Mental Health and Social Inc

Social support, depressive symptoms, and online gaming network communication

Journal:	*Mental Health and Social Inclusion*
Manuscript ID	MHSI-11-2019-0033
Manuscript Type:	Primary Research Paper
Keywords:	social network analysis, online gaming, help seeking, social support, depressive symptoms

Social support, depressive symptoms, and online gaming network communication

Purpose: The increase of videogame use has raised concerns regarding mental health of gamers (e.g., social isolation, depression); however, online gaming may offer the benefit of social connectivity. Many games provide ways for people to meet and interact, providing social opportunities difficult to come by for some young adults. One way to investigate social connection is through social network analysis, which explores the influence of connections on behaviors. This study aims to analyze factors related to social connections within an online gaming community, with an emphasis on the influence of social support and depressive symptoms on network ties.

Methodology: All members of an online gaming site were asked to report demographics, site use, depressive symptoms, "in-real-life" (IRL) social support, and online social support. Members were also asked to nominate those in their gaming network with whom they spoke to about important life matters. Moran's I determined the spatial autocorrelation of depressive symptoms and IRL support within the network. Exponential random graph modeling determined factors significantly associated with tie presence between members.

Findings: Members (n=37) were significantly more likely to speak to other members about important life matters if they reported more site hours, more depressive symptoms, and less IRL support. Depressive symptoms and IRL support were not significantly spatially autocorrelated within this network.

Value: Results suggest members may be filling an IRL social support deficit with friends they have met online. Additionally, members who reported more depressive symptoms may be seeking help from informal online connections through online gaming.

Keywords: social network analysis, help seeking, social support, depressive symptoms

Introduction

According to an industry report from the Entertainment Software Association (2019), over 65% of Americans play some form of video game daily (Entertainment Software Association, 2019). The same report stated the video game industry accounted for a reported $43.4 billion in 2018 (Entertainment Software Association, 2019). The rise in popularity of online gaming has been met with many concerns over its potential negative health effects, including risk for isolation (Orleans and Laney, 2000), addiction (Grüsser et al., 2006), increased aggressive behavior (Grüsser et al., 2006), increased risk for depressive symptoms (Wei et al., 2012), and reduced real life social involvement (Kraut et al., 1998). Overall, greater internet usage has also been associated with increased risk for depressive symptoms and anxiety (Bernardi and Pallanti, 2009, Christakis et al., 2011). Meanwhile, increased video game use has been associated with higher BMI and lower physical activity among undergraduate males (Ballard et al., 2009).

Despite these preliminary concerns, a growing body of literature supports these games, identifying cognitive, emotional, and social benefits to game participation (Granic et al., 2014). Uttal et al. (2013) found that cognitive improvements to spatial skills resulting from playing video games may be comparable to improvements from formal courses on spatial reasoning and skills. Video game use is also associated with improved creativity in children (Jackson et al., 2012). Additionally, casual video game use (defined as 30 minutes three times per week), was linked to a reduction in depressive symptoms in a sample of adults with clinical depression (Russoniello et al., 2013). Players have reported playing games as a form of relaxation and enjoyment (Olson, 2010, Reinecke, 2009), as well as turning to these games as an outlet or a coping mechanism for real life stress or conflict (Olson, 2010, Reinecke, 2009).

While there has been concern related to social isolation due to excessive gaming (Orleans and Laney, 2000), some games provide the opportunity for social connectivity through cooperative play and chat functions. An industry report indicated 63% of adult gamers reported gaming with others through online and local gameplay (Entertainment Software Association, 2019). Further, respondents indicated they played with others online and in person for an average of 4.8 hours and 3.5 hours per week, respectively (Entertainment Software Association, 2019). In addition to cooperative play, many games also provide a chat function for players to extend real life relationships and make new online friendships (Trepte et al., 2012). These games can be a comfort zone and form a vital “third place”(place outside work and home where an individual feels comfortable) for individuals to connect and share with others (Steinkuehler and Williams, 2006). In one study, coping through gaming was important for those who reported less “real life” social support (Reinecke, 2009). Similarly, a longitudinal study on psychosocial causes and consequences of gaming concluded young adults may use online games to compensate for pre-existing in-person social difficulties (Kowert et al., 2015).

