, 2006; Wasko and Faraj, 2005]. Reciprocity in mutual relationships originates from the inherent tendency of people toward fairness. People may deviate from self-interested behaviors when encountering the friendly and supportive actions of others [Fehr and Gächter, 2000].

Similarly, social interaction can be facilitated when people share similar characteristics such as race, education, gender, and age [Feld, 1982; Marsden, 1988; McPherson, Smith-Lovin, and Cook, 2001], a phenomenon known as homophily [McPherson et al., 2001], or the similarity-attraction principle [Monge and Contractor, 2003]. Social exchange theory predicts that people within a social network seek mutual reciprocity in return for the time and effort made participating in the network and potentially helping others [Chiu et al., 2006], and they are more willing to interact with others who have much in common with them because the interactions are generally more comfortable, rewarding, and efficient [Carley, 1991]. Therefore, in this study, we seek to investigate if the above findings still apply in the context of virtual health communities.

At the group level, we focus on the aggregated participation within discussion threads. To investigate what group-level factors affect overall vibrancy of discussion threads, we differentiate power users [Panciera, Halfaker, and Terveen, 2009; Panciera, Priedhorsky, Erickson, and Terveen, 2010] from other less active users in the community, and discussion initiators from respondents. In this vein, we examine how different types of discussion initiators may influence interactions within the threads.

In summary, in this study, we attempt to address the following research questions:

1. How does the reciprocal interaction with other members impact one's participation in a virtual health community?
2. How does the homophily in member characteristics impact one's participation in a virtual health community?
3. How does the membership status of a thread initiator affect the overall vibrancy of the thread?
4. How does the level of engagement by thread initiator affect the overall vibrancy of the thread?

The results of our study have important practical and theoretical implications. From the practical perspective, our findings support the positive impact of thread initiators who are highly active in the entire community or participate actively in the threads they initiate on the overall thread vibrancy, and partially support the role of reciprocity and homophily in dyadic support exchange relationships. These findings enhance the community providers' understanding of user participation at the individual and group levels as well as the interaction dynamics within these online communities. The administrators of these systems can leverage these findings to support exchange relationships, facilitate group discussions, and promote user participation in the health information seeking and contribution processes to enhance networks' prosperity and sustainability. Furthermore, healthcare providers can utilize our findings to incorporate social capabilities in the form of community platforms and functionalities into other PCEH applications, further improving the ease of adoption of their PCEH systems.

From the theoretical perspective, our results enhance the understanding of the social exchange theory realized in the form of reciprocity, as well as similarity-attraction principle [Monge and Contractor, 2003] in the context of virtual health communities and computer-mediated health communications. This understanding can lead to future research that draws upon those theories and principles within the realm of online communities and, more specifically, virtual health communities.

The remainder of this article is structured as follows. The second section provides a literature review. The third section presents our research framework and hypotheses. The fourth section describes the method. The fifth section discusses the data used for our analysis and the results. Finally, the last two sections summarize the results and provide suggestions for further research.

II. RELATED WORK

User participation is an important driver for the sustainable growth of online communities [Koh et al., 2007; Ling et al., 2005]. Recent research efforts have focused on investigating user participation in online communities. The results of this research show that needs such as social identity and social presence play a crucial role in one's contribution in online communities [Bishop, 2007; Ma and Agarwal, 2007; Nonnecke, Andrews, and Preece, 2006]. Other research has focused on structural characteristics of the community, such as community size [Butler, 2001; Koh et al., 2007], or on relational dimensions, such as trust [Chiu et al., 2006; Hsu, Ju, Yen, and Chang, 2007; Ridings, Gefen, and Arinze, 2002; Salehan and Kim, 2012], and sense of belonging [Bateman, Gray, and Butler,

2011; Chai and Kim, 2011; Chiu et al., 2006; Zhao, Lu, Wang, Chau, and Zhang, 2012] that influence participation in virtual communities.

Among these factors, norm of reciprocity has been found to be one of the main relational factors that may influence user participation in virtual communities [Chiu et al., 2006; Musembwa and Paul, 2012; Wasko and Faraj, 2005]. Reciprocity can be realized at different levels of communication, such as with individuals or to an entire group [Monge and Contractor, 2003; Wasko and Faraj, 2005]. Some members join social support networks because they enjoy helping others and realize their intrinsic motivation by doing so [Wasko and Faraj, 2000, 2005]. Other members may only provide assistance if they feel that others provide them with similar help [Nahapiet and Ghoshal, 1998]. Network members consider this reciprocal support as a "personal reward" that serves as an incentive for them to contribute more actively to the community [Von Hippel and Von Krogh, 2003]. Equity Theory [Adams, 1966] suggests that people compare the social support they receive with what they provide to others in the network. If they perceive equality, they are motivated to contribute in the future; otherwise, they may reduce their support. Wasko and Faraj [2000] argue that the exchange of knowledge and support within a community is facilitated if members perceive such exchange to be fair and reciprocal. Chiu et al. [2006] find that norm of reciprocity has a significant relationship with quantity of knowledge sharing within online communities. These arguments and findings are consistent with Expectation Theory [Blau, 1986; Monge and Contractor, 2003], which contends that the expectation of receiving value in terms of respect, status, and reputation [Wasko and Faraj, 2005], as well as support from others [Chiu et al., 2006; Shumaker and Brownell, 1984] plays a crucial role in the amount which members contribute to a social support network.

Within the context of virtual health communities, the expected value received from community members include informational aid such as health-related knowledge and experience, as well as emotional aid such as empathy, affection, love, and encouragement [Buis, 2008; Houston, Cooper, and Ford, 2002]. Consistent with Expectation Theory, people tend to show reciprocal behaviors by providing social support for other members of the community, hoping that this will drive the support recipients to help them in their future needs. Some users may also decide to contribute more because they feel they benefited from the contributions of other members of the community in the past and would like to return the favor by paying forward to the community (i.e., not necessarily to the same users who helped them before). Another gain for support providers are the feelings of achievement, importance, and relief that result from helping the members who need their support [Alexander, Peterson, and Hollingshead, 2003].

Homophily is another factor that can potentially influence user participation within online communities. Different forms of homophily have been proposed by the extant literature. For instance, various researchers have discussed the impact of gender homophily on the membership and participation of members within networks and communities, specifically in the organizational or task-specific context. Ruef, Aldrich, and Carter [2003] find that business discussion networks dominated by male members are more willing to admit men rather than women and such homophily also positively affects the formation of organizational founding teams. Similarly, gender homophily also plays a crucial role in shaping the friendship relationships of young children and their playmates [McPherson et al., 2001; Ridgeway and Smith-Lovin, 1999]. Within the context of discussion networks, there is a high degree of gender homophily in political discussion networks [Huckfeldt and Sprague, 1995].

Age homophily is another form of homophily widely discussed in prior studies as a predictor of friendship ties [Feld, 1982; McPherson et al., 2001; Thelwall, 2009]. These studies assert that the importance of age homophily varies among different types of relationships. For instance, in close friendships, age has been shown to be the strongest dimension of homophily [McPherson et al., 2001]. However, until recently, most studies on age homophily concentrated on face-to-face or offline relationships. With the emergence of online social networks, researchers have begun investigating the role of this type of homophily in online social ties. For example, Thelwall [2009] researched friendships among MySpace users. His study shows a high degree of age homophily among people up to age forty who exchanged messages with each other. Although his results do not suggest age homophily among older users, he argues that this might be due to the dominance of younger users in the dataset.

Tenure homophily may also impact the participation level of users in any type of online communities, including virtual health communities [Wasko and Faraj, 2005]. In the context of virtual communities, tenure is defined as the period of time in which a user has been a member of a community [Nov, Naaman, and Ye, 2010]. Unlike ascribed characteristics such as age and gender, tenure is attributed to each individual in a particular network [McPherson et al., 2001]. Members of a variety of social networks would have different tenure homophily, dependent upon when they joined a given social network. Pahor, Škerlavaj, and Dimovski [2008] find a significant influence of tenure homophily on the formation of social ties among people within the organizational context. In a study of online game interactions, Huang, Shen, Williams, and Contractor [2009] find that online gamers were more willing to interact and play with others who had similar tenure in terms of their experience in playing the game.

