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Social capital, coplaying patterns, and health disruptions: A survey of Massively Multiplayer Online Game participants in China

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ABSTRACT

We examined the relationship between social capital, coplaying patterns and health disruptions in a large sample of gamers in a popular Chinese Massively Multiplayer Online Game, Chevaliers' Romance 3. Partnering with the game operator, we fielded an online survey (N = 18813) in 2011. Social capital was measured by (1) psychometric measures of bridging and bonding social capital, and (2) core discussion network size using name generators, as well as the number of strong and weak ties within the core network. Controlling for sociodemographic variables, we found that bonding social capital was associated with lower odds of frequent or occasional health disruptions, but bridging social capital did not have any effect. Weak ties in the core network were associated with greater odds of health disruptions. Coplaying patterns also mattered – people playing with friends first met through CR3 were less likely to have health disruptions, while playing with existing friends and families tended to have the opposite effect.

Overall, social capital and coplaying patterns appear to have significant health implications for participants in online games.

1. Introduction

An increasingly significant portion of people's lives are spent in front of screens. Research in the past few decades has made strides in linking media use, especially Internet use, to various health outcomes (Caplan, 2003; Kraut et al., 1998; Nabi, Prestin, & So, 2013; Stepanikova, Nie, & He, 2010). Essential to the question is how specific online media/activities might differ in affecting health and wellbeing (Shen & Williams, 2011). One particular activity, online gaming, has seen explosive growth over the past decade, yet its effect on health and wellbeing remains murky. According to the Entertainment Software Association, a staggering 59% of all Americans play digital games, and they have been playing for 14 years on average (ESA, 2014). European and Asian countries are also similar hotbeds for gaming consumption and development. The extent to which online gaming activities are influencing people's physical and mental health poses a pressing yet under studied question.

This study focuses on a specific genre of online games with growing popularity: Massively Multiplayer Online Games (MMOs). MMOs are two- or three-dimensional persistent online spaces where participants could complete quests, coordinate joint actions, and advance their character, called "avatars" (Castronova, 2005; Ducheneaut, Yee, Nickell, & Moore, 2006; Williams, Yee, & Caplan, 2008). More important, all these activities can be, and sometimes must be, accomplished through social interactions with other players. The capability of building social relationships, transient or long-lasting, fundamentally distinguishes MMOs from other games where interacting with non-player characters (NPCs) rather than other player had been the norm. Because of MMOs' social nature, investigating their psychosocial and health outcomes could also contribute to the larger conversation on the effects of Internet and social media in general.

This study makes a unique contribution to the field of online games and health as it represents one of the first projects systematically assessing how social capital and coplaying patterns are associated with health disruptions for players of a large-scale Chinese MMO. Social capital, broadly referring to social structures and the individual and collective benefits associated with them (Burt, 1992; Coleman, 1988; Putnam, 2001), has been linked to various health outcomes, but few studies have tested its effects on health in the context of online games. This study also uses two distinct measures of social capital: (1) individual-level psychometric measures of bridging and bonding social capital, and (2) the

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players' core discussion networks. In addition, it is the first study that examines the health implications of coplaying patterns, a crucial variable measuring players' social experiences in MMOs.

2. Literature review

2.1. Displacement hypotheses

One mechanism through which online gaming may affect health and wellbeing is the time displacement hypothesis. The inelasticity of time, that there are only a fixed number of hours in a day, dictates that participation in a new activity is bound to displace the time originally spent on another (Nie, 2001; Shen & Williams, 2011). As an often sedentary and solitary activity, gaming inevitably displaces the time that would otherwise be spent on physical activities and/or interacting with family and friends. The displacement hypothesis has received early support for Internet use in general (Kraut et al., 1998), and has been used to explain lower participation in sports and higher socioemotional difficulties for game players (Booker, Skew, Kelly, & Sacker, 2014). Time-diary research of adolescents also showed that gamers spent less time doing homework, reading and interacting with family and friends than non-gamer peers (Cummings & Vandewater, 2007).