One way to investigate social connections present online is through social network analysis (SNA). SNA is a set of theories and methods which allow researchers to investigate connections between individuals and analyze the social structure of groups (Borgatti et al., 2018). In sociocentric, or whole network studies, the researcher must determine a group with a defined boundary and subsequently survey connections within the group (Borgatti et al., 2018). In this case, participants only report their connections to members of a specified network, creating a census of connections present within the bounded group. Thus, the data includes attributes of all network members, as well as the larger structure by which the members have organized themselves (Borgatti et al., 2018). Additionally, sociocentric data collection and analysis allows the investigation of individual, group, and network level measures that would not be possible in other designs (Borgatti et al., 2018). SNA has been used to analyze many health concerns such as body dissatisfaction among sorority members (Prochnow et al., 2019), physical activity in children (Salway et al., 2018), and spread of infectious diseases (Verdery et al., 2017).

Network theory suggests social relationships and position within networks are important sources of social capital for individuals, serving as a mechanism for health and quality of life (Perry and Pescosolido, 2015). Studies have also shown the negative impacts of social isolation, including risk of depression and suicide (Cacioppo et al., 2010). Based on literature suggesting the possible positive impacts of online relationship building within gaming environments, particularly for those who experience greater social isolation in real life, it is important to understand factors related to the formation of social ties online. Thus, this study aims to use SNA to investigate the social structure of an online gaming site. More specifically, we will examine how factors such as social support and depressive symptoms influence the odds of whether members choose to connect with other gamers in their network, and how those factors are distributed across the online gaming network.

Methods

This study uses a specific online gaming website as a bounded network, with a clear member list, in order to perform sociocentric network analysis. The site is a football simulation game in which members take on the role of managing a team and compete with other members in football games. Members can communicate on site via forums, a chat function, and direct messaging. At the time of the study, the site had 101 active members, defined by the site as having logged in at least once in the previous two weeks. All active members over the age of 18 were invited to participate in an online survey by a posting in the main forum. All study procedures were approved by the Institutional Review Board prior to the start of the study.

Measures

Members were asked to report on various demographics such as age, sex, race, ethnicity, employment, and marital status. They were also asked how many hours they spent per week on the site, as well as how many hours they spent playing other video games per week.

Depressive Symptoms

Depressive symptoms were measured using the 9-item Patient Health Questionnaire (PHQ-9)(Kroenke et al., 2001). Members were asked to rate how often they had been bothered with certain problems over the last two weeks, including having little interest or pleasure in doing things, feeling tired or having little energy, and feeling down, depressed, or hopeless. The scale provides response options of “not at all”, “several days”, “more than half the days”, and “nearly every day” which are scored from 0 to 3 respectively. Responses are summed to create a total scale score ranging from 0 to 27. This scale has been previously validated and has excellent internal and test-retest reliability (Kroenke et al., 2001). This scale exhibited good internal reliability within our sample (α=0.87).

Appraisal Social Support

Appraisal social support, or a perceived availability to talk to someone about one's problems, was measured by adapting a subscale of the Interpersonal Support Evaluation List (ISEL-12) (Cohen et al., 1985). The original scale included belonging and tangible subscales as well. In order to normalize the scale across online and "in-real-life" connections, the appraisal subscale was used to denote social support from having someone to speak to about life issues. For this study, participants were asked to think of people in their life ("in-real-life") and then think of only people with whom they speak to on the site, and then were asked three questions based on the support they felt from each group separately (e.g., "I feel that there is someone I can share my most private worries and fears with"; "There is someone I can turn to for advice about handling problems with my family"). Participants were asked if they strongly disagree, disagree, agree, or strongly agree with each statement scored 1 to 4. Scores for online and "in-real-life" items were averaged separately to generate scale scores for each setting. In our sample both online and "in-real-life" scales displayed fair to good internal reliability (α=0.85, 0.74 respectively).

Social network data

Members were given a list of all active members on the site and asked to select any and all members with whom they had spoken to about important life matters. Members could select as many other members (alters) as they would like by checking a box for each person. Direction of connection was maintained in order to determine parameters for sending and receiving network ties separately (i.e. Member A speaks to Member B is represented differently than Member B speaking to Member A). Additionally, members were also asked to report up to five individuals they spoke to about important life matters "in-real-life."

