Causes and consequences of pathological gaming

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Chapter 4

Psychosocial Causes and Consequences of Pathological Gaming

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Abstract

Pathological use of computer and video games has been associated with indicators of psychosocial well-being, such as loneliness, low self-esteem, low social competence, and low life satisfaction. However, few studies have decisively demonstrated whether these indicators of psychosocial well-being are causes or consequences of pathological gaming. To address this gap in the literature, we conducted a two-wave panel study among 851 Dutch adolescents (543 gamers). Causal relations were analyzed using autoregressive structural equation models. These analyses indicated that social competence, self-esteem, and loneliness were significant predictors of pathological gaming six months later. Thus, lower psychosocial well-being can be considered an antecedent of pathological gaming among adolescent gamers. Our analyses further indicated that loneliness was also a consequence of pathological gaming. This suggests that displacement of real-world social interaction resulting from pathological use of video games may deteriorate existing relationships, which could explain the increase in adolescent gamers' feelings of loneliness.

Psychosocial Causes and Consequences of Pathological Gaming

Over the last decade, many studies have found associations between low psychosocial well-being and excessive, compulsive and/or pathological use of computer and video games. For instance, studies have shown that pathological gamers show less satisfaction with daily life (Wang, Chen, Lin & Wang, 2008), less self-esteem (Ko et al., 2005), less social competence (Lo, Wang & Fang, 2005), and more loneliness (Seay & Kraut, 2007) than non-pathological gamers. However, because longitudinal research on pathological gaming is scarce, there is little evidence that decisively demonstrates whether these indicators of psychosocial well-being are causes or consequences of pathological gaming. Specifically, we do not know whether (a) pathological gaming decreases well-being; (b) low well-being leads to pathological gaming; or (c) pathological gaming and well-being are reciprocally related. To address this gap in the literature, we performed a longitudinal study using four common indicators of psychosocial well-being (i.e., loneliness, social competence, life satisfaction, and self-esteem) that have empirically established relations with pathological gaming.

Pathological gaming has been defined as persistent and excessive involvement with computer or video games that cannot be controlled despite associated social and/or emotional problems (Lemmens, Valkenburg & Peter, 2009). Although the terminology is still under debate, the general concept of pathological gaming has gained widespread acceptance among researchers as a legitimate behavioral disorder (e.g., Gentile, 2009; Young, 2009). Studies have consistently shown that a small group of players spend excessive amounts of time on games while displaying numerous symptoms of pathological behavior, such as withdrawal, preoccupation, loss of control, and interpersonal or intrapersonal conflicts (e.g., Charlton & Danforth, 2007; Gentile, 2009;

Grüsser, Thalemann, & Griffiths, 2007). In general, adolescents are more likely to show signs of pathological gaming than older age groups (Griffiths, Davies, & Chappel, 2004; Griffiths & Wood, 2000; Ha et al., 2007). Because of its relatively high prevalence among adolescent gamers, this group is considered particularly vulnerable to any effects pathological gaming may have on the psychosocial well-being of players.

Psychosocial well-being can be defined as a dynamic concept encompassing a wide array of constructs that reflect the quality of intrapersonal and interpersonal functioning (Lent, 2004). Previous research has used the underlying constructs loneliness, life satisfaction, self-esteem and social competence as indicators of well-being (e.g., Halpin & Allen, 2004). Specifically, these four constructs have been used in research on the relation between psychosocial well-being and problematic computer use (Caplan, 2002). Because these constructs are indicators of well-being, they are interrelated. For instance, social incompetence and low self- esteem result in avoidance of social interaction (e.g., Sletta, Valas, & Skaalvik, 1996), which may eventually lead to loneliness (Dill & Anderson, 1999; Parker & Asher, 1993). Furthermore, diminished social interaction and less satisfying relationships are related to lower satisfaction with life (Jarvinen & Nicholls, 1996). Psychosocial well-being is of particular importance among adolescents because adolescence is a pivotal time in which youth face many developmental tasks, including strengthening and expanding self-concepts, forming stable intimate relationships, making career decisions, and achieving independence from parents. Low psychological well-being during this stage can lead to poor psychosocial functioning, lower life and career satisfaction, more interpersonal difficulties, greater need for social support, more comorbid psychiatric conditions, and increased risk of suicide (Paradis, Reinherz, Giaconia, & Fitzmaurice, 2006).