A corollary of time displacement is social displacement. Numerous empirical studies debunked the stereotype that gamers tend to be isolated couch potatoes (Williams et al., 2008). In fact, online games today are enjoyable precisely because they are designed to engage players with other people—either their existing social ties or new ones (Cole & Griffiths, 2007). However, because one's time and energy on creating and maintaining social relationships are also limited, playing online games naturally takes away time from face-to-face interactions with one's offline ties, resulting in displacement of existing social contacts for online ones. The net effect of social displacement is still inconclusive. Some researchers found evidence for an overall smaller and poorer offline social circle as a result of online gaming (Kowert, Domahidi, Festl, & Quandt, 2014). Negative life consequences, ranging from physical fatigue to depressive tendencies may ensue when MMO players develop a preference for online social interactions over offline exchanges (Liu & Peng, 2009; Stetina, Kothgassner, Lehenbauer, & Kryspin-Exner, 2011). Yet, many others demonstrate that online gaming may result in broader as well as deeper social relationships (Kobayashi, 2010; Trepte, Reinecke, & Juechems, 2012).

2.2. Social capital

A concept critical to understanding the net effect of social displacement is social capital. It also connects individuals' social relationships with health outcomes as an important intermediate variable. Social capital generally refers to people's social relationships and the benefits, trust and reciprocity made available through such relationships (Burt, 1992; Kawachi, Kennedy, & Glass, 1999; Putnam, 2001; Williams, 2006). As Coleman (1988) put it, social capital "... is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors—whether persons or corporate actors—within the structure" (p. S98). As such, social capital subsumes both the social structure and outcomes produced by the structure (Shen, Monge, & Williams, 2014; Williams, 2006). Social capital has become a key concept in studying the effects of emerging media, including social networking sites (Ellison, Steinfield, & Lampe, 2007), online news (Gil de Zúñiga, Jung, & Valenzuela, 2012), and online communities (Ganley & Lampe, 2009; Shen & Cage, 2015).

Based on the types of social structures and the associated outcomes, social capital can be further categorized into bridging social capital and bonding social capital (Putnam, 2001; Williams, 2006). Bridging social capital refers to the type of social structure consisting of weak and episodic ties, which often link people from heterogeneous groups. Bridging social capital provides the focal individual with diverse information and perspectives, but falls short of emotional and social support. By contrast, bonding social capital refers to the type of social structure encompassing primarily strong and long-lasting ties, which often link people in homogeneous social circles. It provides emotional support and solidarity, which could insulate people from the negative consequences of stressful life events (Granovetter, 1983; Putnam, 2001; Williams, 2006).

The health implications of social capital are well-established. Researchers have suggested several mechanisms connecting social capital with individual and community health indicators: (1) social capital facilitates the diffusion of health-related information, (2) social capital promotes the diffusion of pro-health behaviors and deters deviant, unhealthy behaviors, (3) social capital may enlarge access to health resources and amenities, and (4) social capital provides emotional and material support at the time of need, shielding people from exposure to stress and helping them cope with stress better (Beaudoin, 2009; Cohen, Brissette, Skoner, & Doyle, 2000; Cohen & Hoberman, 1983; Kawachi & Berkman, 2000; Thoits, 2010). These mechanisms were supported by empirical data. For example, social capital is found to associate with better wellbeing (Kawachi, Subramanian, & Kim, 2008), lower risk of mortality (Kawachi et al., 1999), and lower susceptibility to infectious diseases such as the common cold (Cohen et al., 2000). In particular, a recent study found that workers in the US and China possessing more social capital tend to have less health disruptions, independent of occupational status and working conditions (McDonald, Chen, & Crowley, 2013).