Data Analysis

Summary statistics including mean, standard deviation, and frequencies were calculated for member demographics and network measures. Calculation of means, standard deviations, and T-tests were conducted using SPSS v. 25 (IBM, 2018). A spatial auto-correlation model was used to generate Moran's I to understand the dispersion of depressive symptoms across the network (Ord, 1975, Moran, 1950). This statistic determines whether depressive symptom scores were significantly clustered within the network. Moran's I was calculated using the ape package in R Studio (Paradis and Schliep, 2018). Exponential random graph modeling (ERGM) was used to determine attributes associated with the presence of within-network social connections (members speaking to other members about important life matters) and network structure (Lusher et al., 2013). ERGM was performed using the ergm and statnet packages in R Studio (Hunter et al., 2008).

Results

Sample Characteristics

Members who responded to the survey (n=37; 37% of total active membership) were on average 24.76 years old (SD=6.55). Respondents all identified as male and 89.2% identified as White. Members reported they spent, on average, 12.57 hours (SD=8.60) on the site per week. In this sample the average PHQ score was 6.92 (SD=5.86). When asked to nominate other members with whom they spoke to about important life matters, members reported an average of 6.11 (SD=5.74) other network members. When asked to list “in-real-life” connections with whom they speak to about important life matters, members listed on average 4.38 people (SD=1.11). Members reported significantly more support from their “in-real-life” network (M=3.49; SD=0.57), when compared to the support they reported from their online network (M=2.81; SD=0.84; $t(36)=4.53$, $p<.001$). See Table 1 for complete sample characteristics.

[Insert Table 1 Here]

Network Spatial Autocorrelation

The Moran’s I calculated in this sample suggested no significant network spatial autocorrelation in how depressive symptom scores were distributed across the network (I=-0.03, p=0.98). This was also the case with online (I=-.013, p=0.51) and “in-real-life” support (I=0.01, p=0.79).

Exponential Random Graph Modeling

Exponential random graph modeling (ERGM) was used to determine factors which may influence members to talk to other members online regarding important life matters. Table 2 contains parameters included in the ERGM as well as the related estimates and standard errors. Interpretations are given next to these statistics for clarity.

[Insert Table 2 here]

Discussion

This study aimed to understand the social structure of an online gaming site, as well as how appraisal social support and depressive symptoms impact the presence of speaking to other members about important life matters. Depressive symptoms were not significantly spatially correlated within this network. This means members reporting similar depressive scores were not clustered together in a significant way. One might hypothesize individuals with more depressive symptoms may cluster together based on homophily (Rosenblatt and Greenberg, 1991), or connecting to another person based on a similarity (McPherson et al., 2001). However, this was not the case within this sample. Previous research has suggested "misery does not love company" as individuals with depression may withdraw from their network and not form ties altogether (Schaefer et al., 2011).

Members in this sample exhibited a significant propensity to reciprocate communication ties (i.e., If Member A reported connecting with Member B, then Member B would most likely report connecting with Member A). In addition, communication ties were significantly more likely to be present in transitive groupings (i.e., If Member A reported a connection with Member B, and Member B reported a connection to Member C, then Member A would most likely connect with Member C). These reciprocal and transitive communication patterns are common in both online and offline social networks (Filiposka et al., 2017). Keijzer and colleagues hypothesized the importance of transitivity in online social networks by showing an increase in isolation and discontinuity in culture change when there is a lack of transitive relationships among network members (Keijzer et al., 2018). Members of a network without transitive relationships may not receive vital feedback from the network on culture change and appropriate behavior, which can lead to isolation (Keijzer et al., 2018). Reciprocal relationships are also noted to provide more social support and be more effective at buffering negative effects of stress (Lu, 1997). Further, reciprocated relationships are associated to reduced depressive symptoms among middle-aged men (Takizawa et al., 2006). This connection to reduction in depressive symptoms is vital as online gaming connections showed a propensity for reciprocity.

Members of this site were more likely to report speaking to other members if they also reported spending more time on the site. This is unsurprising, as members who spend more time on the site would have more time to talk to and get to know other members. Since these results are only associative and not causal, it could be that those speaking to more people on this site results in spending more time on the site. While we did not specifically aim to measure gaming addiction or internet addiction, individuals who spend more hours online and more hours gaming have a higher risk of addiction and dependency, which has been linked to an increased risk of depression (Banjanin et al., 2015, McDougall et al., 2016). Thus, while increased social connection might be a positive aspect of an online gaming community, it might also encourage increased use that could lead to problematic outcomes such as addiction and dependency.