Prior research has also focused on the overall activity within discussion threads and the thread-level factors that can stimulate such participation. A body of literature examining participation at this level seeks to understand how thread initiators can influence overall activity within discussion threads. Some researchers find that active engagement by thread initiators enhances the degree and quality of conversations within discussion threads [Hara, Bonk, and Angeli, 2000; Heo and Breuleux, 2009]. Others emphasize the social role of the thread initiator in the community and the positive impact of the highly active thread initiators on the vibrancy of the discussion threads initiated by them [Preece and Shneiderman, 2009; Romero, Galuba, Asur, and Huberman, 2011; Trusov, Bodapati, and Bucklin, 2010].

In addition to thread initiators, the extant literature also shows that a minority of users within open content online communities, such as wikis, online discussion groups, and online social networks, contribute a vast majority of content to the community [Kittur, Chi, Pendleton, Suh, and Mytkowicz, 2007; Panciera et al., 2009; Whittaker, Terveen, Hill, and Cherny, 1998; Zhang, Ackerman, and Adamic, 2007]. From a resource based perspective [Butler, 2001], those highly active participants, often called “power users” [Panciera et al., 2009; Panciera et al., 2010] or “elite users” [Kittur et al., 2007], are considered the main source of knowledge in the community and a major driver for community growth and viability. The presence of power users can affect overall information dissemination in online social networks [Romero et al., 2011] or motivate others to contribute more actively [Preece and Shneiderman, 2009]. In the context of political discussion groups, researchers identify “discussion catalysts” as the community members who receive a disproportionate number of replies to the threads they initiate [Himelboim, Gleave, and Smith, 2009] and conclude that those members who initiate discussion threads more frequently receive a significantly greater volume of responses to their threads, suggesting a potential augment effect on thread dynamics when discussion initiators happen to be a power user.

In summary, the extant literature has addressed participation within various forms of online communities such as online communities of professionals, online technical discussion groups, and general-purpose online social networks (e.g., Twitter). Nonetheless, very few studies have focused on user participation within virtual health communities. A main difference between virtual health communities and other types of online communities, such as general-purpose online social networks (e.g., Facebook) and special-purpose social networks (e.g., political discussion groups), is that participation in many other types of online communities does not revolve around social support exchange activities. Therefore, dyadic relationships and discussion threads formed based on social support exchange in virtual health communities may possess specific characteristics and have unique dynamics of their own.

A prominent aspect of social support exchange in virtual health communities, which distinguishes them from other types of online communities, is the essence of emotions conveyed through communications among members of these communities [Buis, 2008; Evans, Donelle, and Hume-Loveland, 2011]. People join these online social networks not only to share knowledge but also to offer love and sympathy to those who need these forms of support [Houston et al., 2002]. A consequence of emotional support for both providers and recipients is the sense of worthiness and self-esteem [Alexander et al., 2003]. Thus, the emotional-oriented relationships within virtual health communities can potentially result in a specific set of participation behaviors that differ from those in other virtual environments.

Depression-specific online communities are among the most common types of health-related virtual communities [Griffiths et al., 2009], which help depressed patients feel less isolated [Powell, McCarthy, and Eysenbach, 2003] and cope with their medical conditions more effectively [Houston et al., 2002]. A major reason for the widespread adoption of online communities by individuals suffering from depression is that many of them are not willing to seek formal support from their healthcare providers [Andrews, Issakidis, and Carter, 2001], due to the inadequate emotional support and practical advice provided by these formal channels [Griffiths et al., 2009; McNair, Highet, Hickie, and Davenport, 2002]. Therefore, given the pervasiveness of the depression symptoms, it is not surprising that individuals with depression concerns and/or disease constitute a major proportion of the users of virtual health communities.

Prior research in virtual health communities including depression-specific support groups focuses primarily on the existence of different types of social support in the posts [Alexander et al., 2003; Evans et al., 2011; Muncer, Burrows, Pleace, Loader, and Nettleton, 2000], clinical status and characteristics of the users [Houston et al., 2002; Powell et al., 2003], and perceived benefits and satisfaction with these online communities [Houston et al., 2002; Powell et al., 2003; van Uden-Kraan, Drossaert, Taal, Seydel, and Van De Laar, 2009]. However, very few studies have addressed users’ participation behaviors, as well as group/thread dynamics within these online communities.

Considering the growing importance of virtual health communities for both individuals and healthcare organizations as a specific form of PCEH system or as a component of integrated PCEH applications, we believe that researchers

should direct more attention toward them. Thus, in this study we focus on user participation within the context of virtual health communities.

III. RESEARCH FRAMEWORK AND HYPOTHESES

Virtual health communities are a form of social support network [Heidelberger, El-Gayar, and Sarnikar, 2011; Tang and Yang, 2010]. Users within these networks may seek reciprocity in their direct or one-to-one relationships with others. We call this one-to-one reciprocity, which we define as the mutual exchange of social support (in the form of supportive messages) between a user in a social network and the user's friends in the network. One-to-one reciprocity can be a driver for participation of members in virtual health communities at the individual level. Users in a network tend to make their social support relationships reciprocal by providing more support to users who have previously provided them with a high level of social support. Therefore, we hypothesize that:

Hypothesis 1: In virtual health communities, there is a positive relationship in the exchange of social support between individual community members.

As discussed earlier, different forms of homophily may facilitate interpersonal communications in social networks, i.e., Huckfeldt and Sprague,1995; Huang et al., 2009. Within the realm of computer-mediated health communications, perceived similarity can potentially persuade people to engage in support exchange activities [Walther, Pingree, Hawkins, and Buller, 2005]. Hence we argue that three major forms of homophily (age, gender, and tenure homophily) may also be present in virtual health communities, where they play an influential role in enhancing social ties among network members and fostering the formation of supportive relationships.

One underlying reason for the potential presence of homophily in this context is the particular characteristics of some diseases and medical conditions that are common among individuals with specific demographic characteristics (e.g., age and gender). For instance, gender homophily is highly expected to be present within prostate cancer and breast cancer online support groups with dominant male-to-male and female-to-female interactions, respectively.

Moreover, we suggest that even in the support groups such as depression, which do not dominantly comprise of individuals with specific attributes, people tend to collaborate with the community members with similar attributes, hence homophily can exist. The reason is that people may feel the community members with a similar profile are more likely to have knowledge, experience, and concerns similar and/or relevant to theirs. Therefore, making social support exchange relationships with these members seem more effective compared to other members with different attributes. Accordingly, we hypothesize that:

Hypothesis 2: In virtual health communities, members tend to communicate with other members of the same gender.

Hypothesis 3: In virtual health communities, members tend to communicate with other members of similar age.

Hypothesis 4: In virtual health communities, members tend to communicate with other members of similar tenure.

The conceptual framework that connects Hypotheses 1 through 4 is depicted in Figure 1.

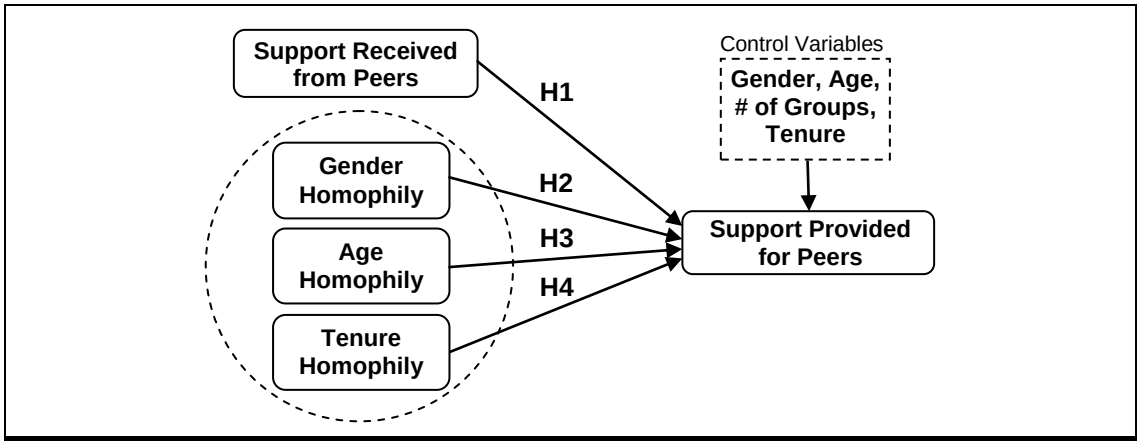

Figure 1. Research Framework (Individual Level Hypotheses)