To date, research on the implications of online gaming has used social capital as a productive conceptual framework. For example, one study found that problematic gamers (those who show signs of compulsive gaming) and non-problematic gamers differ significantly in the social capital they accrue as a result of game use – the former group showed higher online social capital but lower offline social capital, while the latter group showed higher online social capital only (Collins & Freeman, 2013). Another study showed that online gamers' physical proximity, social proximity, and their mutual familiarity all contributed to bridging and bonding social capital, which in turn contributed to offline social support (Trepte et al., 2012). However, the connection between social capital and health indicators in an online game context remains to be examined.

Among the four mechanisms linking social capital and health, the "buffering" mechanism, that social capital buffers against life's inevitable stress and health disruptions, is particularly relevant for MMO gamers. This study contributes to the extant literature by examining social capital and health disruptions in a large Chinese MMO. It operationalizes social capital using a two-pronged approach, covering both the perceived *benefits* of social relationships as well as the *relationships* themselves. First, it uses the validated psychometric scales of bridging and bonding social capital (Williams, 2006). The scales measure the perceived social capital benefits such as emotional and substantive support, trust, and access to heterogeneous information. This operationalization has been widely used in prior studies of emerging media in general (e.g., Ellison et al., 2007) and online games in particular (e.g., Trepte et al., 2012).

Second, this study also operationalizes social capital using the size of one's core discussion network and the number of strong and weak ties within the core network. The core discussion

network refers to the people with whom one discusses important matters (also called name generators), and has been consistently included in the General Social Survey to assess social connectivity in the US (Burt, 1984; McPherson, Smith-Lovin, & Brashears, 2006). Different from bridging and bonding social capital scales, core discussion network indicators reveal the actual social structures within which individuals' are embedded. It is an established measure of social capital, with significant implications on individuals' instrumental and emotional support (Wellman & Wortley, 1990) as well as health and well-being (Song & Chang, 2012). This measure has also been adopted in studies of online gaming (Kowert et al., 2014; Shen & Chen, 2015). Therefore, we ask:

RQ1: How is players' social capital, as measured by bridging and bonding scales as well as by core discussion networks, associated with health disruptions?

2.3. Coplaying patterns

The literature on social capital charts out the qualitative differences of social structure in two broad categories (bridging and bonding), but it does not address the specific relationship type with whom one interacts in MMOs. Yet, studies failing to differentiate coplay partners essentially assume all social interactions in online game worlds have exactly the same psychosocial impact. It is not until recently that game researchers began to consider play partners as a central factor shaping the social gaming experience (Waddell & Peng, 2014). For example, Coyne, Padilla-Walker, Stockdale, and Day (2011) found that girls co-playing with their parents showed less aggressive behaviors, more prosocial behaviors and higher parent–child connectedness. Similarly, a study of the MMO EverQuest II found that players who engage their existing family and friends in the game have better psychosocial wellbeing than those playing with strangers only (Shen & Williams, 2011). There is evidence that people playing with "real life" (RL) friends tend to play more, especially so for women and those playing with their romantic partners (Debeauvais, Nardi, Schiano, Ducheneaut, & Yee, 2011).

However, even though the practice of playing with "RL" friends and family as well as strangers is well documented (Nardi & Harris, 2006; Williams et al., 2006), its effect on health has not been systematically tested. As argued previously, social relationships created and strengthened in online games can insulate individuals from health disruptions resulting from stressful life events. Naturally, we would expect health outcomes to vary according to individuals' coplaying patterns—whether they mingle with complete strangers or existing social contacts should make a difference. Therefore, this study also examined how coplaying patterns may affect health disruptions.

RQ2: How are coplaying patterns associated with players' health disruptions?

In addition to the above, we also controlled for a range of individual-level variables that are commonly associated with health outcomes, including players' gender, age, education, relationship status, household income, and extraversion (Braveman, Egerter, & Williams, 2011; Shen & Williams, 2011).