Because of the importance of psychosocial well-being during

adolescence, and adolescents' vulnerability to pathological use of video games (Griffiths & Wood, 2000; Ha et al., 2007), most research on the relation between well-being and pathological gaming has focused on adolescents (e.g., Chiu, Lee & Huang, 2004; Gentile, 2009; Salguero & Morán, 2002). Despite the consistent cross-sectional correlations that were found between low well-being and pathological gaming, very few studies have compellingly demonstrated a causal direction between these concepts. It is important to examine whether low psychosocial well-being is a cause or consequence of pathological gaming, because this may provide physicians, care workers, parents, and gamers confronted with problems associated with pathological gaming with an indication of where to focus their interventions. Furthermore, controlling or preventing pathological gaming among adolescents seems especially poignant because previous research has indicated that all addictions and dependencies identified in adults commonly start in adolescence or young adulthood (e.g., Wagner & Anthony, 2002).

Casual Relations between Psychosocial Well-being and Pathological Gaming

Psychosocial well-being as an outcome. There is considerable concern that excessive or pathological use of computer and video games may have a detrimental influence on the psychosocial well-being of players. This concern is based on the idea that excessive (online) gaming displaces activities that serve to maintain and improve healthy relationships (e.g., Kraut et al., 1998). Research confirms that playing video games can fulfill some of the needs that are otherwise met through friendships, thereby reducing the need for real-life contacts with friends (Colwell and Kato, 2003). Furthermore, playing violent video games can reduce feelings of empathy (Bartholow, Sestir & Davis, 2005) and may foster the development of aggressive problem-solving skills (Anderson & Bushman,

2001). Reduced empathy and aggressive problem-solving skills may hinder the maintenance of healthy friendships or romantic partnerships, thereby decreasing players' psychosocial well-being (Colwell and Payne, 2000). Although theoretically plausible, there is little empirical support for the notion that pathological gaming decreases players' psychosocial well-being.

Psychosocial well-being as a cause. An effect of well-being on pathological gaming implies that adolescents who are socially incompetent, low in self-esteem, lonely and/or generally dissatisfied with their life are more likely to develop signs of pathological gaming. In general, individuals with low self-esteem or unsatisfactory personal relations may use video games to escape reality, find friendship, or attain a sense of achievement that they are unable to attain in real life (e.g., Leung, 2004; Williams, Yee & Caplan, 2008). In that regard, *online* multiplayer games seem particularly suited as a substitute for real-life social interaction because they enable large-scale social interaction within the anonymity of the internet (Morahan-Martin & Schumacher, 2000; Peters & Malesky, 2009). Therefore, games in general, and online games in particular, should appeal more to adolescents with low psychosocial well-being because they tend to avoid real face-to-face social situations in which they may lack the proper skills to foster good relationships. One longitudinal study partially supports the assumption that low well-being, specifically loneliness, is an antecedent of pathological gaming (Seay & Kraut, 2007).

Reciprocal relationships. Given the lack of empirical validation for the causal direction between pathological gaming and well-being, a reciprocal relation between the two may also be possible. For instance, for lonely and socially incompetent people, online games may provide a welcome alternative to uncomfortable everyday offline interactions. At the same time, excessive playing may lead to social problems, which could subsequently increase their loneliness, or decrease their life satisfaction. A recent study by Kim, LaRose, and Peng (2009) provided evidence of such a

reciprocal relationship between loneliness and problematic internet use (including online games) among adolescents. However, since that study was based on cross-sectional data, the causal predictions were not rigorously tested. The longitudinal design of the present study allows us to investigate the exact causal relations between pathological gaming and indicators of psychosocial well-being. Moreover, it allows us to single out which of these variables are the most important antecedents or consequences of pathological gaming. In the following paragraphs, we will briefly discuss the four indicators of psychosocial well-being and, when available, empirical evidence of the causal relation with pathological gaming.