In the second part of the study, we focus on user participation within discussion threads and examine the factors that are expected to contribute to overall thread vibrancy. Overall thread vibrancy refers to the length of a discussion thread or the number of users who participate in it. It is often deemed an important indicator of the overall viability of the community. At this level, we examine whether the presence of power users will influence the level of participation within the thread. We argue that not only power users initiate a significantly greater number of discussion threads, but also the threads initiated by them attract a higher level of social support from community. Thus, we hypothesize that:

> *Hypothesis 5: In virtual health communities, the number of responses posted to the threads initiated by a power user is significantly greater than that for the threads initiated by a non-power user.*

Thread vibrancy is manifested in both the number of respondents and the total number of responses. The differences between these two measures are important, as they represent different aspects of thread vibrancy. A greater number of respondents can enhance the richness and diversity of the knowledge and experience shared within a thread, while a greater number of responses show the depth and intensity of the interaction within a thread. Moreover, the number of responses to a thread is not necessarily associated with the number of respondents to a thread. For instance, the twenty responses to a given thread may be posted by only one user, which makes the thread an in-depth dialogue between the initiator and that user. In another instance, the twenty responses can be contributed by fifteen users, which represent a thread with a broader and more diversified group of participants. Thus, in order to capture both dimensions of thread vibrancy, we test them separately in H5 and H6. Thus, we hypothesize that:

> *Hypothesis 6: In virtual health communities, the number of users responding to the threads initiated by a power user is significantly greater than that for the threads initiated by non-power users.*

Moreover, prior studies show that in discussion threads within online communities, the initiator's active participation in threads can make the potential respondents more willing to contribute to that discussion topic [Heo and Breuleux, 2009]. We predict that this outcome also applies to virtual health communities due to the similar discussion-based community structure. In these virtual health communities, a thread initiator not only starts a discussion, but also reinforces other participants' contributions and moves the conversations forward. As a result, we expect active participation by thread initiators will lead to a higher level of overall thread vibrancy which in turn will lead to a more viable community. Thus, we hypothesize that:

> *Hypothesis 7: In a given discussion thread within virtual health communities, there is a positive relationship between the thread initiator's participation and others' contribution.*

The conceptual framework for the group level hypotheses (Hypotheses 5–7) is illustrated in Figure 2.

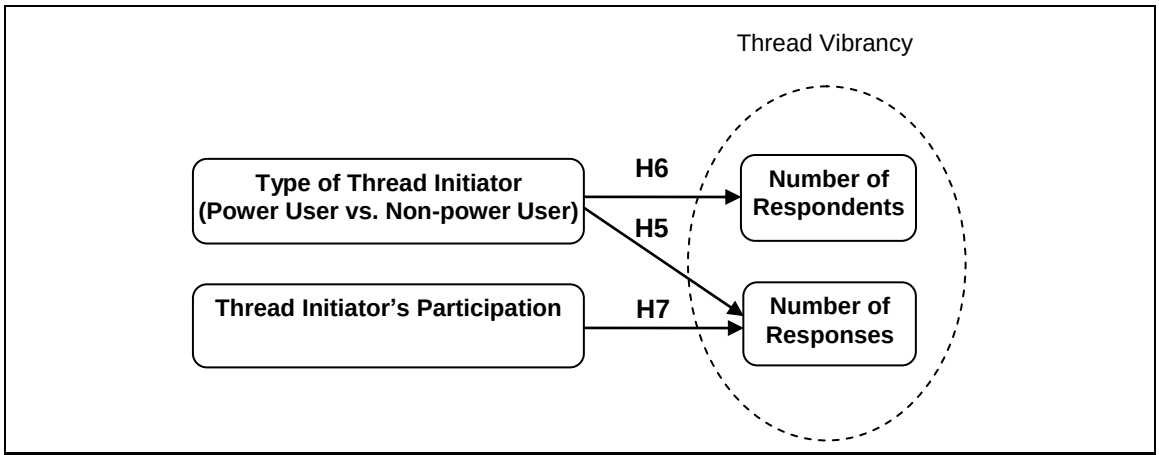

Figure 2. Research Framework (Group Level Hypotheses)

IV. METHOD

Site Selection

We chose DailyStrength.org as our data collection site. It is a popular virtual health community, with more than 500,000 registered members who can subscribe to approximately 500 support groups dedicated to different health-related topics (e.g., cancer, diabetes, depression, etc.). Members can seek, obtain, or exchange support through initiating or responding to discussion threads posted in various support groups. The number of members subscribed

to each support group varies from less than 100 to more than 48,000. Membership and subscription to individual support groups are free, and there is no restriction on the number of support groups to which a member can subscribe. Registered members have a profile page that displays their demographic information such as age, gender, location, the date they became a member, and the support groups to which they subscribe.

Measures

The key variables of interest in this study are the support provided and received at the individual and thread levels. On DailyStrength.org, this is best represented by the number of messages exchanged between any two members (individual level) and the number of messages posted to a discussion thread by the initiator and other respondents (thread level).[1] Members seeking help or support usually do so by initiating a discussion thread that describes the problem, and other members typically provide help or support by responding to these discussion threads with an answer or encouraging words. Based on the dynamics observed on DailyStrength.org and other virtual health communities, we define *support received* as the number of responses a member receives in the threads initiated, and *support provided* as the number of replies a member posts in the threads initiated by other members.

Sampling and Data Collection

To ensure a representative yet random sample, we randomly selected 130 members[2] from the largest support group, the "Depression" group, and followed their messages (initiated or responded to) posted in the discussion threads. We also gathered the demographic information of the other members who participated in these threads. We call these initial 130 members the "focal users" as they served as focal points in our data collection process. We call the members the focal users interacted with the "non-focal users." In other words, a non-focal user is a registered member who has either responded to a thread initiated by a focal user or received a response from one or more focal users in an initiated thread.[3]

We ran software scripts to parse data from all discussion threads that involve a focal user. The data we gathered included thread title, username of the thread initiator and each respondent, date and time of each message sent, and the discussion group where the message was posted. Although our sample was selected from Depression support group, most of the focal users in our sample subscribe to multiple support groups, and their activities occur both within and outside the support groups they subscribe to.[4] To ensure we capture the broad scope of their activities, we collected data on all the focal users' messages (posted by or responded to) in the discussion threads within any support group on DailyStrength.org, and we control for their group memberships in our analysis. We also parsed focal and non-focal user profile pages to obtain their demographic data, such as age, gender, tenure (length of membership), and the support groups to which they subscribed. DailyStrength.org keeps a full record of all discussion threads since the launching of the website. Therefore, we collected data on a full history of the interactions between focal and non-focal users that spans a period of four years and two months, which consists of a total of 1,947 messages that involve 130 focal users and their peers (focal and non-focal users). Table1 lists the descriptive statistics of these focal users.

V. DATA ANALYSIS AND RESULTS

To test our hypotheses, we performed both OLS regressions and ANOVA tests. In this section, we present the results associated with each hypothesis.

Individual Level Hypotheses (H1–H4)

For Hypotheses 1 through 4, we are interested in examining factors that affect user participation at the individual level. Thus, we constructed our dataset based on the interactions between a focal user and either a focal or non-focal user. The longitudinal nature of the dataset allows us to identify the sequence of any reciprocal interaction. The following scenario describes our data collection mechanism.

---

[1] Another way to measure support is to analyze each individual message and convert qualitative data to quantitative measures. However, given the number of messages in our dataset, this approach demands huge amounts of time and resources and a sophisticated coding scheme to capture the highly context-dependent information embedded in messages. Hence we adopt the simplified but more consistent numeric measure.

[2] We started by randomly selecting 1 percent of the total number of members in the "Depression" support group. After removing users who are not active (do not have any interaction with other users) or have missing data on our key variables such as gender, age, tenure, etc., we ended up with an initial focal user set with 130 users.

[3] Note that the dataset captures all of the focal user activities but not all non-focal users' activities. For example, we did not capture non-focal user activities in threads that did not involve the focal users in our sample. This was deemed unnecessary and technically infeasible.