3. Methods

3.1. Data

The dataset used in this study was part of a large-scale survey examining the attitudes and behaviors of more than 20,000 participants of a popular Chinese MMO, Chevaliers' Romance 3 (CR3) (see Xiong, 2012 for more information on the survey). CR3 is a fantasy-based MMO that has become the second most popular game in China since it launched in 2009, according to China Game Weight Rank (CGWR, 2014). The game mechanics and character class system were similar to mainstream MMOs in the US such as World of Warcraft.

Partnering with the creator of the game, KingSoft, the research team fielded a comprehensive online survey to CR3 participants in late 2011. An announcement was made on the official CR3 website to recruit participants who were 18 and above, offering a virtual weapon desirable for all players as a reward for survey completion. Self-selected respondents were then redirected to the survey website. The survey was active for five weeks after the initial announcement, collecting over 20,000 responses. After removing duplicates, spam and blank responses, the sample used in the current study contained 18,813 responses. All survey questions were translated from English to Chinese, and cross-checked by bilingual researchers.

3.2. Measures

3.2.1. Dependent variable: health disruption

The dependent variable was health disruption in the past 12 months. Following the same measure in previous studies (McDonald et al., 2013), respondent was asked "how often was your daily life disrupted for more than a week due to health related matters?" (1 = frequently, 2 = occasionally, 3 = seldom, and 4 = never). Because this dependent variable was ordinal, we originally conducted ordinal regression analysis to predict health disruptions. Our data failed to support the proportional odds assumption, suggesting that ordinal regression models may produce invalid results (Bender & Grouven, 1998). Therefore, based on this item, we created a dichotomous outcome measure of health disruption (1 = frequently or occasionally, 0 = seldom or never) and used logistic regression models instead.

3.2.2. Independent variable: social capital

We adopted two sets of measures of social capital, psychometric measures and the core network name generators. Bridging social capital ($\alpha = .93$) was measured by a 10-item scale developed and validated by Williams (2006), including items such as "Interacting with people makes me interested in what people unlike me are thinking" and "Interacting with people makes me feel connected to the bigger picture." Bonding social capital ($\alpha = .78$) was also measured by a 10-item scale (Williams, 2006), including items such as "The people I interact with would share their last dollar with me." and "When I feel lonely, there are several people I can talk to." Respondents were asked to rate how much they agree with these statements on a 5-point scale (1 = strongly disagree to 5 = strongly agree).

The second set of measures was based on core discussion network name generators. Following the exact wording of the name generator questions in the General Social Survey (Marsden, 1987; McPherson, Smith-Lovin, & Cook, 2001), we asked "From time to time, most people discuss important matters with other people. Looking back over the last six months, who are the people with whom you discussed matters that are important to you?" Players (ego) were able to nominate up to five confidants (alters). Core network size was measured by counting the total number of confidants. Respondents were also asked how much they feel close to each of the nominated confidants, on a 5-point Likert scale (1 = not close at all to 5 = very close) (Marsden & Campbell, 1984; McPherson et al., 2001). This emotional closeness measure was later transformed into two variables, the number of strong ties in one's core network (the number of alters scoring 4 and higher) and the number of weak ties in one's core network (the number

of alters scoring 3 and lower). Core network size had small but significant correlations with bridging (r = .10) and bonding (r = .15) social capital, and very high correlation with the number of strong ties (r = .77) (see Table 2). Therefore, core network size and strong ties/weak ties were placed in separate models in data analysis.

3.2.3. Independent variable: coplaying patterns

On a 5-point scale (1 = never to 5 = frequently), respondents were asked to indicate the frequency of coplaying CR3 with 6 types of relations: (1) a friend they knew offline before joining the game, (2) a romantic partner, e.g. spouse, fiancé or boyfriend/girlfriend, (3) an immediate relative who is not a spouse, e.g. parents, siblings, (4) a remote relative, e.g. a cousin, uncle, nephew, niece, (5) a friend (or friends) first met in CR3, and (6) a stranger. Correlation analysis showed moderate to high correlations among several items. A factor analysis of the six coplaying partners revealed two factors with an eigenvalue larger than 1. The first factor included the first 4 items, existing friend, romantic partner, immediate relative, and remote relative. They were then combined into an index of existing ties, by taking the mean of items 1–4 (α = 0.72). The second factor included items 5 (friend first met in CR3) and 6 (stranger), which had low reliability (α = .48). Therefore, these two items were kept separate in the analysis.

