Soc. Netw. Anal. Min. (2011) 1:341–353
DOI 10.1007/s13278-011-0025-9

ORIGINAL ARTICLE

# Interaction networks and patterns of guild community in massively multiplayer online games

**Chee Siang Ang**

Received: 4 November 2010 / Revised: 9 March 2011 / Accepted: 2 April 2011 / Published online: 27 April 2011


**Abstract** In this study, we adopted the social network analysis (SNA) approach and applied it to massively multiplayer online games studies. Virtual participant observation was carried out through which we identified seven types of interaction (grouped into task and social orientated interaction categories) using thematic analysis and recorded "who-talk-to-whom" relationships for each of these seven interaction types. The first part of the study was conducted to explore descriptively the patterns of user interaction. It was followed by a detailed study to look into these issues using SNA statistical techniques known as P* modeling. We found that task interactions were more unequal and expansive while social interactions were more densely knitted, resulting in horizontal and cohesive group formation. The studies also demonstrated the benefits of combining SNA and qualitative methods.

**Keywords** Massively multiplayer online games · P* model · Social network analysis · Virtual community

## 1 Introduction

Computer-mediated communication (CMC) technology has evolved considerably since its inception in human communication, triggering the formation of virtual communities. In the last few years, we have witnessed the development of Internet technology from personal communication such as e-mails to massive network and community building webs such as Facebook and YouTube.

Recently, there is an emergence of a new form of virtual community phenomena, in which user interaction takes place in 3D virtual worlds. These 3D worlds often feature a large number of virtual locations users can visit and a variety of virtual artifacts users can interact with. The commercial success and the sheer number of people spending a huge amount of time in 3D virtual worlds, such as massively multiplayer online games (MMOGs), has attracted attention from the academic community. Already, some scholars have studied this social phenomenon from various angles, most notably media studies (Steinkuehler 2004), psychology (Yee 2005), sociology (Squire 2002) and computer science (Ducheneaut et al. 2004).

Most of the work in this research area assumed the "conventional" social science analytical perspective, treating individuals (e.g. players, groups, communities) as the basis of analysis. The structural nature of interaction is often overlooked. In this paper, we adopted a social network analysis (SNA) standpoint, focusing on relations and structures, to cast new light onto user interaction in virtual worlds. SNA is the mapping and measuring of relationships and structures between actors (e.g. people, groups, organizations, etc.) (Wasserman and Faust 1994). In the context of MMOGs, instead of measuring players' attributes such as gender, number of hours spent playing the game, level of the player, etc., we can look at the structural attributes such as with whom the player usually does a quest, from whom the player seeks help, to whom the player gives help, etc.

The current paper aimed to investigate the user interactions in the guild community of World of Warcraft (WoW). Particularly we aimed to:

C. S. Ang (✉)
School of Engineering and Digital Arts, University of Kent, Canterbury, UK
e-mail: csa8@kent.ac.uk

(a) Identify the interaction types with the community through thematic analysis and content analysis
(b) Analyse the network structure using SNA methods
(c) Discuss the results gathered through qualitative and quantitative methods

## 2 MMOG

Game play activity is essentially a social experience as it is impossible to play a game in isolation in a meaningful sense. This social dimension of play is further amplified with the inception of the Internet in gaming, which leads to the expansion of the social interaction scope to involve a massive number of players playing simultaneously.

Perhaps the most prominent example of online game community is MMOGs (Ang et al. 2007; Ducheneaut et al. 2004, 2006). Understanding the patterns of interaction in these communities is important, as these virtual communities function as a major mechanism of socialization of the players. One of the most evident examples of social interaction in MMOGs is the concept of "guilds". Guilds are a fundamental component of MMOG culture, giving the players a chance to run a virtual association, which has formalized membership, and rank assignments that encourage participation. Each guild usually has a leader and several guilds could team up in a battle. This involves a complicated leader–subordinate and leader–leader relationship.

## 3 Social network analysis: structures and relations

Several studies have been conducted to analyze the user behavior and online interaction within the 3D virtual world of MMOGs. For instance, work by Yee (2005) captured a typology of player motivation through a large-scale survey study. Another study conducted by Ducheneaut et al. (2004) attempted to examine the sociability of players in Star Wars Galaxies. These results were very insightful, underscoring some game design aspects, which could facilitate different styles of player interaction.

Although rare in the context of social interaction and play, the interest of SNA in the work context is gradually growing. Some prominent research has been carried out to study how social relationships between co-workers affect their interaction tendencies. Koku and Wellman (2002) investigated a scholarly network in a CMC setting. Using SNA techniques such as block-modeling (White et al. 1976) and centrality measures, they found that the closeness of relationship at work was associated with the frequency of interaction. In addition, people who exchanged more types of information tended to use more media (e.g. email, telephone).

Cross et al. (2002) in another study analyzed informal networks in a work environment with SNA visualization (i.e. socio-grams) and concluded that interactions within informal networks were a main contributor for job satisfaction and performance. Furthermore, statistical methods for SNA such as Quadratic Assignment Procedure (QAP) (Dekker et al. 2003) have been developed and successfully applied in work by White et al. (2004) in order to investigate the citation interaction of the members within interdisciplinary research groups. Their results showed that citation interaction was based on intellectual ties rather than social ties such as friendship.

Recently, we have witnessed the application of SNA in analyzing learners' behavior and their interaction patterns. A series of studies have been undertaken by Laghos and Zaphiris (2005) in an attempt to develop a framework for analyzing computer supported collaborative learning (CSCL). They proposed the incorporation of SNA methodology in the evaluation framework of e-learning. McDonald et al. (2005) on the other hand applied SNA to identify the ties of learners to examine the impact of social exclusion on the user participation and experience of online learning.

There is also a few SNA research in social-oriented interaction in virtual communities. Zaphiris and Sarwar (2006), for example, investigated the differences in online discussions between younger and older users. Some work has also been carried out to analyze user online behavior in blogs (Chang et al. 2007) and Flickr (Negoescu 2007), a photo sharing online community. Newer studies have also made use of SNA to study large scale online networks (Fazeen et al. 2011; Adnan et al. 2011; Bhattarcharyya et al. 2011).