[4] For example, on average each member subscribes to seven groups and the activities of all the subjects included in our sample span 194 support groups.

Table 1: Descriptive Statistics for Focal Users		
Gender	Age	Tenure (days)
Frequency distribution: Female: 88 (67.7 %) Male: 32 (24.6 %) Missing: 10 (7.7 %)	Mean: 33.45 S.D.: 11.53 Frequency distribution: < 20: 13 (10.0%) 20–30: 37 (28.5%) 30–40: 28 (21.5%) 40–50: 19 (14.6%) 50–60: 10 (7.7%) > 60: 2 (1.5%) Missing: 21 (16.2%)	Mean: 868.42 S.D.: 438.57 Frequency distribution: < 250: 19 (14.6%) 250–500: 13 (10.0%) 500–750: 16 (12.3%) 750–1000: 15 (11.6%) 1000–1250: 29 (22.3%) 1250–1500: 29 (22.3%) > 1500: 3 (2.3%) Missing: 6 (4.6%)

Suppose that during our sample period, focal user A sent a total of eight messages to discussion thread(s) initiated by user B and user B sent a total of three messages to discussion thread(s) initiated by user A. For these two users we can divide the sample period into shorter interaction periods so that each interaction period consists of only either user (A or B) sending message to the discussion thread(s) initiated by the other user.

Period 1: Three messages from A to B.

Period 2: Two messages from B to A.

Period 3: Five messages from A to B.

Period 4: One message from B to A.

Accordingly, a total of eleven messages exchanged between user A and user B were recorded and converted to four data points in our dataset.[5]

To test Hypothesis 1, we ran an OLS regression using the following model:

$$Last\_sent = \beta_0 + \beta_1 Last\_received + \beta_2 Received\_so\_far + \beta_3 Diff\_sent\_received + \beta_4 Respondent\_groups + \beta_5 Respondent\_gender + \beta_6 Respondent\_age + \beta_7 Respondent\_tenure + \varepsilon$$

The dependent variable (*Last_sent*) represents the operationalization of the construct *support provided for peers*. *Last_sent* denotes the number of "consecutive" comments user A has sent to user B over the last interaction period.[6] Similarly, the independent variable *Last_received* represents the number of comments sent from user B to user A in the period prior to their last interaction period, and *Received_so_far* measures the number of comments sent from user B to user A from their first interaction to the period prior to their last interaction. Moreover, in order to measure the influence of the relative reciprocity between users, we define the independent variable *Diff_sent_received* as the difference in the cumulative number of comments sent and received between users A and B. Based on these definitions, the hypothetical scenario described earlier results in the following four data points (see Table 2).

Table 2: Variables and Values Associated with the Scenario on the Previous Page				
Data point #	Last_sent	Last_receive	Received_so_f	Diff_sent_received
1	3	0	0	0
2	2	3	0	0
3	5	2	0	3
4	1	5	3	-1

Each row in Table 2 represents a data point in the regression data set. For instance, data point #3 implies that user A has sent five messages to user B in the third interaction period (*Last_sent* = 5) and user B, has sent two messages to user A in the second interaction period (*Last_received* = 2). However, no responses were posted by user B to user A before their second interaction period (*Received_so_far* = 0). The cumulative number of responses

[5] Mathematical notations and definitions of variables are provided in the Appendix A.

[6] For the sake of simplicity in explanations, we suppose that A is the respondent over the last interaction period between user A and user B. However, if $Y_i > 0$ then B is the respondent over their last interaction period and consequently A and B in all the statements in this paragraph as well as the next paragraph should be swapped.

sent by user A to user B until the second period equals three, which implies *Sent_so_far* = 3. Therefore, *Diff_sent_received* = *Sent_so_far* – *Received_so_far* = 3.

Our final data set contains a total of 445 data points associated with 445 interaction periods between the focal users in our sample and their peers. Based on the reciprocity principle, we expect *Last_sent* to be positively associated with the recent support received, as represented by *Last_received* and the cumulative support received in the past, as represented by *Received_so_far*. Finally, we also expect that a greater *Diff_sent_received* will lead to a reduced willingness for user A to provide support to user B.

The control variables in our model are *Respondent_groups*, *Respondent_gender*, *Respondent_age*, and *Respondent_*tenure, which refer to the number of groups a respondent subscribed to, the respondent's gender, age, and length of membership (in days), respectively.

Table 3 presents a summary of the regression results. The results indicate that *Last_received* (*β* = .210, *p*-value <.001) significantly influences *Last_sent*, supporting the reciprocity phenomenon predicted in H1. *Received_so_far* (*β* = –.015, *p*-value <.05), however, does not significantly impact *Last_sent* implying that the cumulative number of comments a user receives from another user does not influence the number of comments the user sends to the other user. What is surprising is that *Diff_sent_received* (*β* = .224, *p*-value <.001) significantly and positively influences *Last_received*. This result is in contrast to the reciprocity phenomenon; the greater the difference between the number of comments user A sends to user B, versus the number of comments user B send to user A, the more likely A will continue to send comments to user B. These contradictory results indicate that reciprocity only occurred on a short-term basis, partially supporting H1.

Table 3: Model Summary Results and Coefficient Estimates

Model	Coefficient	Std. error	*p*-Value
(Constant)	3.296***	0.358	0.000
Last_received	0.210***	0.041	0.000
Received_so_far	-0.015	0.009	0.085
Diff_sent_received	0.224***	0.018	0.000
Respondent_groups	-0.047***	0.012	0.000
Respondent_gender	-0.297	0.217	0.172
Respondent_age	-0.025***	0.007	0.001
Respondent_tenure	4.332E-5	0.000	0.856
F-Value = 26.583 (0.000)*** R^2 = 0.308; Adjusted-R^2 = 0.296 *p<.05; **p<.01; ***p<.001 (two tailed tests)			

Table 3 also shows that two of the four control variables have a significant impact on *Last_sent*. *Respondent_groups* (*β* = –.047, *p*-value <.001) and *Respondent_age* (*β* = –.025, *p*-value <.001) negatively influence *Last_received*. In other words, the greater the number of groups a user has subscribed to and the older a user is, the less likely that user sends messages to other users. *Respondent_gender* (*β* = –.297, *p*-value =.172) and *Respondent_tenure* (*β* = 4.332E-5, *p*-value = .856), however, do not significantly influence *Last_sent*.

To test the homophily hypotheses (H2, H3, and H4), we performed different ANOVA models. The results of the first model, shown in Table 4, demonstrate a significant difference between the level of support a user provides for users with the same gender compared to users with opposite gender (F = 7.707, *p*-value <.01). Thus, the findings support H2.

Table 4: ANOVA Results for Gender Homophily

Source of variance	Degree of freedom	Mean square	*F*-value
Between groups	1	23.797	7.707
Within groups	424	3.088	
Total	425		

To test age homophily (H3), we started by setting a cut-off point for contrasting similar and dissimilar ages of any pair of users. We used different cut-off points from an age difference of less than five years to an age difference of less than nine years, and conducted ANOVA in each case. The results show that the *F*-values of the models vary between cut-off points (see Table 5). However, none of the models shows a significant relationship between age similarity and member participation. Therefore, the age homophily hypothesis (H3) was not supported.

To test tenure homophily (H4), we first defined a specific set of tenure differences that could be regarded as the border between similarity and dissimilarity of users' tenure. To do so, we considered three alternative cut-off points

and conducted ANOVA in each case to assess the pattern of the *F*-values. The results show that in none of the three cases, significant relationship exists between participation and tenure similarity (see Table 5).

Table 5: ANOVA Results of Age Homophily and Tenure Homophily for Different Cut-off Points

Hypothesis	Variable	Cut-off point	*F*-value
H3	Age difference (in years)	< 5	2.088
		< 6	2.314
		< 7	3.252
		< 8	1.614
		< 9	1.119
H4	Tenure difference (in days)	< 61	2.485
		< 101	2.793
		< 121	1.390

Group Level Hypotheses (H5–H7)

In order to test H5 and H6, first, we identified the power users and distinguished them from non-power users in our sample of focal users. The operational definition of power users in the extant literature varies from study to study. However, most of the studies investigating power users in online communities show that 2.5 percent - 10 percent of the top highly-active community members can be regarded as power users [Kittur et al., 2007]. In this study, we define power users as the top 10 percent of the active focal users (thirteen individuals) who have been a member of the community for at least three months. The remaining 117 users constitute the group of non-power focal users. To measure user activity we use the following formula:

User_activity = Total number of responses one has posted to the discussion threads initiated by other community members **/** One's tenure.