3.2.4. Controls: demographic and socioeconomic variables

Past studies showed that many demographic and socioeconomic variables could affect health outcomes (Braveman et al., 2011). We included gender, age (based on birth year), years of education, household income (1 = No income to 27 = CHY 140000 and above annually) and relationship status (1 = married/in a relationship; 0 = single/divorced/separated). Past studies also indicated that personality traits, especially extraversion, may also influence health outcomes (Lu, Shen, & Williams, 2014; Shen & Williams, 2011; Zhu, Woo, Porter, & Brzezinski, 2013). Therefore, we included items from a validated brief scale of Big-Five personality to measure extraversion (Gosling, Rentfrow, & Swann, 2003). Respondents were asked to indicate how much they agree with the following statements on a 5-point scale: (1) I see myself as someone who is outgoing, sociable; and (2) I see myself as someone who is reserved (reverse coded). The mean of these two items were taken as extraversion score in our analysis.

3.3. Analysis

Because the dependent variable was dichotomous, we used logistic regression models in SPSS to examine how social capital and coplaying patterns were associated with health disruption. Three models were estimated. The first included control variables only. The second model added coplaying patterns and social capital (bridging, bonding, and core network size), and the third model replaced core network size with the number of strong ties and weak ties in the core network (core network size was excluded because it correlated highly with the number of strong ties).

4. Results

The descriptive statistics of our sample are presented in Table 1 and the correlations are in Table 2. Female players constituted one quarter of our sample, which was consistent with past studies of similar games (Williams et al., 2008). The average age was 23.58 (SD = 4.29), and the average years of education was 14.90 (SD = 2.17), suggesting that the majority of the sample were either in college or college-educated young professionals. Average annual household income was in the CHY 60,000–65,000 range (approximately US$ 10,000–10,833), more than double the national average of CHY27, 200 (Gan et al., 2013).

Table 1
Characteristics of CR3 participants in study of social capital, coplaying patterns and health disruptions: China 2011 (N = 18813).

	Mean or %	SD
Female	25.5%	
Age	23.58	4.29
Years of education	14.90	2.17
Household income	14.09	8.49
Married/in a relationship	0.36	0.48
Extraversion	1.90	0.56
Coplaying patterns		
With friends and families	2.34	0.95
With friends met in CR3	4.03	0.97
With strangers	3.63	1.30
Bridging social capital	3.83	0.62
Bonding social capital	3.77	0.60
Core network size	3.98	1.76
# of strong ties in core network	3.29	1.86
# of weak ties in core network	0.70	1.23
Health disruptions		
Frequently	2.6%	
Occasionally	15.2%	
Seldom	36.1%	
Never	46.0%	

Notably, CR3 gamers have large core discussion networks (Mean = 3.98, SD = 1.76), with most being strong ties (Mean = 3.29, SD = 1.86). As a point of reference, the 2004 General Social Survey in the US revealed an average core network of 2.04 people, down from 2.94 in 1985 (McPherson et al., 2006). The gamers also coplayed frequently with friends they met first in the game (Mean = 4.03, SD = 0.97), followed by strangers (Mean = 3.63, SD = 1.30) and existing friends and families (Mean = 2.34, SD = 0.95). Among them, 17.8% reported that they were frequently or occasionally down for one week or more due to health reasons in the past twelve months.

We regressed health disruptions (1 = frequently or occasionally) on the covariates in the first model (Table 3). We found that women had 34% more odds than men to have frequent or occasional health disruptions (95% CI = 1.22, 1.47). Better education (OR = 0.97, 95% CI = 0.95, 0.99) and higher household income (OR = 0.99, 95% CI = 0.99, 1.00) could reduce the likelihood of health disruptions, respectively. Personality traits such as extraversion also played a role in reducing health disruptions (OR = 0.92, 95% CI = 0.86, 0.99).