Psychosocial Well-being

Satisfaction with life. Life satisfaction refers to a general cognitive assessment of a person's subjective well-being (Diener, Emmons, Larsen, & Griffin, 1985). Cross-sectional survey studies have shown that lower satisfaction with daily life is related to online game addiction (Ko et al., 2005; Shapira, Goldsmith, Keck, Khosla, & McElroy, 2000). Research has also shown a positive correlation between addiction to online games and depression (Seo, Kang & Yom, 2009). Life satisfaction and depression are related concepts and very low life satisfaction can predict the onset of depression up to two years prior to diagnosis (Lewinsohn, Redner, & Seeley, 1991). Regarding causality, it has been argued that online games may provide addicted players a means of channeling their real-life dissatisfaction (Wan & Chiou, 2006). Furthermore, some longitudinal evidence indicated that heavy use of video games during adolescence did not increase chances of depression in adulthood (Primack, Swanier, Georgiopoulos, Land & Fine, 2009). Although this finding alone does not necessarily indicate opposite causality, combined with arguments put forth by Wan and Chiou (2006) we expect that dissatisfied individuals are more

likely to become pathologically involved with games.

Loneliness. Loneliness has been defined as an unpleasant experience that derives from important deficiencies in a person's network of social relationships (Peplau & Perlman, 1982). Feelings of loneliness may result from an unfulfilled desire to have friends, a gap between actual and desired social status, and a lack of affective bonding. Thus, loneliness is a complex emotion that is heavily dependent on peer influences (Bauminger & Kasari, 2000). Cross-sectional studies have consistently confirmed the relation between loneliness and addiction to online games (e.g., Parsons, 2005; Qin, Rao, & Zong, 2007). In general, playing an online game is an effortless, speedy and inexpensive way to socialize and avoid feelings of loneliness (Chappell, Eatough, Davies, & Griffiths, 2006). If players rely solely on online games to alleviate loneliness, this would likely increase their social problems because excessive playing may displace activities that maintain and improve healthy relationships (Caplan, 2003; Kraut et al., 1998). Through deterioration of real contacts, pathological gaming may increase loneliness (Blais, Craig, Pepler & Connolly, 2008). One cross-sectional study indicated that loneliness was both a cause and a consequence of pathological online gaming, thereby suggesting a reciprocal relation (Kim, LaRose, & Peng, 2009). However, a longitudinal study by Seay and Kraut (2007) found that loneliness was a predictor of problematic gaming one year later, but found no significant effect of problematic gaming on players' loneliness. In line with findings from this longitudinal study, we expect loneliness to be an antecedent of pathological gaming.

Social competence. Social competence refers to the relative tendency or disposition to be sociable or associate with one's peers (Inderbitzen & Foster, 1992). A cross-sectional study by Lo, Wang and Fang (2005) indicated that the time spent playing online games increased with higher levels of social anxiety. Lower social competence has also been found directly related to pathological gaming (Lemmens, Valkenburg &

Peter, 2009). Several researchers have suggested that social interaction in online games particularly appeals to people who are socially unskilled; have an unmet need for sociability in their offline lives; and feel anxious over establishing real-life interpersonal relationships (Chak and Leung, 2004; Peters & Malesky, 2009). Others suggested that online game addiction has a detrimental effect on the development of social skills (e.g., Chiu, Lee, & Huang, 2004). Because of the lack of longitudinal data, combined with the contradictory interpretations of previous cross-sectional studies, no causal assumptions regarding social competence are made.