In our sample, members who felt less “in-real-life” support were significantly more likely to report speaking to other site members. We hypothesize individuals who feel a lack of support from their “in-real-life” social circles may be looking to supplement the deficit with their online network. This result was echoed in a recent study among college students where social media served as an important source of support for students who reported less in-person support (Cole et al., 2017). Students in this study viewed online support and in-person support as non-overlapping forms of support that each had unique value (Cole et al., 2017).

Lastly, members of this site were more likely to report speaking to others online about important life matters if they also reported more depressive symptoms. This can be seen visually in Figure 1, as the larger nodes (sized based on PHQ-9 score) tend to have more ties compared to smaller nodes. The increased propensity of online connections is in direct opposition to literature suggesting social isolation and loneliness as predecessors and consequences of depression (Cacioppo et al., 2010). This may mean that individuals with more depressive symptoms felt more comfortable reaching out to others online about life matters. In a study on specific subsets of depressed individuals, participants with suicidal thoughts were less likely than participants without suicidal thoughts to seek help from all sources except for online forums (Harris et al., 2014). In another study, seeking help from informal online sources such as anonymous forums were shown to be an important source of support for those with depression and improved psychosocial wellbeing (Heerde and Hemphill, 2018). Therefore, the online gaming community could be a safe environment for people to cope and connect that might not be afforded to them within their "real life" social circles. Future research should measure whether online social connection developed through gaming sites decreases depression over time.

[Insert Figure 1 here]

Limitations

Because this study is cross sectional, results are limited to associative interpretations. Researchers may wish to utilize a longitudinal study design in future projects to track how network structure may change in respect to depressive symptoms and feelings of support. Further, the wide array of depressive symptoms combined in the PHQ-9 scale may also complicate the autocorrelation results. Some researchers are now advocating analysis of mental health at the symptom level, instead of using a combined, self-report score (Fried and Nesse, 2015).

The sample size and demographics are a clear limitation to the generalizability of the study. This study provides a pilot and preliminary approach to analyzing online social connections generated through online gaming. As with many network studies, generalizability to other networks should be cautioned, as the analysis is specific to the network specified here (Borgatti et al., 2018). As such, researchers may wish to replicate this study using other online game genres (e.g. role-playing game, first-person shooter) and platforms (e.g. mobile, web based, console), as each game has unique social components affecting the difficulty and impact of socialization. One assumption to consider when developing a whole network study is every member should have the possibility to come in contact or create a tie with any other member (Borgatti et al., 2018), which may not be the case in certain larger systems with multiple divided servers. In this case, researchers may need to replicate this study multiple times in each server and then using a controlling variable or parameter for the different segments.

Finally, only 37% of the whole network participated in data collection. Missing data is a notorious issue for sociocentric network designs (de la Haye et al., 2017), and the absence of important connections could change the structure of the entire network (Costenbader and

Valente, 2003). There is no way to know if there were systematic similarities across those missing or if they were missing at random, and the potential influence those people have on the entire network is unknown. Future research using sociocentric designs should consider strategies to improve response rate (e.g., follow-up invitations for participation, incentives) whenever feasible.

Implications

Given these limitations, this study did benefit from using sociocentric network analysis procedures, which revealed important network and health-related factors related to the creation of social ties within the online gaming site. This pilot study supports taking a similar approach to study other online gaming networks. This article adds to the literature surrounding online gaming structure and communication specifically from the lens of depressive symptoms and “in-real-life” support. The novel use of ERGMs and spatial analysis within a gaming community has not been reported on before, to our knowledge. Further research may wish to build on these findings to examine dynamics within other online and/or gaming networks.

This study offered a glimpse into the social networks of online gamers, and how those who report depressive symptoms were more likely to connect with other gamers. While future studies are needed to confirm this relationship, this information could be useful for future mental health efforts. Using online forums related to gaming as a means to connect people, especially young people, might help reduce social isolation. Further, services such as telehealth could be an effective clinical alternative for people experiencing depression that might prefer an online connection versus a real-life connection. While the online gaming community could provide otherwise isolated people a place to network and connect, it is also important to note that in-person support was still more important than online support. Creating mechanisms for gamers to meet in person might be a useful approach to bridging online and in-person support.

Conclusions

While members of an online gaming site did not significantly cluster based on depressive symptoms, there were many parameters that significantly impacted the social structure of the site, including less "in real life" support and greater depression scores. Understanding the complex nature of online gaming socialization may help bridge the gap between the negative side effects originally attributed to gaming and the positive aspects of enjoyment and connection that can be possible through the online gaming experience.