The social network perspective to 3D virtual world studies is starting to emerge. Ducheneaut et al. (2006, 2007) for instance carried out a study on guild communities using SNA by correlating the network density and the guild size. They then used regression analysis to further identify aspects of network structures deemed vital to guild survival. Other studies (Shi and Huang 2004; Rodrigues and Mustaro 2007; Szella and Thernera 2010) focused on large-scale quantitative analysis, emphasizing the high-level network characteristics rather than local interaction. Indeed, SNA has immense possibilities and potentials to analyze user interaction through structural and relational perspectives in various settings: offline and online, work and social. We believe that combining SNA and qualitative analysis using participant observation will cast new light onto online user interactions in a playful and social context such as MMOGs.

## 4 Methods

### 4.1 Data collection

We carried out a case study of a guild community in WoW (Blizzard Entertainment 2004) to understand its interaction networks and patterns. We collected data from a relatively big guild (with 76 members at the time of observation) through participant observation, which meant the researcher was participating in the community while carrying out the data collection. The guild was chosen because of its "casual nature", in which e-players joined to engage in social interaction as well as getting help for quests. Using the in-game chat-log function, we kept a record of guild members' chat activities throughout the study. We also kept a field note in order to record additional information and reflect on our observation. In order to observe social interactions in a natural setting, we decided that a covert participation observation was more appropriate.

Although the guild members were not aware of the researcher's involvement, ethical consideration was carefully taken into account when carrying out this study. Specifically, the usernames of the members were not revealed in the study. By focusing on network structure and the categorization of users' interaction, we analyzed our data independently from the person who sent the message. It was impossible to identify the users' identity and their anonymity was thus strictly protected.

A total of 1,944 guild messages were collected in 30 h of observation (spanning across 1 month). Then, we categorized the messages using thematic (Krippendorff 1980) aided by MaxQDA qualitative data analysis software package. Systematic examination and categorization was carried out to identify the emerging themes of social interaction. More specifically, an initial set of categories was identified through the field notes. Using these initial categories, the data was examined in detail to revise and strengthen the categories. Through a repetitive process, we identified, merged and reorganized the categories until data saturation was reached. We found that in general, the guild players were related to each other through seven types of interaction:

- Group management: activities which are related to organizing the groups including: soliciting/responding to invitations, identifying group members, deciding meeting points, (re) structuring the group, leaving the group among guild members.
- Coordination: task coordination, involving coordinating group member activities towards task completion such as: pointing out targets, coordinating actions, looting, discussing strategies, trading.
- Ask help: asking for help or asking questions. It usually involves situations that need immediate solutions such as: the solution of quests, equipment, asking for game items and money.
- Give help: giving help and answering questions. It could also be attempts to help/answer questions.
- Friendly remarks: short messages that express friendliness towards others such as: apologizing, greeting, laughing, being polite, smiley, non-verbal communications such as "dancing".
- Game chats: socializing messages and chats including: small talks, talking about WoW/other games, telling jokes, being sensitive to others, being supportive and encouraging.
- Real life chats: chats that reveal the member's real life identities (real life gender, nationality, etc.) and chats about real life topics such as their work/college life.

We coded all the messages into these seven categories. In order to establish inter-coder reliability, we used a second coder. The second coder was randomly assigned 10% of the messages and second coding was carried out independently. Inter-coder reliability was 0.7069 using Cohen's Kappa's coefficient (Cohen 1960), which was considered good (Fleiss 1981).

We then tabulated the messages into directional socio-matrices for SNA by identifying "who talked to whom" relationships in the chat log. A social-matrix for each interaction type was generated. An additional overall socio-matrix (called overall interaction network) representing the aggregate interaction (of all seven categories) was also produced.

One interesting issue regarding user interaction in MMOGs is the distinction between task and social interaction (Ducheneaut et al. 2004; Kolo and Baur 2004). In order to explore this, we merged the seven types of interaction into two higher-level categories: task interaction and social interaction. Task interaction includes the categories of "give help", "ask for help", "group management" and "coordination" while social interaction consists of "friendly remark", "game chat" and "real life chat".

### 4.2 Data analysis

In the first study, the seven types of player interaction were examined to obtain a general picture of the player social network in WoW. Socio-grams were generated and the following descriptive SNA measures were calculated for each interaction type (Nooy et al. 2005):

- Density: density of the whole network is the number of observed ties in proportion to the maximum theoretical possible number of ties.

- Reciprocity: a tie is reciprocated if two actors send a message to each other. The reciprocity of the whole network measures the proportion of dyads (a group of two actors), which have a reciprocated tie between them.
- In-degree centrality and centralization: in-degree centrality of an actor is the number of in-coming ties it has. In-degree centralization of the whole network is the variation in the in-degree centrality of actors divided by the maximum degree of variation possible in a network of the same size.
- Out-degree centrality and centralization: out-degree centrality of an actor is the number of out-going ties it has. Out-degree centralization of the whole network is the variation in the out-degree centrality of actors divided by the maximum degree of variation possible in a network of the same size.
- Transitivity: in a transitive relationship, if actor A has a tie directed to actor B, and actor B has a tie directed to actor C, then actor A has a tie directed to actor C. The transitivity of the whole network measures the proportion of triads (a group of three actors) which have a transitive relationship.
- Betweenness centrality and centralization: if actor A is connected to actor C through actor B, then actor B is said to be in between this relationship. Betweenness centrality of an actor measures the proportion of all shortest paths between two other actors that include this actor. Betweenness centralization of the whole network is the variation in the betweenness centrality of actors divided by the maximum variation in betweenness centrality possible in a network of the same size.

The UCInet (Borgatti et al. 2002) software package was used to assist the analysis.

Then, higher order exponential random graph model (ERGM), or commonly known as P* modeling (Robins et al. 2007) was carried out on each interaction type. Through this, we analyzed in greater detail the local network properties. SIENA in StOCNET (Stokman et al. 2004) was used to assist the analysis for this study.

## 5 Results and findings

### 5.1 General network structures of the Guild

In this section, we describe some of the network properties that give us a general idea about the interaction structure in the guild community.