In addition to covariates, Models 2 and 3 included measures of coplaying patterns and social capital (Table 4). Model 2 showed that coplaying patterns played a significant role in influencing health disruptions over and above social capital. Surprisingly, the likelihood to play CR3 with preexisting friends and family members may increase the odds of having frequent or occasionally health disruptions for over a week (OR = 1.06, 95% CI = 1.01, 1.12), while playing with friends met in CR3 attenuates health disruptions (OR = 0.93, 95% CI = 0.89, 0.98). Bridging social capital did not have any significant effect, while one unit increase of bonding social capital could decrease the odds of having frequent or occasional health disruptions by one quarter (OR = 0.75, 95% CI = 0.68, 0.82).

While Model 2 did not find significant health implications from the size of the player's core discussion network, Model 3 further tested the specific effects of the number of strong and weak ties in the core network. Interestingly, it was the weak ties that mattered to health disruption – one weak tie in the core discussion network, nominated by the player, increases the odds of having frequent or occasional health disruptions by 10% (OR = 1.10, 95% CI = 1.05, 1.15).

Table 2
Correlations among major study variables: China 2011.

	Variables	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Frequent/occasional health disruptions	*.04*	.00	*−.03*	*−.03*	*.02*	*−.02*	.01	*−.04*	*−.01*	*−.03*	*−.06*	.00	*−.03*	*.04*
2	Female		*−.05*	*.16*	*.09*	*−.02*	*−.03*	.01	*.13*	*.09*	*.08*	*.16*	*.08*	*.10*	*−.05*
3	Age			.01	*.09*	*.30*	*−.02*	*.02*	*−.07*	−.01	*−.05*	.00	*−.03*	*−.02*	−.01
4	Years of education				*.14*	.01	*.03*	*.05*	*.06*	*.07*	*.11*	*.15*	*.07*	*.10*	*−.05*
5	Household income					*.13*	*.08*	*.06*	*.07*	*.04*	*.10*	*.18*	*.05*	*.10*	*−.07*
6	Married/in a relationship						*.10*	*.17*	*−.02*	−.01	*.04*	*.08*	.01	*.05*	*−.06*
7	Extraversion							*.22*	*.14*	*.10*	*.31*	*.22*	*.05*	*.12*	*−.09*
8	Coplaying w/existing friends & family								*.18*	*.04*	*.18*	*.16*	*.06*	*.11*	*−.07*
9	Coplaying w/friends met in CR3									*.33*	*.26*	*.24*	*.07*	*.12*	*−.08*
10	Coplaying w/strangers										*.18*	*.12*	*.04*	*.06*	*−.02*
11	Bridging social capital											*.57*	*.10*	*.20*	*−.16*
12	Bonding social capital												*.15*	*.29*	*−.22*
13	Core network size													*.77*	*.27*
14	# of strong ties in core network														*−.41*
15	# of weak ties in core network														

Note. $p < .05$ in italics.

Table 3
Logistic regression of health disruptions on covariates only: China 2011.

Variable	Model 1, OR	(95% CI)
Female	*1.34*	(1.22, 1.47)
Age	1.00	(0.99, 1.01)
Years of education	*0.97*	(0.95, 0.99)
Household income	*0.99*	(0.99, 1.00)
Married/In a relationship	*1.17*	(1.07, 1.29)
Extraversion	*0.92*	(0.86, 0.99)

Note. CI = confidence interval; OR = odds ratio. $p < .05$ in italics.

Table 4
Logistic regression of health disruptions on social capital and coplaying patterns: China 2011.