Among the total of 2176 discussion threads initiated by focal users, 841 threads were initiated by power users while 1335 threads were initiated by non-power users.

After identifying power users, we ran two separate ANOVAs to test H5 and H6. The results of both models are presented in Table 6. The significant *F*-value of the first model indicates that threads initiated by a power user receive a greater number of responses compared to the threads initiated by a non-power user (*F*-value = 6.688; *p-value* = 0.010), thus supporting H5.

The results of the next ANOVA model also provide support for H6, demonstrating that if a thread is initiated by a power user, more users contribute to that thread (*F-value* = 6.925; *p-value* = .009).

In testing H5 and H6, we defined a controlled variable, *Thread_life_length*, to capture the duration between the day a thread was initiated and the day the last response is posted to that thread, called the life length of the thread. To further our understanding of H5 and H6, we also ran an ANOVA model to examine the difference in *Thread_life_length* between the threads initiated by power users vs. those initiated by non-power users.

Interestingly, the results of the ANOVA, presented in Table 6, show that the mean value for that variable associated with the threads initiated by a power user is significantly lower than that number for the threads initiated by a non-power user. A plausible explanation is that, according to H5 and H6, power users are able to attract more attention in terms of social support and unique supporters. Therefore, the knowledge required to satisfy the needs of the initiator, i.e., to answer the question posted by the initiator, is provided within a shorter period of time. Another possible explanation is that power users initiated threads more frequently. Thus, shortly after a power user initiates a thread, she may quickly initiate another relevant thread that shifts the attention of the potential supporters to the more recently-initiated threads. This conjecture is proved in an ANOVA test as summarized in the third row of Table 6, which shows that threads initiated by power users typically have a shorter thread life than those by non-power users.

Table 6: ANOVA Results for Threads Initiated by Power Users vs. Non-Power Users

Hypothesis	Dependent variable	Power† (N=841)	Non-power† (N = 1335)	*F*-value	*p*-value
H5	Response_by_others	7.20 (.283)	6.30 (.214)	6.688**	.010
H6	Unique_respondents	5.77 (.179)	5.20 (.131)	6.925**	.009
Further analysis	Thread_life_length	1.24 (.108)	2.64 (.211)	25.157***	.000

† The values in this column are the means with std. errors in parentheses. *$p < .05$; **$p < .01$; ***$p < .001$

Finally, in order to test the hypothesized impact of thread initiator involvement in the thread discussions on the overall vibrancy of a given discussion thread (H7), we empirically estimate the coefficients in the following model:

$$Responses\_by\_others = \beta_0 + \beta_1 Responses\_by\_initiator + \beta_2 Thread\_life\_length + \beta_3 Support\_group + \beta_4 Initiator\_groups + \beta_5 Initiator\_gender + \beta_6 Initiator\_age + \beta_7 Initiator\_tenure + \varepsilon$$

The dependent variable is *Responses_by_others*, which measures the number of responses to a thread by users other than the thread initiator. The key independent variable, *Responses_by_initiator*, measures the number of replies/comments and represents the thread initiator's self-contribution. To control for other factors that may influence the hypothesized reciprocity, we also included several other variables such as *Thread_life_length*, *Support_group* which represents whether a thread is initiated in depression support group or in a group other than depression, the number of support groups to which an initiator of a thread has subscribed, as well as age, gender, and tenure of the initiator. The OLS regression results are presented in Table 7.

Table 7: Model Summary Results and Coefficient Estimates

Variable	Coefficient
(Constant)	6.246*** (0.782)
Responses_by_initiator	1.861*** (0.067)
Thread_life_length	0.154*** (0.026)
Support_group	-0.324 (0.374)
Power_user	0.004 (0.329)
Initiator_groups	-0.117*** (0.032)
Initiator_gender	-0.671 (0.487)
Initiator_age	-0.036* (0.018)
Model Fit: *F*-Value =109.833 (0.000)*** R^2 = 0.311; Adjusted-R^2=0.308 *p<.05; **p<.01; ***p<.001 (two tailed tests)	

The regression results demonstrate that there is a significant positive relationship between the key independent variable *Responses_by_initiator* (β = 1.861, p-value <.001) and the dependent variable *Responses_by_others*, which suggests that more active participation of the thread initiator is associated with more active participation by other community members, as represented by their corresponding number of posts, thus supporting H7. Among the control variables, *Power_user* does not show any significant relationship with *Response_by_others*. This implies that the effect of *Responses_by_initiator* dominates the influence of power users when both are present simultaneously. Among other control variables, *Thread_life_length*, *Initiator_groups*, and *Initiator_age* are significant in the expected directions.

In summary, our empirical analysis shows that at the individual level, reciprocity exists for a relatively short period of time, hence H1 is supported only on a short-term basis. Among the homophily hypotheses, only gender homophily (H2) is supported, but not age homophily (H3) and tenure homophily (H4). At the thread level, our analysis shows that the presence of power user and the active participation of the thread initiator both contribute to more vibrant thread activities, thus supporting H5, H6, and H7. A summary of the results is presented in Table 8, and we discuss the implications of these results in the next section.

VI. DISCUSSION

In this study, we focus on examining factors that may affect user participation in a virtual health community. The data collected from DailyStrength.org allowed us to analyze this problem both at the individual (dyadic) and group (thread) levels. At the individual level, we found that reciprocity has only short-term impact and, with the exception of gender homophily, most homophily indicators have little impact on communication between members of virtual

health

Table 8: Research Hypotheses and Results			
Hypothesis	Level of analysis	Relation	Result
H1	Individual	Support Received ⟶ Support Provided	Partially supported
H2	Individual	Gender Homophily ⟶ Support Provided	Supported
H3	Individual	Age Homophily ⟶ Support Provided	Not supported
H4	Individual	Tenure Homophily ⟶ Support Provided	Not supported
H5	Group	Type of Thread Initiator ⟶ # of Responses	Supported
H6	Group	Type of Thread Initiator ⟶ # of Respondents	Supported
H7	Group	Thread Initiator's Participation ⟶ # of Respondents	Supported

communities. Members in virtual health communities such as DailyStrength.org appear to be more concerned with the subject matter (healthcare) and less concerned with the history of the past interaction and the characteristics of the people with whom they are communicating. However, we do see that gender homophily has a positive impact on the interaction of individual members, implying that the sensitivity and personal nature of the topic may induce members to communicate with members of the same gender, or gender homophily may facilitate the continuous interaction on the subject matter due to the fact that some symptoms are gender-specific.

By contrasting our findings with those derived from studies that focus on other types of social networks, we found that virtual health communities demonstrate characteristics not present in other social networks. More specifically, the primary goal of virtual health community users is to seek health-related information, rather than making friends or socializing. And, we support that notion. We believe this important distinction merits close attention from both future researchers and administrators of virtual health communities as the design of these websites should focus on facilitating the exchange of information rather than the social relationships among members.

Our results also demonstrate the importance of highly active users (power users) in promoting the vibrancy of discussion threads. Our findings show that both the number of responses posted and the number of users responding to threads initiated by power users were significantly greater than those to threads initiated by non-power users. Power users seem to serve as "catalysts" that stimulate the interest and contribution of members in the community, which seems to suggest that the role of power users in other social networks is carried over to virtual health communities. The influence of power users may be in part due to the social status or popularity of the power users in the community, or because power users contribute substantially and provide a high level of support to the threads initiated by others; hence other community members feel obligated to return the favor by contributing to the threads initiated by power users.

Furthermore, our findings highlight the pivotal role of thread initiators as discussion leaders. Our results reveal that individuals contribute more to threads in which thread initiators participate more actively. This suggests that posting a question and starting a discussion does not guarantee receiving an adequate level of support. Thread initiators need to take on the responsibility to move the discussion forward and cannot simply rely on respondents to provide support. Active participation by thread initiators motivates the respondents to contribute more and involve in the conversations with the thread initiator and other respondents to the thread.