Note that the data came from a guild community with a fixed number of members. However, not all members were engaged in every type of interactions. In order to reduce data noises, isolates were removed from each network for analysis since some players joined the guild without participating in the activity at all. Such data would not have been useful in understanding the actual interaction that took place in the community.

Table 1 shows that about the same number of players were engaged in social interaction and task interaction. However, the social interaction network was more densely knitted than task interaction.

It was also found that a large number of players were involved in “friendly remark” (85.14%) and “give help” (81.08%) interaction types. This was an expected result as most of the players tried to participate in these activities actively, which gave a positive impression of being a good guild member. Only as little as 21.62% chatted about real life topics and got engaged in coordination. This was partly due to the fact that real life chats were considered more private and were thus not shared across the whole guild. Similarly, coordination interaction mainly took place within a quest group, rather than at the guild level.

The density for all interaction types was relatively low, indicating that most members of the guild were not directly connected to each other. “Ask for help” and “give help” had particularly low density (0.0333 and 0.0331, respectively) and we believe that this was mainly because players often asked for help from and gave help to a specific small set of people.

Furthermore, from the socio-grams (Table 1), we observed that there was an “in-star” structure in “real life chat”, indicating the existence of one particularly “popular” player to whom other players liked to talk. Apart from this, a specific section of “coordination” network seemed to form a “triangle” structure. We also found indirect relation in “coordination” network, in which two players were connected indirectly, through another player.

Visualizations such as these are very helpful in understanding the user interaction, but are impossible to be identified in a much more complicated socio-gram like the “friendly remark” network. Therefore, social network measurements were calculated to reflect on the network characteristics for each interaction type (Table 2). We highlight some interesting findings from Table 2.

Firstly, we noted that in-degree centralization was higher than out-degree centralization in the case of “ask for help” while it was the reverse in “give help”. This means there was a tendency of certain groups of players being asked for help much more frequently than others. This of course follows that some players seemed to give help more frequently than others, as indicated by the higher out-degree centralization.

Secondly, examining the reciprocity for each interaction type, we found that chatting interaction in general (i.e. friendly remark, game chat and real life chat) was more likely to be reciprocated compared to helping interaction (ask for help, give help).

Thirdly, “friendly remark” interaction had both higher in and out degree centralization compared to “game chat”. Centralization tells us about the variation (or heterogeneity) of the networks in term of their out-degree, in-degree and betweenness centrality (Freeman 1979). Centrality can also be associated with power and prestige (Koehly and Wasserman 1996). An actor with high out-degree centrality is *influential* (and thus has more power) in a way that it has direct relation towards many others while an actor with high in-degree centrality is *popular* (has more prestige) since others try to interact with it frequently. In other words, high degree centralization often results in a more unequal network in term of power/prestige distribution. Therefore, despite the fact that they are similar types of interactions (both are chatting interactions), friendly remark interaction resulted in more unequal network than game chat interaction.

Finally, from Table 2, we noted that social interaction had higher (in and out) degree centralization than task interaction. Apart from this, the transitivity score of social interaction was also higher than task interaction, implying that players tended to form triangle clique structures (or small groups) while interacting with each other socially.

In summary, the descriptive analysis highlighted several interesting issues worth analyzing further:

- Guild players tend to ask for help from a specific small group of players.
- Compared to helping interaction, chatting interaction is inclined to be reciprocated.

**Table 1** Socio-grams and general descriptions of each interaction type

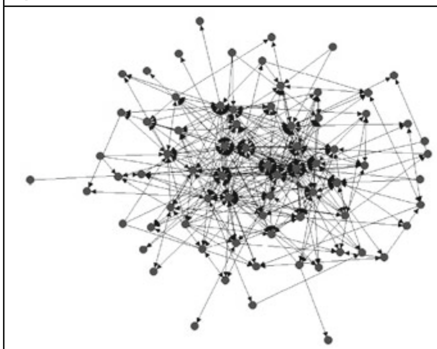
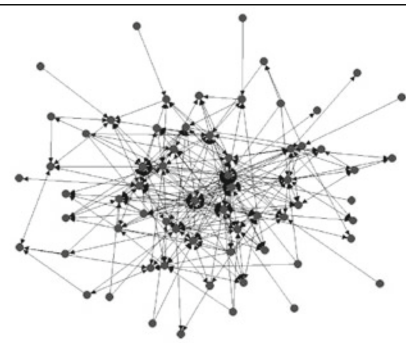
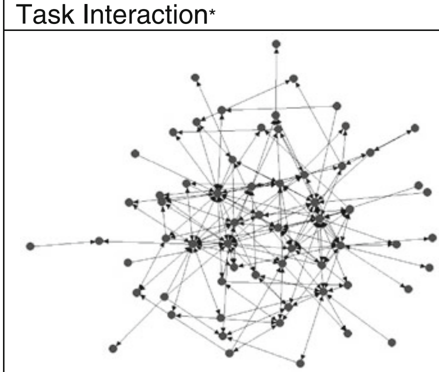
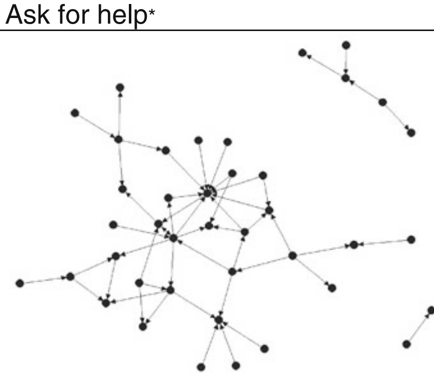
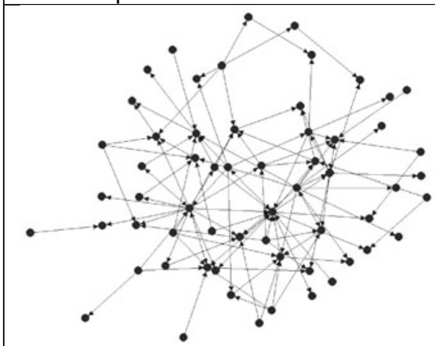
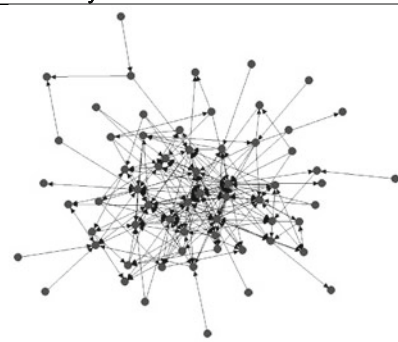
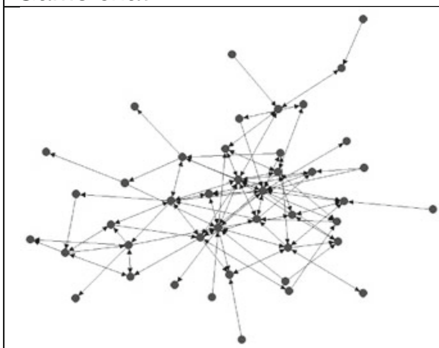
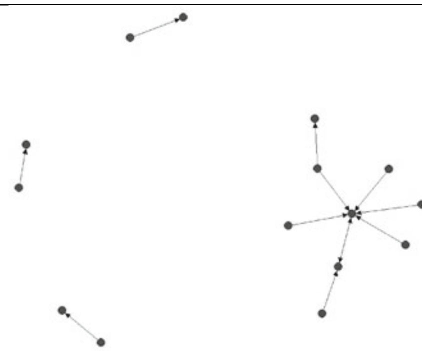
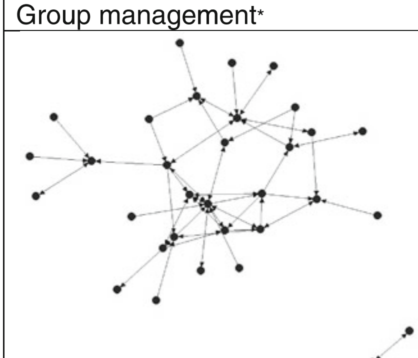
| Overall Interaction* | Social Interaction* |
|---|---|
| <br>Number of actors = 74<br>Number of observed ties = 457<br>Density (SD) = 0.0869 (0.2818) | <br>Number of actors = 65<br>Number of observed ties = 329<br>Density (SD) = 0.0791 (0.2699) |
| **Task Interaction*** | **Ask for help*** |
| <br>Number of actors = 63<br>Number of observed ties = 219<br>Density (SD) = 0.0561 (0.2301) | <br>Number of actors = 40<br>Number of observed ties = 52<br>Density (SD) = 0.0333 (0.1795) |