Self-esteem. Self-esteem has been defined as an evaluation of one's self-concept, heavily dependent on reflected appraisals, social comparisons, and self-attributions (Rosenberg, Schooler, & Schoenbach, 1989). Since early research on video games, low self-esteem has been associated with playing games. For instance, Dominick (1984) stated that a weak self-image can be compensated for by success in playing video games. Later, Roe and Muijs (1998) found that heavy use of computer games was associated with lower levels of self-esteem. Recently, a longitudinal study on internet addiction (Ko et al., 2005) indicated that low self-esteem was a cause, and not a consequence, of internet addiction among adolescents. Given the conceptual and empirical proximity of internet addiction and pathological use of online games (e.g., Kim, Namkoong, Ku & Kim, 2008) we expect that self-esteem will be a negative predictor of pathological gaming.

The Moderating Role of Gender

It has been well documented that boys and girls differ in their use of games. Not only are girls less likely to play games altogether, when girls do play games, they spend much less time on them than boys do (Bickham et al., 2003; Lee, Bartolic & Vandewater 2009). The same gender differences are found when examining pathological gaming, as boys are

more likely to show signs of pathological gaming than girls (Chiu, Lee & Huang, 2004; Gentile, 2009; Grüsser, Thalemann, Albrecht, & Thalemann, 2005; Ko, Yen, Chen, Chen, & Yen, 2005). Research also suggests that boys and girls differ in their psychosocial well-being. For instance, girls may be better at skills necessary for demonstrating social competence (e.g., Buhrmester, 1996), and boys have been found to report more self-esteem than girls (Van der Aa et al., 2009). These gender differences may also show up in the relation between well-being and pathological gaming. Therefore, we examined whether gender moderates possible psychosocial causes and consequences of pathological gaming.

Method

Sample

We conducted a two-wave longitudinal survey study among Dutch adolescents. The age of respondents varied between 11 and 17 years, (M = 13.9, SD = 1.4). In December 2008, 1,024 adolescents from four schools of secondary education throughout the Netherlands participated (51% boys). Six months later, in June 2009 we fielded the second wave among 941 adolescents (mean age 14.3, SD = 1.4). In the second wave, we were unable to reach 83 of our original respondents (8%), mostly due to illness or unavailability of supervising teachers. Of the remaining 941 respondents, we were unable to match 74 questionnaires (8%) between waves because of discrepancies in respondents' names or student numbers. Another 16 respondents were removed because of missing variables, or severe irregularities in their responses, indicating that the questionnaire was not filled in sincerely. In total, 851 respondents (51% male) were matched between waves (i.e., corresponding names or student numbers, see procedure below). Of these respondents, 543 had played video games throughout the two waves and had fully completed both questionnaires. Only these 543 game-playing adolescents were included in our analyses.

Procedure

In both waves, a paper-and-pencil survey was distributed during school hours after acquiring active consent from the schools and teachers, and passive consent from respondents' parents (i.e., parents were informed and could reply if they refused their child to participate). Respondents were assured that their answers would be analyzed only by the principal investigators, and not shown to their teachers or parents. In order to match responses from the two waves, respondents were required to fill in either their name, or their personal student number. Items for each measure were grouped. Most participants completed the survey within 20 minutes, and received a small present for their participation. If respondents indicated that they had not played a video game in the past month, they were exempt from filling in any game-related questions. Out of 851 matched respondents, 169 (20%) reported not playing any games during any of the two waves (89% girls). In the first wave, 76% (N = 649) of the respondents had played games (36% girls). In the second wave, 68% (N = 584) played games (33% girls). In total, 543 matched game-playing respondents (70% boys) were included in our analyses.