Variable	Model 2[a], OR	(95% CI)	Model 3[a], OR	(95% CI)
Coplaying patterns				
With friends and families	*1.06*	(1.01, 1.12)	*1.07*	(1.02, 1.12)
With friends met in CR3	*0.93*	(0.89, 0.98)	*0.94*	(0.89, 0.98)
With strangers	0.99	(0.95, 1.02)	0.98	(0.95, 1.02)
Bridging social capital	1.08	(0.98, 1.18)	1.08	(0.99, 1.19)
Bonding social capital	*0.75*	(.068, 0.82)	*0.78*	(0.70, 0.85)
Core network size	1.03	(0.99, 1.07)		
# of strong ties in core network			1.01	(0.97, 1.05)
# of weak ties in core network			*1.10*	(1.05, 1.15)

Note. CI = confidence interval; OR = odds ratio. $P < .05$ in italics.
[a] Adjusted for all covariates in Model 1 (shown in Table 3).

5. Discussion

5.1. Summary of findings

Although the health implications of social capital are well-established in the literature, we knew little about whether social capital created or maintained in the context of online games have similar effects. This study represents one of the first efforts to systematically assess how social capital and coplaying patterns are associated with health disruptions for players of a large-scale Chinese MMO. It also makes a unique contribution in using both individual-level psychometric measures of bridging and bonding, and the players' core discussion networks, to measure social capital.

Overall, we found strong evidence that exposure to bonding social capital appeared to reduce the risk of health disruptions. This accords with our expectation as well as previous studies in non-game contexts (Beaudoin, 2009), as bonding social capital provides much-needed emotional support and solidarity at times of adversity, thus shielding people from distress as well as helping them to cope with distress better. Bridging social capital, despite the diverse information and opinions it brings to the mix, did not result in observable health benefits. It should be noted, however, that online environments do not necessarily nurture bridging and bonding social capital equally—empirical evidence from similar MMOs showed that players tend to gain bridging social capital at the expense of bonding (Williams, 2007). Consequently, players who are depleting their bonding social capital by engaging in predominantly superficial relationships online may potentially see adverse health outcomes.

The size of one's core discussion network did not produce any significant health effects on its own, however the number of weak ties in the core network was associated with increased odds of health disruptions. Two points should be highlighted: First, the high correlation between core network size and the number of strong ties suggests that the core network was dominated by strong ties. Second, we found notably large core networks among Chinese gamers, while our survey only allowed respondents to nominate up to five confidants. Had our survey provided options to nominate six or more confidants, the core networks could be even larger. Taken together, weak ties, or rather, the lack of strong ties, within the very core of individuals' social world may indicate insufficient supply of strong social support, which may contribute to increased health disruptions.

Coplaying patterns also had significant health implications, yet in a somewhat counterintuitive fashion. On one hand, playing with one's existing families and friends *increased* the likelihood of frequent or occasional health disruptions, which is in stark contrast with previous research showing a psychosocial benefit of playing with existing social ties, because it provided an additional avenue to deepen these connections (Shen & Williams, 2011). On the other hand, we found that playing with friends first met in the game helped attenuate health disruptions. This indicates that, as least for our respondents, these connections may have transcended the often transitory and superficial nature to a dependable network capable of lasting and substantial social support. It is not clear whether this finding is unique to our sample, so more studies in diverse populations are clearly warranted.

5.2. Implications

This study has several implications for researchers and practitioners. Conceptually and methodologically, our two-pronged operationalization of social capital revealed additional nuances to understanding the mechanisms connecting social capital and health outcomes. Psychometric scales of bridging and bonding focused on individuals' *perceived* social capital benefits, while core network indicators focused on the *composition* of individuals' immediate social structures. Our findings confirm the "buffering" mechanism that socioemotional support, which largely comes from one's strong, rather than weak, social ties, attenuates adverse health outcomes. Meanwhile, the inclusion of coplaying patterns specified the exact type of social relationships engaged in online game worlds. Findings challenged the common assumption that ties initiated online with strangers tend to be shallow while ties with existing social circles tend to be more meaningful. Instead, we found that encounters with strangers could evolve into substantive relationships that reducing health disruptions. This again demonstrates that researchers should not make a "one-size-fits-all" assumption about the nature of online interactions. Instead, only a multi-dimensional approach that takes into account actual social structures and relationship types could reveal significant nuances about gamers' social experiences.