**Table 1** continued

| Give help* | Friendly remark* |
| --- | --- |
| <br>Number of actors = 60<br>Number of observed ties = 117<br>Density (SD) = 0.0331 (0.1788) | <br>Number of actors = 63<br>Number of observed ties = 258<br>Density (SD) = 0.0661 (0.2484) |
| Game chat* | Real life chat* |
| <br>Number of actors = 43<br>Number of observed ties = 123<br>Density (SD) = 0.0681 (0.2519) | <br>Number of actors = 16<br>Number of observed ties = 12<br>Density (SD) = 0.0500 (0.2179) |
| Group management* | Coordination* |
| <br>Number of actors = 32<br>Number of observed ties = 62<br>Density (SD) = 0.0625 (0.2421) | <br>Number of actors = 16<br>Number of observed ties = 24<br>Density (SD) = 0.1000 (0.3000) |

- Interestingly, the out and in degree centralization measures indicate that friendly remark interaction tends to result in a network with unequal power and prestige distribution.
- The out and in degree centralization measures suggest that, compared to task interaction, social interaction tends to result in a networks with unequal power and prestige distribution.

**Table 2** General network characteristics

| | Reciprocity | Out-degree centralization | In-degree centralization | Transitivity | Betweenness centralization |
|---|---|---|---|---|---|
| Whole network | 0.4281 | 0.3202 | 0.2357 | 0.3112 | 0.1139 |
| Social interaction | 0.3160 | 0.3164 | 0.2529 | 0.2908 | 0.1524 |
| Task interaction | 0.4408 | 0.1889 | 0.1561 | 0.1705 | 0.1486 |
| Ask for help | 0.0196 | 0.1499 | 0.2025 | 0.1053 | 0.0772 |
| Give help | 0.0636 | 0.1905 | 0.1388 | 0.0889 | 0.1812 |
| Friendly remark | 0.2286 | 0.2934 | 0.2443 | 0.2547 | 0.1326 |
| Game chat | 0.3977 | 0.1984 | 0.1984 | 0.1945 | 0.2239 |
| Real life chat | 0.0909 | 0.0889 | 0.3733 | 0.0000 | 0.0235 |
| Group management | 0.3778 | 0.2019 | 0.2352 | 0.1656 | 0.1991 |
| Coordination | 0.5000 | 0.1778 | 0.1778 | 0.3636 | 0.0568 |

- The network transitivity also suggests that players tend to form cliques when engaging in social interaction than in task interaction.

## 5.2 Results from the P* model study

In the second study, we attempted to further explore the issues we identified earlier with exponential random graph models (ERGM or P* model). We modeled each type of interaction through the analysis of its local network structure. P* models are stochastic (or probabilistic) models that could represent local interaction regularities quantitatively through estimations from the observed networks. We can also understand the global consequences of these local regularities. Several newer SNA studies have taken advantage of this technique to analyze the dynamics and evolution of social networks (Igarashi et al. 2006; Steglich et al. 2006).

We applied the high-order P* models (Robins et al. 2007) to estimate the structural properties of the network of each interaction-type. Essentially, the high-order P* model consists of five parameters as explained in Table 3. Note that density was also included in this model as a control parameter.

**Table 3** Network configurations of higher order P* model

| Parameters | Explanation | Graphical structure |
|---|---|---|
| Reciprocity | Mutuality of the tie |  |
| Alternating out-K-star | The distribution of the out-degree. An actor has various out-going ties |  |
| Alternating in-K-star | The distribution of the in-degree. An actor has various in-coming ties |  |
| Alternating K-triangle | The tendency to transitivity. Two actors are tied to one another and also to various numbers of the same other actors. It is a measure of the extent to which triangles themselves group together |  |
| Alternating K two path | The tendency to indirect ties. Two actors are not tied to one another, but are tied to various numbers of the same other actors |  |

For the purpose of brevity, the term "alternating" was dropped when referring to these parameters in the rest of the paper.