References

BALLARD, M., GRAY, M., REILLY, J. & NOGGLE, M. 2009. Correlates of video game screen time among males: Body mass, physical activity, and other media use. *Eating Behaviors,* 10**,** 161-167.

BANJANIN, N., BANJANIN, N., DIMITRIJEVIC, I. & PANTIC, I. 2015. Relationship between internet use and depression: Focus on physiological mood oscillations, social networking and online addictive behavior. *Computers in Human Behavior,* 43**,** 308-312.

BERNARDI, S. & PALLANTI, S. 2009. Internet addiction: a descriptive clinical study focusing on comorbidities and dissociative symptoms. *Comprehensive Psychiatry,* 50**,** 510-516.

BORGATTI, EVERETT, M. G. & JOHNSON, J. C. 2018. Analyzing social networks. 2nd edition. ed. Los Angeles: SAGE.

CACIOPPO, J. T., HAWKLEY, L. C. & THISTED, R. A. 2010. Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the Chicago Health, Aging, and Social Relations Study. US: American Psychological Association.

CHRISTAKIS, D. A., MORENO, M. M., JELENCHICK, L., MYAING, M. T. & ZHOU, C. 2011. Problematic internet usage in US college students: a pilot study. *BMC Medicine,* 9**,** 77.

COHEN, S., MERMELSTEIN, R., KAMARCK, T., HOBERMAN, H., SARASON, I. & SARASON, B. 1985. Social support: Theory, research and applications. *Measuring the functional components of social support***,** 73-94.

COLE, D. A., NICK, E. A., ZELKOWITZ, R. L., ROEDER, K. M. & SPINELLI, T. 2017. Online social support for young people: Does it recapitulate in-person social support; can it help? *Computers in Human Behavior,* 68**,** 456-464.

COSTENBADER, E. & VALENTE, T. W. 2003. The stability of centrality measures when networks are sampled. *Social networks,* 25**,** 283-307.

DE LA HAYE, K., EMBREE, J., PUNKAY, M., ESPELAGE, D. L., TUCKER, J. S. & GREEN JR, H. D. 2017. Analytic strategies for longitudinal networks with missing data. *Social networks,* 50**,** 17-25.

ENTERTAINMENT SOFTWARE ASSOCIATION. 2019. 2019 Essential Facts About the Computer and Video Game Industry. Available: https://www.theesa.com/wp-content/uploads/2019/05/2019-Essential-Facts-About-the-Computer-and-Video-Game-Industry.pdf [Accessed 8/27/2019].

FILIPOSKA, S., GAJDUK, A., DIMITROVA, T. & KOCAREV, L. 2017. Bridging online and offline social networks: Multiplex analysis. *Physica A: Statistical Mechanics and its Applications,* 471**,** 825-836.

FRIED, E. I. & NESSE, R. M. 2015. Depression sum-scores don't add up: why analyzing specific depression symptoms is essential. *BMC Medicine,* 13**,** 72.

GRANIC, I., LOBEL, A. & ENGELS, R. C. 2014. The benefits of playing video games. *American psychologist,* 69**,** 66.

GRÜSSER, S. M., THALEMANN, R. & GRIFFITHS, M. D. 2006. Excessive computer game playing: evidence for addiction and aggression? *CyberPsychology & Behavior,* 10**,** 290-292.

HARRIS, K. M., MCLEAN, J. P. & SHEFFIELD, J. 2014. Suicidal and online: How do online behaviors inform us of this high-risk population? *Death studies,* 38**,** 387-394.

HEERDE, J. A. & HEMPHILL, S. A. 2018. Examination of associations between informal help-seeking behavior, social support, and adolescent psychosocial outcomes: A meta-analysis. *Developmental Review,* 47**,** 44-62.

HUNTER, D. R., HANDCOCK, M. S., BUTTS, C. T., GOODREAU, S. M. & MORRIS, M. 2008. ergm: A Package to Fit, Simulate and Diagnose Exponential-Family Models for Networks. *2008,* 24**,** 29.

IBM 2018. IBM SPSS Statistics for Windows Version 25. Armonk, NY: IBM Corp.

JACKSON, L. A., WITT, E. A., GAMES, A. I., FITZGERALD, H. E., VON EYE, A. & ZHAO, Y. 2012. Information technology use and creativity: Findings from the Children and Technology Project. *Computers in Human Behavior,* 28**,** 370-376.