Implications

Our research findings offer several theoretical and practical implications to the ongoing research of emerging PCEH applications. From a theoretical standpoint, we demonstrated that social exchange theory realized in the form of reciprocity exists on a short-term basis. This implies that although individuals within virtual health communities exchange social support, they may not be interested in making long-term social ties. This also extends the high-level concept of reciprocity adopted by the extant literature [Chiu et al., 2006; Wasko and Faraj, 2005] to short-term and long-term reciprocities and reveals that this distinction in the analysis may yield different results when evaluating user participation.

Additionally, our results suggest that overall, similarity attraction does not play a major role in promoting individual participation in dyadic exchange relationships. This is in contrast to other virtual environments such as general-purpose online social networks [Thelwall, 2009] and online gaming platforms [Huang et al., 2009] in which homophily motivates people to engage in building and extending one-to-one relationships. With regard to the role of gender in virtual health communities, prior research focuses primarily on gender distributions in these communities [Houston et

al., 2002; Powell et al., 2003], as well as the language styles used and the types of social support provided by male members compared to female members of the community [Gooden and Winefield, 2007]. Our study extended this understanding by finding evidence that supports the positive role of gender homophily on user participation within these communities. Furthermore, prior studies emphasize the role of power users as thread initiators [Romero et al., 2011], as well as the impact of the active engagement by the thread initiator on the thread's overall vibrancy in various online social networks [Hara et al., 2000; Heo and Breuleux, 2009]. Our results enhanced this understanding by extending it to the context of virtual health communities.

From a practical point of view, providers of virtual health communities can employ our findings to facilitate reciprocal relationships and enhance thread vibrancy within those communities. Based on the findings on short-term reciprocity, community developers can provide a mechanism through which individuals can receive updates on recent activities (i.e., threads initiated, comments posted) of the users to whom they have interacted lately. Moreover, based on the findings on gender homophily, community providers can add recommendation features to the community platform so that users can easily find the users with the same gender and similar health concerns.

Our findings on the role of power users as the "catalysts" within discussion threads suggest that it is essential for a virtual health community to always try to attract and keep as many power users as possible by better understanding and accommodating their needs within the virtual community. Additionally, community providers can take advantage of the potential active role of thread initiators. By providing various types of incentives for thread initiators, community providers can motivate them to engage actively in the conversations within their threads. This can ultimately lead to the sustainable growth of the community.

Limitations and Future Research

The results of our study may be subject to a couple limitations. The sample used in this study is limited to users from a specific virtual health community (i.e., DailyStrength.org) and may not represent various types of users in other virtual health communities. Moreover, we measured social support as the number of the responses posted to discussion threads which may not fully capture the subjective and emotional aspect of social support. We believe the results of our study can be better applied if we were able to convert the content of thread responses into other quantitative measures.

In future studies, researchers can focus on the content of the responses as well as on collaboration platforms other than discussion threads (e.g., personal health blogs, email, and chat services). Researchers can also utilize other methods, data collection, and analysis techniques such as content analysis, survey, and interview with community members to determine the factors that influence their participation and their interaction preferences. Moreover, the role of other potentially influential variables such as structural characteristics of community as well as cognitive and personality traits of the members can be assessed in future studies.

Another potential direction for future research is to adopt IS theories to better understand the adoption/use of virtual health communities and the PCEH applications encompassing them. For instance, drawing on the Theory of Reasoned Action [Fishbein and Ajzen, 1975] from the social psychology discipline, the Technology Acceptance Model (TAM) contends that perceived usefulness can affect attitudes toward using an information system, which ultimately can lead to the behavioral intentions to use and actual system use [Davis, 1989]. Building on the extant literature on TAM, future studies can examine how information richness resulting from active participation of users within virtual health communities can enhance perceived usefulness of these communities and the socially-enabled PCEH applications, and how this perception can affect the intention to use and the actual adoption of these systems.

VII. CONCLUSION

The recent proliferation of virtual health communities as stand-alone collaboration environments and/or social features/components of PCEH applications has made it essential for the providers of these platforms to better understand user participation within these virtual environments. In this study, we proposed and tested research models on user participation at both individual-level and group-level analyses to enhance this understanding. Our individual-level analysis on reciprocity and homophily shows that exchange of social support largely occurs on short-term basis and it is more likely to occur between members of the same gender. However, age and tenure similarities do not play a major role in the formation of a reciprocal relationship between community members. These findings suggest that users in virtual health communities are less interested in building long-term social ties as found in other general-purpose online social networks such as Facebook and MySpace. Rather, the reciprocal interactions occur in relatively short periods of time and are likely to be topic-based rather than identity-based, and gender homophily can positively contribute to the formation of such reciprocal relationships.

At the group level, our analysis reveals that power users play a pivotal role in enhancing overall community vibrancy by initiating discussion threads. Their presence typically attracts more thread participants with a greater number of responses compared to discussion threads initiated by non-power users. Moreover, the overall thread vibrancy could also be enhanced if the thread initiators actively respond to comments in their own threads and moderate the discussions. These results suggest that community providers should actively identify power users and motivate them to initiate discussion threads. Moreover, mechanisms such as auto-notification of response can be introduced to better involve thread initiators in their own threads, leading to a sustainable growth of the community.

REFERENCES

Editor's Note: The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the article on the Web, can gain direct access to these linked references. Readers are warned, however, that:

1. These links existed as of the date of publication but are not guaranteed to be working thereafter.
2. The contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. The author(s) of the Web pages, not AIS, is (are) responsible for the accuracy of their content.
4. The author(s) of this article, not AIS, is (are) responsible for the accuracy of the URL and version information.

Adams, J. (1966) "Inequity in Social Exchange", In L. Berkowitz (eds.), *Advances in Experimental Social Psychology, 2nd edition,* New York, NY: Academic Press, pp. 267–299.

Alexander, S.C., J.L. Peterson and A.B. Hollingshead (2003) "Help Is at Your Keyboard: Support Groups on the Internet", In L.R. Frey (eds.), *Group Communication in Context: Studies of Bona Fide Groups, 2nd edition,* Mahwah, NJ: Erlbaum, pp. 309–334.

Andrews, G., C. Issakidis and G. Carter (2001) "Shortfall in Mental Health Service Utilisation", *The British Journal of Psychiatry,* (179)5, pp. 417–425.

Bateman, P.J., P.H. Gray and B.S. Butler (2011) "Research Note—The Impact of Community Commitment on Participation in Online Communities", *Information Systems Research,* (22)4, pp. 841–854.

Bishop, J. (2007) "Increasing Participation in Online Communities: A Framework for Human-Computer Interaction", *Computers in Human Behavior,* (23)4, pp. 1881–1893.

Blau, P. (1986) *Exchange and Power in Social Life*, New York, NY: Wiley and Sons.

Buis, L.R. (2008) "Emotional and Informational Support Messages in an Online Hospice Support Community", *Computers Informatics Nursing,* (26)6, pp. 358–367.

Butler, B.S. (2001) "Membership Size, Communication Activity, and Sustainability: A Resource-based Model of Online Social Structures", *Information Systems Research,* (12)4, pp. 346–362.

Carley, K. (1991) "A Theory of Group Stability", *American Sociological Review,* (56)3, pp. 331–354.

Chai, S. and M. Kim (2011) "A Socio-technical Approach to Knowledge Contribution Behavior: An Empirical Investigation of Social Networking Sites Users", *International Journal of Information Management,* (32)2, pp. 118–126.

Chiu, C., M. Hsu and E. Wang (2006) "Understanding Knowledge Sharing in Virtual Communities: An Integration of Social Capital and Social Cognitive Theories", *Decision Support Systems,* (42)3, pp. 1872–1888.

Davis, F.D. (1989) "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", *MIS Quarterly*, (13)3, pp. 319–340.

Demiris, G. (2006) "The Diffusion of Virtual Communities in Health Care: Concepts and Challenges", *Patient Education and Counseling,* (62)2, pp. 178–188.

Evans, M., L. Donelle and L. Hume-Loveland (2012) "Social Support and Online Postpartum Depression Discussion Groups: A Content Analysis", *Patient Education and Counseling*, (87)3, pp. 405–410

Eysenbach, G. (2001) "What Is e-Health?", *Journal of Medical Internet Research,* (3)2, article e20.

Fehr, E. and S. Gächter (2000) "Fairness and Retaliation: The Economics of Reciprocity", *The Journal of Economic Perspectives,* (14)3, pp. 159–181.