The Markov model (with density, 2-star, 3-star and triangle parameters) tends to be degenerate in complex social networks, e.g. networks with high transitivity (Robins et al. 2007). To overcome this, models with new specifications (i.e. P* model) have been proposed by Snijders et al. (2005).

In view of model interpretation, Robins et al. (2007) explained that a positive (in or out) K-star parameter indicates "a degree distribution containing some higher degree nodes, and a resulting 'loose' core-periphery structure; whereas a negative parameter suggests a truncated degree distribution with a tendency against particularly high degree nodes". A positive k-triangle parameter on the other hand implies a tendency for triangulation, with the triangles incline to form clusters together. For a detailed description and interpretation of the higher order model, please refer to Robins et al. (2007).

All networks for each interaction type were dichotomized at cut off point >0. The model converged successfully and fitted the data well for each interaction type networks. Table 4 shows the final phase of parameter estimates (with standard errors in parentheses) for each interaction type and for the overall interaction. Density was included in the P* model to capture the general tendency in the social networks.

P* modeling revealed some interesting interaction patterns in the guild community. Supported by qualitative observation data, we provide explanations to these interaction patterns. Firstly, let us look at the overall interaction of the guild community. Table 4 shows that the overall interaction network exhibited significantly high reciprocity (2.6167) than the parameter we would have obtained from randomly generated networks of the same size. This suggests a mutual relationship between players in general. The significant (but relatively low) out-K-stars parameter indicates that the network tended to be slightly expansive (i.e. some high degree nodes with out-going ties), meaning that the players had an inclination to interact with many other players. The network also had a relatively high K-triangle parameter, implying small group (i.e. clique) formation within the community.

### 5.2.1 *Ask for help and give help*

It was noted that "give help" interaction had a significant positive reciprocity structure while it was not significant for "ask for help" interaction (see Table 4). In other words, players who gave help to others tended to receive help from the same players. On the other hand, players who asked for help from another player did not seem to be asked for help by the same player.

Examining the content of the observation, it was found that, there was a tendency of stronger members giving help to each other. By strong members, we refer to players who had been playing the game for a relatively long time (even though they might have been playing low level characters). Similarly, weaker members were relatively new players to the game. This could result in a higher reciprocity in "give help". On the other hand, stronger members almost never asked for help from anyone while weaker member did not ask help from each other. This caused low reciprocity in "ask for help".

Furthermore, significantly positive tendency of in-K-star patterns implies that players were inclined to ask for help from the same players. However, players were more likely to reach out and give help to different players, indicated by the significantly positive out-K-star parameter of the "give help" category. This phenomenon is not difficult to explain, since it is reasonable to assume that players who had been playing longer knew more about the game hence were more able to provide help to others. Similarly, players tended to ask for help from the players who were known to be more knowledgeable in the guild community. Table 4 shows a high in-K-star parameter in give help interaction. This was due to the fact that often a number of knowledgeable players engaged in providing help to the same needed player. The data excerpt below shows for example that two players were involved in giving help to a player:

Player_B: letter [..] for [Stalvan]
Player_B: where [is he]?
Player_V: uhm wait a sec[ond]
Player_S: that['s] where [I] found him
Player_S: maybe he walks about
Player_V: it['s] on the park side of the canals
Player_S: [I] found him on the other side […]
Player_V: on the end of the walkway is the guy you['re] looking for

### 5.2.2 *Friendly, game chat and real life chat*

The reciprocity parameter shows that friendly remark (1.2829) and game chat (3.0757) networks had significantly higher reciprocity than randomly generated networks. Although not significant, real life chat had a relatively high reciprocity (2.0724). Therefore, we can conclude that chatting interaction was inclined to be reciprocated.

The significant in-K-star parameter for the friendly remark network suggests that the friendly remark network tended to consist of some players with higher in-degree (i.e. popular players). Through this, we can safely conclude that some stronger members tended to receive a lot of

**Table 4** Parameter estimates of the higher order P* models in the guild network (results printed in bold face were statistically significant)

| | Density | Reciprocity | Out-K stars | In-K stars | K-triangles | Two paths |
|---|---|---|---|---|---|---|
| Overall interaction | **−2.9981** (0.0659) | **2.6167** (0.1823) | **0.4417** (0.1836) | 0.1664 (0.2020) | **0.6709** (0.0944) | **0.0213** (0.0062) |
| Social interaction | **−3.4148** (0.0789) | **1.7692** (0.2150) | 0.1085 (0.1936) | 0.2867 (0.1845) | **0.7340** (0.1034) | **0.0244** (0.0087) |
| Task interaction | **−4.1508** (0.1102) | **3.6316** (0.2630) | **0.6820** (0.1898) | 0.1901 (0.1988) | **0.1057** (0.0835) | **0.0742** (0.0188) |
| Friendly | **−3.0689** (0.0821) | **1.2829** (0.2444) | 0.1915 (0.2093) | **0.5297** (0.1779) | **0.6170** (0.1089) | **0.0358** (0.0141) |
| Game chat | **−3.4260** (0.1418) | **3.0757** (0.3517) | 0.2471 (0.2573) | 0.1395 (0.2497) | **0.2428** (0.1213) | **0.0850** (0.0363) |
| Real life chat[a] | **−3.0819** (0.3304) | 2.0724 (1.4920) | −1.9532 (1.1980) | **1.6668** (0.4554) | −2.6771 (7.5715) | −0.2385 (0.4252) |
| Ask help | **−3.3728** (0.1462) | 0.0720 (1.1732) | 0.2245 (0.3228) | **0.5231** (0.2575) | 0.4891 (0.4738) | −0.0838 (0.1076) |
| Give help | **−3.4730** (0.1015) | **0.9756** (0.4541) | **1.0267** (0.1928) | **0.5981** (0.1906) | −0.0129 (0.2211) | 0.0238 (0.0426) |
| Group management | **−3.4724** (0.1948) | **3.2400** (0.5099) | −0.5346 (0.4349) | **0.6487** (0.3069) | 0.2067 (0.1816) | 0.0950 (0.1023) |
| Coordination[a] | **−3.2581 (0.3669)** | **3.3081 (0.8755)** | −1.0984 (0.8225) | **−0.3631 (0.7442)** | 0.8293 (0.3336) | 0.0391 (0.3977) |

[a] Due to the small number of nodes in these sub-networks, the results should be treated with care

"friendly remarks" from others (new and weaker members), resulting in this in-K-star structure. Therefore, "friendly remark" interaction did indeed tend to result in a network with unequal *prestige* (in degree) distribution. However, the positive out-K-star of the "friendly remark" interaction network occurred only by chance. Thus, friendly remark interaction *did not* tend to result in a network with unequal *power* (out degree) distribution.