KEIJZER, M. A., MAS, M. & FLACHE, A. 2018. Communication in Online Social Networks Fosters Cultural Isolation. *Complexity,* 2018**,** 18.

KOWERT, R., VOGELGESANG, J., FESTL, R. & QUANDT, T. 2015. Psychosocial causes and consequences of online video game play. *Computers in Human Behavior,* 45**,** 51-58.

KRAUT, R., PATTERSON, M., LUNDMARK, V., KIESLER, S., MUKOPHADHYAY, T. & SCHERLIS, W. 1998. Internet paradox: A social technology that reduces social involvement and psychological well-being? US: American Psychological Association.

KROENKE, K., SPITZER, R. L. & WILLIAMS, J. B. W. 2001. The PHQ-9. *Journal of General Internal Medicine,* 16**,** 606-613.

LU, L. 1997. Social Support, Reciprocity, and Weil-Being. *The Journal of Social Psychology,* 137**,** 618-628.

LUSHER, D., KOSKINEN, J. & ROBINS, G. 2013. *Exponential random graph models for social networks: Theory, methods, and applications*, Cambridge University Press.

MCDOUGALL, M. A., WALSH, M., WATTIER, K., KNIGGE, R., MILLER, L., STEVERMER, M. & FOGAS, B. S. 2016. The effect of social networking sites on the relationship between perceived social support and depression. *Psychiatry Research,* 246**,** 223-229.

MCPHERSON, M., SMITH-LOVIN, L. & COOK, J. M. 2001. Birds of a Feather: Homophily in Social Networks. *Annual Review of Sociology,* 27**,** 415-444.

MORAN, P. A. 1950. Notes on continuous stochastic phenomena. *Biometrika,* 37**,** 17-23.

OLSON, C. K. 2010. Children's motivations for video game play in the context of normal development. *Review of General Psychology,* 14**,** 180-187.

ORD, K. 1975. Estimation methods for models of spatial interaction. *Journal of the American Statistical Association,* 70**,** 120-126.

ORLEANS, M. & LANEY, M. C. 2000. Children's computer use in the home: Isolation or sociation? *Social Science Computer Review,* 18**,** 56-72.

PARADIS, E. & SCHLIEP, K. 2018. ape 5.0: an environment for modern phylogenetics and evolutionary analyses in R. *Bioinformatics,* 35**,** 526-528.

PERRY, B. L. & PESCOSOLIDO, B. A. 2015. Social network activation: the role of health discussion partners in recovery from mental illness. *Social science & medicine (1982),* 125**,** 116-128.

PROCHNOW, T., PATTERSON, M. S. & UMSTATTD MEYER, M. R. 2019. A social network approach to analyzing body dissatisfaction among sorority members using two network generators. *Journal of American College Health***,** 1-9.

REINECKE, L. 2009. Games and recovery: The use of video and computer games to recuperate from stress and strain. *Journal of Media Psychology,* 21**,** 126-142.

ROSENBLATT, A. & GREENBERG, J. 1991. Examining the world of the depressed: Do depressed people prefer others who are depressed? *Journal of Personality and Social Psychology,* 60**,** 620.

RUSSONIELLO, C. V., FISH, M. & O'BRIEN, K. 2013. The Efficacy of Casual Videogame Play in Reducing Clinical Depression: A Randomized Controlled Study. *Games Health J,* 2**,** 341-6.

SALWAY, R. E., SEBIRE, S. J., SOLOMON-MOORE, E., THOMPSON, J. L. & JAGO, R. 2018. Associations within school-based same-sex friendship networks of children's physical activity and sedentary behaviours: a cross-sectional social network analysis. *International Journal of Behavioral Nutrition and Physical Activity,* 15**,** 18.

SCHAEFER, D. R., KORNIENKO, O. & FOX, A. M. 2011. Misery Does Not Love Company: Network Selection Mechanisms and Depression Homophily. *American Sociological Review,* 76**,** 764-785.

STEINKUEHLER, C. A. & WILLIAMS, D. 2006. Where Everybody Knows Your (Screen) Name: Online Games as "Third Places". *Journal of Computer-Mediated Communication,* 11**,** 885-909.

TAKIZAWA, T., KONDO, T., SAKIHARA, S., ARIIZUMI, M., WATANABE, N. & OYAMA, H. 2006. Stress buffering effects of social support on depressive symptoms in middle age: Reciprocity and community mental health. *Psychiatry and Clinical Neurosciences,* 60**,** 652-661.