Feld, S. (1982) "Social Structural Determinants of Similarity Among Associates", *American Sociological Review,* (47)6, pp. 797–801.

Fishbein, M. and I. Ajzen (1975) *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*, Reading, MA: Addison-Wesley.

Fox, S. (2011a) "Peer-to-peer Healthcare", http://www.pewinternet.org/Reports/2011/P2PHealthcare.aspx (current Nov. 12, 2011).

Fox, S. (2011b) "Health Topics", http://www.pewinternet.org/Reports/2011/HealthTopics.aspx (current Oct. 10, 2012).

Greenhalgh, T., S. Hinder, K. Stramer, T. Bratan and J. Russell (2010) "Adoption, Non-adoption, and Abandonment of a Personal Electronic Health Record: Case Study of HealthSpace", *BMJ: British Medical Journal,* (341), http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2982892. (current Oct. 10, 2012)

Gooden, R.J. and H.R. Winefield (2007) "Breast and Prostate Cancer Online Discussion Boards: A Thematic Analysis of Gender Differences and Similarities", *Journal of Health Psychology,* (12)1, pp. 103–114.

Griffiths, K M., A.L. Calear, M. Banfield and A. Tam (2009) "Systematic Review on Internet Support Groups (ISGs) and Depression (2): What Is Known About Depression ISGs?", *Journal of Medical Internet Research,* (11)3, article e41.

Hara, N., C.J. Bonk and C. Angeli (2000) "Content Analysis of Online Discussion in an Applied Educational Psychology Course", *Instructional Science,* (28)2, pp. 115–152.

Heidelberger, C.A., O. El-Gayar and S. Sarnikar (2011) "Online Health Social Networks and Patient Health Decision Behavior: A Research Agenda", *Proceedings of HICSS '11: Hawaii International Conference on System Sciences*, Kauai, HI: IEEE, pp. 1–7, doi: 10.1109/HICSS.2011.328.

Heo, G.M. and A. Breuleux (2009) "Roles of Initiators and Interaction Patterns: Exploring an Informal Online Community at the Interpersonal Plane", *Proceedings of CSCL '09: The International Conference on Computer Supported Collaborative Learning,* Rhodes, Greece: ACM, pp. 13–17.

Himelboim, I., E. Gleave and M. Smith (2009) "Discussion Catalysts in Online Political Discussions: Content Importers and Conversation Starters", *Journal of Computer-mediated Communication,* (14)4, pp. 771–789.

Houston, T.K., L.A. Cooper and D.E. Ford (2002) "Internet Support Groups for Depression: A 1-Year Prospective Cohort Study", *American Journal of Psychiatry,* (159)1, pp. 2062–2068.

Hsu, M.H., T.L. Ju, C.H. Yen and C.M. Chang (2007) "Knowledge Sharing Behavior in Virtual Communities: The Relationship Between Trust, Self-efficacy, and Outcome Expectations", *International Journal of Human-Computer Studies,* 65(2), pp. 153–169.

Huang, Y., C. Shen, D. Williams and N. Contractor (2009) "Virtually There: Exploring Proximity and Homophily in a Virtual World", *Proceedings of CSE '09: The International Conference on Computational Sciences and Engineering,* Vancouver, Canada: IEEE, pp. 354–359, doi: 10.1109/CSE.2009.471.

Huckfeldt, R. and J. Sprague (1995) *Citizens, Politics, and Social Communication: Information and Influence in an Election Campaign*, New York, NY: Cambridge University Press.

Kittur, A., E. Chi, B.A. Pendleton, B. Suh and T. Mytkowicz (2007) "Power of the Few vs. Wisdom of the Crowd: Wikipedia and the Rise of the Bourgeoisie", *Proceedings of the 25th Annual ACM Conference on Human Factors in Computing Systems, San Jose, CA: ACM*, pp. 1-9.

Koh, J., Y.G. Kim, B. Butler and G.W. Bock (2007) "Encouraging Participation in Virtual Communities", *Communications of the ACM,* (50)2, pp. 68–73.

Kordzadeh, N. and J. Warren (2013) "Toward a Typology of Health 2.0 Collaboration Platforms and Websites", *Health and Technology,* (3)1, pp. 37-50, doi: 10.1007/s12553-013-0043-x.

Lau, A. and T. Kwok (2009) "Social Features in Online Communities for Healthcare Consumers—A Review", *Proceedings of OCSC '09: The International Conference on Online Communities and Social Computing,* San Diego, CA: Springer, pp. 682–289, doi: 10.1007/978-3-642-02774-1_73.

Lewis, D., B.L. Chang and C.P. Friedman (2005) "Consumer Health Informatics", in Lewis, D., G. Eysenbach, R. Kukafka, P.Z. Stavri and H.B. Jimison (eds.), *Consumer Health Informatics: Informing Consumers and Improving Health Care,* New York, NY: Springer, pp. 1–7.

Ling, K., G. Beenen, P. Ludford, X. Wang, K. Chang, X. Li and A.M. Rashid (2005) "Using Social Psychology to Motivate Contributions to Online Communities", *Journal of Computer Mediated Communication,* (10)4, Article 10.

Ma, M. and R. Agarwal (2007) "Through a Glass Darkly: Information Technology Design, Identity Verification, and Knowledge Contribution in Online Communities", *Information Systems Research,* (18)1, pp. 42–67.

Marsden, P. (1988) "Homogeneity in Confiding Relations", *Social Networks,* (10)1, pp. 57–76.

McNair, B.G., N.J. Highet, I.B. Hickie and T.A. Davenport (2002) "Exploring the Perspectives of People Whose Lives Have Been Affected by Depression", *Medical Journal of Australia,* (176)10, p. 69.

McPherson, M., L. Smith-Lovin and J. Cook (2001) "Birds of a Feather: Homophily in Social Networks", *Annual Review of Sociology,* (27)1, pp. 415–444.

Monge, P. and N. Contractor (2003) *Theories of Communication Networks*, New York, NY: Oxford University Press.

Muncer, S., R. Burrows, N. Pleace, B. Loader and S. Nettleton (2000) "Births, Deaths, Sex and Marriage … But Very Few Presents? A Case Study of Social Support in Cyberspace", *Critical Public Health,* (10)1, pp. 1–18.

Musembwa, S. and S. Paul (2012) "Social Networks: Cultural Diversity, Trust, Reciprocity and Social Capital", *Proceedings of AMCIS '09: The Americas Conference on Information Systems*, Seattle, WA, Paper 18.

Nahapiet, J. and S. Ghoshal (1998) "Social Capital, Intellectual Capital, and the Organizational Advantage", *Academy of Management Review*, (23)2, pp. 242–266.

Nonnecke, B., D. Andrews and J. Preece (2006) "Non-public and Public Online Community Participation: Needs, Attitudes and Behavior", *Electronic Commerce Research,* (6)1, pp. 7–20.

Nov, O., M. Naaman and C. Ye (2010) "Analysis of Participation in an Online Photo Sharing Community: A Multidimensional Perspective", *Journal of the American Society for Information Science and Technology,* (61)3, pp. 555–566.

Oh, H.J. and B. Lee (2012) "The Effect of Computer-mediated Social Support in Online Communities on Patient Empowerment and Doctor–Patient Communication" *Health Communication,* (27)1, pp. 30–41.

Pahor, M., M. Škerlavaj and V. Dimovski (2008) "Evidence for the Network Perspective on Organizational Learning", *Journal of the American Society for Information Science and Technology,* (59)12, pp. 1985–1994.

Panciera, K., A. Halfaker and L. Terveen (2009) "Wikipedians Are Born, Not Made: A Study of Power Editors on Wikipedia", *Proceedings of GROUP '09: The ACM International Conference on Supporting Group Work,* Sanibel Island, FL: ACM, pp. 51–60, doi: 10.1145/1531674.1531682.

Panciera, K., R. Priedhorsky, T. Erickson and L. Terveen (2010) "Lurking? Cyclopaths? A Quantitative Lifecycle Analysis of User Behavior in a Geowiki", *Proceedings of CHI '10: The International Conference on Human Factors in Computing Systems,* Atlanta, GA: ACM, pp. 1917–1926, doi: 10.1145/1753326.1753615.