It was perhaps not surprising that "ask for help" networks were unequal (out-K-star = 0.5231) since it was obvious that stronger players were in a better position to give help than weaker players and thus were asked more frequently to do so. However, it was rather counter intuitive that the "friendly" network also tended to be unequal (in-K-star of 0.5297). One would assume that everyone would be at the same position to interact and thus inequality would be less likely to emerge in "friendly" interaction since it did not depend on the players' ability or knowledge about the game. This assumption held true for "game chat" interaction, where no significance could be found in either out-K-star or in-K-star. Why did such a discrepancy exist?

Analyzing the content provides us with an interesting explanation. We believe that this was due to the fact that friendly interaction was often followed by or preceded "ask help" and "give help" behavior. It is often in the form of a short "thank you" message when the player was asking for help and when the player was receiving help (as shown in the data excerpt below). Therefore, like these two types of helping interaction, friendly interaction tended to be directed toward certain players.

> Player_R: […] where in [deadmine] I can find the items needed [for] the Oh Brother [quest]
> Player_S: they're in the undead part
> Player_R: thanks a lot :)

Taking this interpretation further, we can even maintain that friendly remark was used by "weaker" members as a means to establish relationship with "stronger" members to obtain help. Therefore, we hypothesize that certain types of social interaction (friendly interaction in this case) indirectly serve a functional or instrumental end. In other words, certain social interactions are important within the community in order for tasks to be accomplished successfully. From this point of view, there is no wonder that friendly interaction in the guild community resulted in an unequal network.

Game chat interaction on the other hand did not tend to form this structure of popularity (prestige) or authority (power). Analyzing the content reveals that only strong members engaged in game chat. This finding has an important implication in understanding the user development in such a community as the result implied that that new members often had to engage actively in task-oriented activities until they reached certain level of "maturity" before they could participate meaningfully in game chat interaction.

### *5.2.3 Group management and coordination*

Moving to group management and coordination, we observe significantly positive reciprocity parameters (3.2400 and 3.3081, respectively). This finding was expected as the nature of these types of interaction required mutuality in order to be meaningful. An interesting observation, however, is the in-K-star of group management. The result suggests that there were "popular" players who were frequently invited to join the group.

Also of interest is the K-triangle parameter, which shows that coordination interaction was more likely to operate in small groups than group management was. From the observation, we can infer that during the process of creating and managing the group, it was often desirable to interact with everyone so that there were more options and opportunities for creating a balanced group (groups with a balanced mix of level and class, see (Ducheneaut 2007). However, quite naturally, once the group was created, the players were coordinating within the group that had been created.

It is also interesting to observe that coordination in the guild community did not seem to impose an unequal structure, as shown by the non significant out-K-star and in-K-star. Through examination of the observation data, it was found that the division is horizontal, in which no special authority was assigned to any players. Instead of operating on a leader–subordinate relationship, coordination interaction mainly consisted of discussion, suggestion, negotiation and agreement. The following data except shows such division:

Player_J: stay here?
Player_J: or [should we go to] deadmine?
Player_D: on to the dead mines
Player_T: how many [quest items] do you all need now?
Player_V: 1 knuckleduster for me

This might be a unique characteristic of "casual guild", which was the type of guild under study. One can imagine a command-and-control relationship in a task-focused guild types such as "raid guild" or "PvP guilds" (Williams et al. 2006).

#### 5.2.4 *Social and task interaction*

Finally, we turn our focus to "social interaction" and "task interaction". Task interaction had higher reciprocity than social behavior. Although "ask for help" and "give help" had a lower reciprocity independently, when combined, we can conclude that asking for help was always reciprocated by giving help. The estimation of reciprocity parameter for "ask for help" and "give help" combined yielded significant results with 2.5261 (0.3483). This also indicates that in such helping interaction, both strong and weak members could become "popular" because strong users received help requests from various periphery members while weak members received helps from various core members. However, only strong members could be "powerful" nodes as they gave help to many other weak members but weak members only asked for help from the same specific strong members.

The descriptive social network measurements (see Table 2) suggested that the social interaction network was unequal both in term of power and prestige (refer Table 2). From Table 4, however, we conclude that the positive out-K-star and in-K-star parameters of social interaction were due to chance (not statistically significant).

In addition, we found that the social interaction network had a significantly positive K-triangle (0.7340) meaning that players tended to form triangle group structures when interacting socially. This is in line with our descriptive analysis that players tended to form cliques (small groups) when engaging in social interaction. Contrasting this result with task interaction, it was found that task interaction has a lower K-triangle parameter. Although small groups still formed in the task interaction network, it was not as often the case as it was in social interaction. Therefore, we can conclude that social interaction was more closely knitted and it was easier for each member to reach one another.

This might be due to the fact that in "task interaction", it did not matter much if the players were interacting with strangers as long as the task could be completed. This could result in an "expansive" (or spread-out) network of interaction patterns. Social interaction on the contrary tended to be more cohesive since the players only interacted socially with familiar faces.

### 5.3 Summary of results

To summarize, we can conclude that:

- There was a group of players who were at the center of the guild community. They were knowledgeable of the game and therefore they interacted with many other players (expansive interaction that reached out to many people) by giving help.
- The reciprocity of the guild community was generally high particularly in game chat and group management networks. In addition, task interaction had higher reciprocity than social interaction.
- In general except for friendly remark interaction, social interaction network was equal both in term of prestige and power (influential players who sent out a lot of messages) while task interaction resulted in unequal power distribution.
- Social interaction tended to be more "cliquey" than task interaction in which more small groups formed.