For game designers and public health practitioners, our findings also suggest ways to improve the MMO social experiences toward better health outcomes. Although social interactions are one of the primary goals of MMOs through various game mechanisms (e.g., division of labor among players, the need to collaborate for difficult tasks, etc.), most mechanisms do not prioritize repeated interactions over random, short-lived ones. Therefore, players are likely to develop loose and transitory ties that create bridging social capital, instead of strong and durable ties that create bonding social capital. One promising direction to enhance players' health outcomes, therefore, is to design proper game mechanisms and social tools (e.g. a function to find people one has played with) so that players are not only incentivized to repeat interactions with the same people, but also have the means to do so.

5.3. Limitations and future work

Our study has a few limitations. First and foremost, the potential mechanisms through which social capital may affect the risk of health disruptions were not elucidated. Our findings pointed to the probable mechanism of enlisting emotional and social support from online and offline social ties at times of adversity, yet this possibility was inferred rather than explicitly tested in our data. Future studies are needed to confirm the buffering mechanism.

Second, due to lack of data, we were not able to control respondents' play time in CR3. Prior studies have shown that play time is one of the most important predictors of health outcomes (Liu & Peng, 2009; Shen & Williams, 2011). This omission also suggests a few alternative interpretations of our results. For example, one surprising finding is that coplaying with existing family and friends increased, rather than decreased, the likelihood of frequent or occasional health disruptions, which contradicts prior research. It is likely that having existing family and friends was positively associated with the amount of time spent on gaming, which then led to increased risk of health problems. We recommend that future studies examining game and health should include play time as much as possible.

Third, we were not able to assess the representativeness of our sample, because our survey method did not allow the calculation of a response rate. The players in our sample were skewed toward the young, educated and affluent, which was consistent with gamer profiles in other countries (Williams et al., 2008). Our recruitment strategy, using a virtual weapon in CR3, could in theory have extracted a heterogeneous sample. However, we still could not rule out the possibility that the profile of our self-selected sample may be systematically different from the CR3 player population. Similarly, it is not clear how much of the findings should be attributed to the game itself or the cultural context. Future studies in other online games and diverse populations should be conducted.

Lastly, several study design factors may create difficulty in comparing and generalizing our study results. Although we strived to use established measures, especially the core network name generators from the GSS, the core networks collected here were capped at five individuals, while GSS allowed more confidants. Our survey was administered online, while GSS relied on face-to-face interviews. And our unique study context may have evoked somewhat different understandings of "important matters" from typical GSS responses. These study design choices limited the extent to which our results could be meaningfully interpreted and compared against existing benchmarks. We hope the current study would spur more future work to replicate the design and disentangle the impacts of these methodological and contextual factors.

6. Conclusions

Massively Multiplayer Online Games have seen growing popularity in recent years, yet their effects on players' health and well-being remain murky. This study is among the first to explicitly test the relationship between social capital, coplaying patterns and health disruptions among MMO players. We drew from a large scale survey of gamers ($N = 18813$) in a popular Chinese Massively Multiplayer Online Game, Chevaliers' Romance 3. Social capital was measured by (1) psychometric measures of bridging and bonding social capital, and (2) core discussion network size using name generators, as well as the number of strong and weak ties within the core network. Controlling for sociodemographic variables, we found that bonding social capital was associated with lower odds of frequent or occasional health disruptions, but bridging social capital did not have any effect. Weak ties in the core network were associated with greater odds of health disruptions. Coplaying patterns also mattered – people playing with friends first met through CR3 were less likely to have health disruptions, while playing with existing friends and families tended to have the opposite effect. Overall, social capital and coplaying patterns appear to have significant health implications for participants in online games.

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