Powell, J., N. McCarthy and G. Eysenbach (2003) "Cross-sectional Survey of Users of Internet Depression Communities", *BMC Psychiatry,* (3)1, p. 19.

Preece, J. and B. Shneiderman (2009) "The Reader-to-Leader Framework: Motivating Technology-mediated Social Participation", *AIS Transactions on Human-Computer Interaction,* (1)1, pp. 13–32.

Ridgeway, C. and L. Smith-Lovin (1999) "The Gender System and Interaction", *Annual Review of Sociology*, (25) pp. 191–216.

Ridings, C.M., D. Gefen and B. Arinze (2002) "Some Antecedents and Effects of Trust in Virtual Communities", *The Journal of Strategic Information Systems,* (11)3–4, pp. 271–295.

Romero, D., W. Galuba, S. Asur and B. Huberman (2011) "Influence and Passivity in Social Media", *Machine Learning and Knowledge Discovery in Databases*, pp. 18–33.

Ruef, M., H. Aldrich and N. Carter (2003) "The Structure of Founding Teams: Homophily, Strong Ties, and Isolation Among US Entrepreneurs", *American Sociological Review,* (68)2, pp. 195–222.

Salehan, M. and D. Kim (2012) "The Effect of Attitude, Social Trust and Trust in Social Networking Sites on Two Dimensions of Sharing Behavior", *Proceedings of AMCIS '12: The Americas Conference on Information Systems*, Seattle, WA: AIS, Paper 11.

Shumaker, S. and A. Brownell (1984) "Toward a Theory of Social Support: Closing Conceptual Gaps", *Journal of Social Issues,* (40)4, pp. 11–36.

Tang, X. and C.C. Yang (2010) "Identifying Influential Users in an Online Healthcare Social Network", *Proceedings of ISI '10: IEEE International Conference on Intelligence and Security Informatics,* Vancouver, Canada: IEEE, pp. 43–48, doi: 10.1109/ISI.2010.5484779.

Thelwall, M. (2009) "Homophily in MySpace", *Journal of the American Society for Information Science and Technology,* (60)2, pp. 219–231.

Trusov, M., A.V. Bodapati and R.E. Bucklin (2010) "Determining Influential Users in Internet Social Networks", *Journal of Marketing Research,* (47)4, pp. 643–658.

Van Uden-Kraan, C., C. Drossaert, E. Taal, E. Seydel and M. Van De Laar (2009) "Participation in Online Patient Support Groups Endorses Patients' Empowerment", *Patient Education and Counseling*, (74)1, pp. 61-69.

Von Hippel, E. and G. Von Krogh (2003) "Open Source Software and the 'Private-collective' Innovation Model: Issues for Organization Science", *Organization Science,* (14)2, pp. 209–223.

Walther, J.B., S. Pingree, R.P. Hawkins and D.B. Buller (2005) "Attributes of Interactive Online Health Information Systems", *Journal of Medical Internet Research,* (7)3, Article e33.

Wasko, M. and S. Faraj (2000) "'It Is What One Does': Why People Participate and Help Others in Electronic Communities of Practice", *The Journal of Strategic Information Systems,* (9)2, pp. 155–173.

Wasko, M. and S. Faraj (2005) "Why Should I Share? Examining Social Capital and Knowledge Contribution in Electronic Networks of Practice", *MIS Quarterly,* (29)1, pp. 35–57.

Whittaker, S., L. Terveen, W. Hill and L. Cherny (1998) "The Dynamics of Mass Interaction", *Proceedings of CSCW '98: T*he *ACM Conference on Computer Supported Cooperative Work*, Seattle, WA: ACM, pp. 257–264, doi: 10.1145/289444.289500.

Wilson, E.V. (2009) *Patient-centered e-Health,* Hershey, PA: IGI Publications.

Wilson, E.V., W. Wang and S.D. Sheetz (2014) "Underpinning a Guiding Theory of Patient-Centered e-Health", *Communications of the Association for Information Systems,* (34)16, pp. 337–350.

Zhang, J., M.S. Ackerman and L. Adamic (2007) "Expertise Networks in Online Communities: Structure and Algorithms", *Proceedings of WWW '07: The International Conference on World Wide Web,* Banff, Canada: ACM, pp. 221–230, doi: 10.1145/1242572.1242603.

Zhao, L., Y. Lu, B. Wang, P.Y.K. Chau and L. Zhang (2012) "Cultivating the Sense of Belonging and Motivating User Participation in Virtual Communities: A Social Capital Perspective", *International Journal of Information Management*, (32)6, pp. 574–588.

APPENDIX A: MATHEMATICAL NOTATIONS AND DEFINITIONS OF VARIABLES

In order to better explain the variables in the regression model on page 10, we define an ordered pair (X_i, Y_i) for each interaction period; where:

X_i is the total number of comments user A has sent to discussion threads initiated by user B over the i^{th} interaction period.

Y_i is the total number of comments user B has sent to discussion threads initiated by user A over the i^{th} interaction period.

$X_i , Y_i \geq 0$; $X_i * Y_i = 0$, and $X_i + Y_i > 0$;

$0 < i \leq$ total number of interaction periods occurred between any two users A and B.

Using the notations, the ordered pairs (X_i , Y_i) in the scenario on page 9 are (3, 0), (0, 2), (5, 0), and (0, 1) for $0 < i \leq 4$, respectively. Thus, we can use these notations to formulate the variables in the regression model on page 22 as follows.

If $X_i > 0$ then

(1) *Last_sent* = X_i;

(2) *Last_received* = Y_{i-1};

(3) *Sent_so_far*= $\sum_{j=1}^{i-2} X_j$ (if $i \geq 3$); otherwise 0;

If $Y_i > 0$ then

(6) *Last_sent* = Y_i ;

(7) *Last_received* = X_{i-1};

(8) *Sent_so_far*= $\sum_{j=1}^{i-2} Y_j$ (if $i \geq 3$); otherwise 0;

(4) *Received_so_far* = $\sum_{j=1}^{i-2} Y_j$ (if $i \geq 3$); otherwise 0;

(5) *Diff_sent_received* = (3) – (4);

(9) *Received_so_far* = $\sum_{j=1}^{i-2} X_j$ (if $i \geq 3$); otherwise 0;

(10) *Diff_sent_received* = (8) – (9);

ABOUT THE AUTHORS

Nima Kordzadeh is a PhD Candidate in Information Technology at the College of Business, The University of Texas at San Antonio. His research interests include applications of social media in the contexts of healthcare and e-commerce with special emphasis on information privacy and participation behaviors within virtual communities. He has published articles in such peer reviewed journals as *Health and Technology* and presented his research at the Americas Conference on Information Systems (AMCIS). He holds an MBA and a B.Sc. in Computer Engineering from Sharif University of Technology.

Charles Zhechao Liu is an Assistant Professor of Information Systems at the University of Texas at San Antonio. He received his PhD in Management Information Systems from the Katz Graduate School of Business, University of Pittsburgh. His research interests include the economics of information systems, technology adoption and diffusion, and standards competition in IT markets. Dr. Liu is an ICIS Doctoral Consortium Fellow (2006) and a recipient of the Net Institute Research Grant (2007). His research has been presented at conferences that include ICIS, AMCIS, WISE, and INFORMS and published in leading information systems journals, such as *MIS Quarterly*, *Information Systems Research*, *Communications of the Association for Information Systems*, and the *Communications of the ACM*.

Yoris A. Au is an Associate Professor of Information Systems at The University of Texas at San Antonio. He received his PhD in Information and Decision Sciences from the University of Minnesota. His research areas include economics of information systems, information technology adoption, information systems security, online social networks, and open source software. His research has been published in a number of leading information systems journals. He is currently on the editorial board of *Information & Management* and serves as an area editor for *Electronic Commerce Research and Applications*.

Jan Guynes Clark is a Professor of Information Systems at The University of Texas at San Antonio. She received her PhD from the University of North Texas. Her research interests include the impact of information technologies on productivity and performance, information security, and IS strategies. Her publications have appeared in leading journals such as *Communications of the Association for Information Systems*, *Communications of the ACM*, *IEEE Transactions on Engineering Management*, and *Information & Management*.

Communications of the Association for Information Systems

ISSN: 1529-3181

Communications of the Association for Information Systems