Although the studies confirmed finding in previous research, the results provide some indications of interesting observations:

- Like help interaction, the friendly remark interaction network was unequal in term of prestige (there was a group of popular players who received a lot of messages). This was because friendly remarks were strongly tied to ask for help interaction.

- In helping interaction, both strong and weak members could become "popular" but only strong members can be "powerful".
- New and weaker members needed to engaged actively in task interaction until they reached a certain level of "maturity" before they could participate in game chat interaction.
- The coordination activity in the guild did not operate on a leader–subordinate relationship; instead it consisted of discussion, suggestion, negotiation and agreement.

## 6 Discussion and conclusions

Through a combination of thematic analysis and social network analysis, we managed to elucidate the online user behavior of the guild community in WoW. In line with previous research (Ducheneaut et al. 2004, 2006, 2007), our studies showed that guild players tended not only to be involved in task interaction, but also actively engaged in social interaction. Our analysis provided further explanations as to how social and task interactions were related.

Furthermore, using qualitative methods, we identified seven types of interaction and analyzed their local interaction patterns. This analysis extended the current studies by adding further granularity to what constituted social and task interactions. We were also able to provide a more qualitative description and understanding to the guild network structures.

Through this qualitative and quantitative method, we found that even for players whose purpose of joining the guild was solely to get help, it was often necessary to be friendly to other players in order to get help for completing their tasks. In other words, friendly behaviors are a means to an instrumental end.

Social interaction is essential in the guild community because it not only creates a friendly environment, but also bridges the gap between "stronger" players and "weaker" players by creating mutual relationships. In task interaction, reciprocity occurs through a multiplex relationship. For instance, "ask for help" is reciprocated with "give help", although independently each relationship is not well reciprocated. In social interaction, in principal, reciprocity does not depend on the players' ability or knowledge. Anyone can enjoy a mutual relationship if she wants to. Therefore, social interaction is essential for sustaining a balanced flow of interaction in the guild. However, our observation highlighted that users still need to build up their basic essential experience through task interactions before they could participate in socialization.

Moreover, social oriented interactions especially "friendly remark" and "game chat" were the key for triangle group structure formation. Literature suggests that one of the factors that promotes sense of belongingness in a community is the emergence of small group structure. It is claimed that although too much structure might weaken the community, some structure is needed (Rovai 2002). Therefore, chatting interaction with moderate K-triangle parameters is important for fostering the sense of community. In other words, we claim that social interaction contributes to the development of cohesive community in which users are more densely knitted.

One of the main motivations of joining the guild is to seek help (Kelly 2004). Therefore, "knowledge players" who provide help regularly is crucial to the growth of the guild. This provides a supportive environment and thus encourages others to join the guild. In addition, task interaction might not be as dependent on knowing the interaction person, they could be a "stranger"; as long as they could be counted on to fulfill their assigned role. Therefore, we maintain that task interactions lead to the expansion of the guild community while social interactions create a cohesive network within the community.

The findings also have some implications on the survival of guilds. A comprehensive study on guild survival has been carried out by Ducheneaut (2007). They found that guilds with smaller subgroups are more likely to survive. Mapping this finding to the results in Table 4, we notice that interaction types with significantly high k-triangle (thus the formation of small subgroups) are predominantly social-oriented interactions. Therefore, we can infer that such interactions might be crucial to guild survival.

Finally and most importantly, through a combination of qualitative (thematic analysis) and quantitative (SNA ERGM model) methods, we not only cast light onto the network structure, but also provided qualitative evidence the nature of interactions embedded within the networks. For instance, high in degree in a network is often associated with "prestige" whilst nodes with a high out degree are seen as having "power". However, without actually examining the content of these specific interactions, it is hard to make an informed conclusion.

### 6.1 Future work

We believe that combing quantitative SNA and qualitative methods such as thematic analysis is fruitful in examining interactions in a virtual environment like MMORPGs. Participant observation was extremely important as it provided a background knowledge and understanding of the sub-culture of the community. This could enhance the validity of the analysis when using thematic analysis to study the interaction content. Of course, this mixed method has its limitation in dealing with huge data set as it would be impossible to examine huge data set manually.

Therefore, linguistic analysis tool such as LIWC might provide an answer to such a mixed method when dealing with large dataset.

Our results indicate that the observed guild community is not made up of one component of structurally equal individuals. Some players were in the centre of the network, contributing to the growth of the guild by providing help (particularly to newcomers), and by creating a friendly atmosphere and a sense of belonging through friendly game chats. Conversely, other players only treat the guild community as a repository of resources from which they can easily get help for their individual tasks, without feeling attached or belonged to the guild. Clearly, there is a need of sociability design to facilitate task/social interactions within and between different social roles. Therefore, this issue calls for future research in examining the structural roles and positions in the guild community.

Apart from this, we must emphasize that this paper only presented a case study of a specific guild community. Previous research in social interaction in MMOG guilds has identified a broad range of different types of guilds, from social guilds, where the game goals are secondary to social interactions, to raiding guilds, which are perhaps the most task-based guilds in MMOGs. Apart from this, the size of the guild is also thought to have an impact on the social dynamics of the guild community. For instance, it was found that in general smaller guilds are more tightly knit, thus they tend to focus on social activities. On the other hand, larger groups are more task-oriented, fairly anonymous, and often hierarchical structure forms in such groups. Different types of guilds can result in the emergence of social networks with distinctive network structures (Williams et al. 2006).