TREPTE, S., REINECKE, L. & JUECHEMS, K. 2012. The social side of gaming: How playing online computer games creates online and offline social support. *Computers in Human Behavior,* 28**,** 832-839.

UTTAL, D. H., MEADOW, N. G., TIPTON, E., HAND, L. L., ALDEN, A. R., WARREN, C. & NEWCOMBE, N. S. 2013. The malleability of spatial skills: a meta-analysis of training studies. *Psychol Bull,* 139**,** 352-402.

VERDERY, A. M., SIRIPONG, N. & PENCE, B. W. 2017. Social Network Clustering and the Spread of HIV/AIDS Among Persons Who Inject Drugs in 2 Cities in the Philippines. *Journal of acquired immune deficiency syndromes (1999),* 76**,** 26-32.

WEI, H.-T., CHEN, M.-H., HUANG, P.-C. & BAI, Y.-M. 2012. The association between online gaming, social phobia, and depression: an internet survey. *BMC Psychiatry,* 12**,** 92.

Table 1: Sample characteristics				
	N	%	Mean	SD
Race				
White	33	89.2%		
Black	2	5.4%		
Asian	2	5.4%		
Ethnicity				
Hispanic	3	8.1%		
Non-Hispanic	34	91.9%		
Education				
High School / GED	13	35.1%		
Some College	3	8.1%		
Bachelor’s Degree	17	45.9%		
Graduate Degree	4	10.8%		
Employment				
Employed	24	64.9%		
Student	13	35.1%		
Marital Status				
Single	30	81.1%		
Married	7	18.9%		
Age			24.76	6.55
Site Hours			12.57	8.60
Other Online Gaming Hours			12.05	9.55
PHQ-9			6.92	5.86
“In-real-life” Support			3.49	0.57
“In-real-life” Connections			4.38	1.11
Online Support			2.81	0.84
Online Connections			6.11	5.74

165x177mm (96 x 96 DPI)

Table 2: Model parameter estimates and standard errors for predicting the odds of members forming connections online.

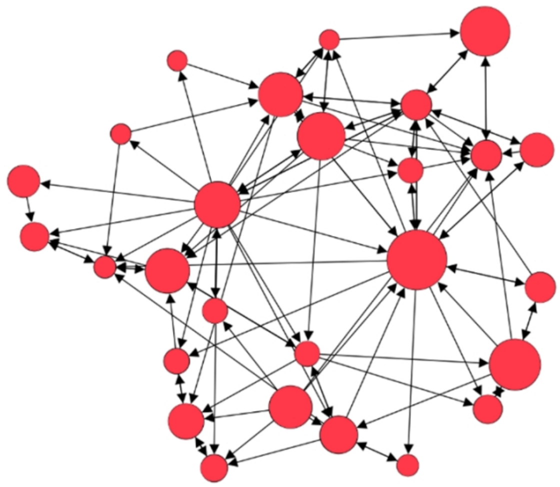
Parameter	Estimate	SE	Interpretation
Edges	-4.38*	0.93	Social connections were statistically sparse in this network and occur less often than at random.
Reciprocity	2.22*	0.37	Social connections were significantly more likely to be reciprocated in this network
Transitivity [x]	0.42*	0.13	Social connections in this network were significantly more likely to occur between members who also speak to a common third person (e.g., having a friend in common).
Demographics			
Marital Status	0.04	0.19	Marital status did not significantly impact the odds of a tie being present between two members.
Age	0.01	0.01	Age did not significantly impact the odds of a tie being present between two members.
Covariates of Sending Ties			
Site Hours	0.03*	0.01	Members were significantly more likely to report speaking to other members about important matters if they spent more time on the site.
PHQ	0.08*	0.02	Members were significantly more likely to report speaking to other members about important matters if they reported more depressive symptoms.
"In-real-life" Support	-0.68*	0.24	Members were significantly more likely to report speaking to other members about important matter if they reported less support "in-real-life".

[x] Transitivity was modeled using geometrically weighted edgewise shared partner distribution with a decay of 0.4

* Parameter estimate is greater than two times the standard error which indicates a significant effect

169x139mm (96 x 96 DPI)

Figure 1: Sociogram of site members and connections between them. Nodes are sized according to PHQ-9 scores (larger size = more depressive sympton



338x190mm (96 x 96 DPI)