## References


Adnan M, Nagi M, Kianmehr K, Tahboub R, Ridley M et al (2011) Promoting where, when and what? An analysis of web logs by integrating data mining and social network techniques to guide ecommerce business promotions. Soc Netw Anal Min 1

Ang CS, Zaphris P, Mahmood S (2007) A model of cognitive loads in massively multiplayer online role playing games. Interact Comput 19(2):167–179

Bhattarcharyya P, Garh A, Wu F (2011) Analysis of user keyword similarity in online social networks. Soc Netw Anal Min 1

Blizzard Entertainment (2004) World of Warcraft. http://www.worldofwarcraft.com/. Last retrieved 4 September 2008

Borgatti SP, Everett MG, Freeman LC (2002) UCINET for windows: software for social network analysis

Chang Y-J, Chang Y-S, Hsu S-Y, Chen C-H (2007) Social network analysis to blog-based online community. In: Paper presented at the International Conference on Convergence Information Technology, Gyeongju-si, Gyeongbuk, Korea

Cohen J (1960) A coefficient of agreement for nominal scales. Educ Psychol Meas 20:37–46

Cross R, Borgatti SP, Parker A (2002) Making invisible work visible: using social network analysis to support strategic collaboration. Calif Manag Rev 44(2):25–46

Dekker D, Krackhardt D, Snijders T (2003) Multicollinearity robust QAP for multiple-regression. http://www.casos.cs.cmu.edu/publications/papers/dekker_2003_multicollinearity.pdf. Last retrieved 5 Sept 2008

Ducheneaut N, Moore RJ, Nickell E (2004) Designing for sociability in massively multiplayer games: an examination of the “third places” of SWG. In: Other players conference

Ducheneaut N, Yee N, Nickell E, Moore RJ (2006) Games and performances: “alone together?” Exploring the social dynamics of massively multiplayer online games. In: Paper presented at the SIGCHI conference on human factors in computing systems CHI ’06, Canada

Ducheneaut N, Yee N, Nickell E, Moore RJ (2007) The life and death of online gaming communities: a look at guilds in World of Warcraft. In: Conference proceedings on human factors in computing systems (CHI 2007), pp 839–848

Fazeen M, Dantu R, Guturu P (2011) Identification of leaders, lurkers, associates and spammers in a social network: context-dependent and context-independent approaches. Soc Netw Anal Min 1

Fleiss JL (1981) Statistical methods for rates and proportions, 2nd edn. Wiley, New York

Freeman SC (1979) Centrality in networks: I conceptual clarification. Soc Netw 1:215–239

Igarashi T, Robins G, Pattison P (2006) Longitudinal changes in friendship networks: approach from exponential random graph models. In: Paper presented at the NetSci2006, Bloomington, IN, USA

Kelly RV (2004) Massively multiplayer online role-playing games: the people, the addiction and the playing experience. McFarland & Company, USA

Koehly L, Wasserman S (1996) Classification of actors in a social network based on stochastic centrality and prestige. J Quant Anthropol 6:75–99

Koku EF, Wellman B (2002) Scholarly networks as learning communities: the case of Technet. In: Barab S, Kling R (eds) Designing virtual communities in the service of learning. Cambridge University Press, Cambridge

Kolo C, Baur T (2004) Living a virtual life: social dynamics of online gaming. Int J Comput Game Res 4(1)

Krippendorff K (1980) Content analysis: an introduction to its methodology. Sage Publications, Newbury Park

Laghos A, Zaphiris P (2005) Frameworks for analyzing computer-mediated-communication in e-learning. In: Paper presented at the 11th international conference on human–computer interaction (HCI-International), Las Vegas, USA

Lee BA, Campbell KE (1999) Neighbor networks of black and white Americans. In: Wellman B (ed) Networks in the global village. Westview Press, Boulder

McDonald B, Stuckey B, Noakes N, Nyrop S (2005) Breaking down learner isolation: how social network analysis informs design and facilitation for online learning. In: Paper presented at the AERA, Montreal

Negoescu R (2007) An analysis of the social network of Flickr. http://lanoswww.epfl.ch/studinfo/courses/Dynamical_Networks/Miniprojects_07/Radu_Negoescu/REP_DynamicalNetworkFlickr%5B1%5D.pdf. Last retrieved 5 Sept 2008

Nooy WD, Mrvar A, Batagelj V (2005) Exploratory social network analysis with pajek. Cambridge University Press, Cambridge

Robins G, Snijders T, Wang P, Handcock M, Pattison P (2007) Recent developments in exponential random graph (p*) models for social networks. Soc Netw 29:192–215

Rodrigues L, Mustaro P (2007) Social network analysis of virtual communities in online games. In: IADIS international conference e-society 2007

Rovai A (2002) Building sense of community at a distance. Int Rev Res Open Distance Learn 3(1)

Shi L, Huang W (2004) Apply social network analysis and data mining to dynamic task synthesis for persistent MMORPG virtual world. In: Entertainment computing—ICEC 2004, vol 3166/2004, pp 151–166

Snijders TAB, Pattison P, Robins GL, Handock M (2005) New specifications for exponential random graph models. Sociol Methodol 36(1):99–153

Squire K (2002) Cultural framing of computer/video games. Int J Comput Game Res 2(1)

Steglich C, Snijders TAB, West P (2006) Applying siena an illustrative analysis of the coevolution of adolescents' friendship networks, taste in music, and alcohol consumption. Methodology 2(1):48–56

Steinkuehler CA (2004) A discourse analysis of MMOG talk. In: Paper presented at the proceedings of the other players conference, IT University of Copenhagen, Copenhagen

Stokman F, Duijin MV, Snijders T (2004) Stocnet: an open software system for the advanced statistical analysis of social networks

Szella M, Thurnera S (2010) Measuring social dynamics in a massive multiplayer online game. Soc Netw 32:313–329

Wasserman S, Faust K (1994) Social network analysis: methods and applications. Cambridge University Press, Cambridge

White HC, Boorman SA, Breiger RL (1976) Social structure from multiple networks I: blockmodels of roles and positions. Am J Sociol 81:730–780

White HD, Wellman B, Nazer N (2004) Does citation reflect social structure? Longitudinal evidence from the "Globenet" interdisciplinary research group. J Am Soc Inform Sci Technol 55(2):111–126

Williams D, Ducheneaut N, Xiong L, Zhang Y, Yee N, Nickell E (2006) From tree house to barracks: the social life of guilds in World of Warcraft. Games Culture 1(4):338–361

Yee N (2005) The psychology of MMOGs: emotional investment, motivations, relationship formation, and problematic usage. In: Schroeder R, Axelsson A (eds) Avatars at work and play: collaboration and interaction in shared virtual environments. Springer, London

Zaphiris P, Sarwar R (2006) Trends, similarities and differences in the usage of teen and senior public online newsgroups. Trans Comput Hum Interact 13(3):403–422