Measures

Pathological gaming. To measure respondent's degree of pathological gaming, we used a seven-item game addiction scale developed by Lemmens et al. (2009), which is based on the DSM IV-criteria for pathological gambling previously adapted by Griffiths (2005). This game addiction scale showed good convergent validity, as indicated by the strong correlations with weekly time spent on games in two independents samples of adolescents, and good criterion validity, as indicated by the correlations with lower life satisfaction, lower social competence, higher loneliness, and higher aggression (Lemmens et al., 2009). This scale includes one item for each of the seven underlying criteria of pathological

gaming: (1) *Salience*: "Did you spend all day thinking about playing a game?" (2) *Tolerance*: "Did you start spending increasing amounts of time on games?" (3) *Mood modification*: "Have you played games to forget about real life?" (4) *Relapse*: "Have others unsuccessfully tried to reduce your game use?" (5) *Withdrawal*: "Did you feel bad when you were unable to play?" (6) *Conflict*: "Did you have fights with others (e.g., family, friends) over your time spent on games?" (7) *Problems*: "Have you neglected other important activities (e.g., school or work) to play games?" Every item was preceded by the statement: 'During the last six months, how often…' Players rated all items on a five-point scale: 1 (*never*), 2 (*rarely*), 3 (*sometimes*), 4 (*often*), 5 (*very often*). Exploratory factor analysis (EFA) indicated that the game addiction scale was unidimensional in both waves, explaining 43% of the variance in wave 1, and 48% in wave 2. The seven-item scale had Cronbach's alphas of .77 (M = 1.82, SD = .64) in the first wave, and .81 (M = 1.68, SD = .62) in the second wave.

Because it is increasingly believed that mental and behavioral disorders can best be understood as scores on a continuum (e.g., Satcher, 2000), we conceptualized pathological gaming as a continuum, instead of using an arbitrary cut-off point to determine if someone is addicted or not. Therefore, contrary to some earlier studies (e.g., Charlton & Danforth, 2007; Gentile, 2009), we performed no dichotomous comparisons (i.e., game addicts versus non-addicts), but used the individual mean score on the seven-item game addiction scale as an indicator of pathological gaming severity (means ranging from 1 through 4.43 across waves). These mean scores were not distributed normally as indicted by the Shapiro-Wilk test. In both waves, mean scores on the game addiction scale were positively skewed. Specifically, 25% (N = 138) in wave 1, and 38% (N = 208) in wave 2, had a mean score below 1.3, thereby indicating that a large group of adolescent gamers generally never experienced signs of pathological gaming. Conversely, 6% (N = 34) in wave 1, and 4% (N = 21) in wave 2, had

a mean score of 3 or higher on the game addiction scale, which makes it reasonable to assume that a small group of gamers had experienced most signs of pathological gaming at least sometimes over the past six months.

Time spent on games. To measure respondents' weekly time spent on games, we asked three sets of questions regarding their time spent on different platforms (PCs, consoles, or handheld gaming devices). First we asked "How many days a week do you play games on a console/pc/handheld". Followed by "On an average day that you play games on a pc/console/handheld, how much time do you spend playing?" The weekly time spent on computer and video games was measured by multiplying the days per week by the number of hours per day spent on these activities. Total time spent on games ranged from 15 minutes through 81 hours per week, with an average of 11.2 hours per week (*SD* = 10.1) across waves. One would expect respondents who show more signs of pathological gaming to spend more time on games. As expected, pathological gaming showed a strong correlation with adolescents' weekly time spent on games, with a correlation of $r = .48$, $p < .001$ in the first wave and $r = .43$, $p < .001$ in the second wave.

Loneliness. Loneliness was measured by selecting the five items with the highest item-total correlations from the 20-item UCLA loneliness scale (Russell, 1996). Convergent validity for this scale has been indicated by significant correlations with other measures of loneliness and measures of the adequacy of the individual's interpersonal relationships (Russell, 1996). Items are: "I feel alone" and "I feel like there is no one I can turn to." Response categories ranged from 1 (*totally disagree*) to 5 (*totally agree*). Items were averaged to create the scale scores. EFA indicated the scale was unidimensional, explaining 72% of the variance in wave 1 and 74% in wave 2. This five-item scale had Cronbach's alphas of .90 ($M = 1.79$, $SD = .80$) in the first wave and .91 ($M = 1.76$, $SD = .79$) in the second wave.

Life satisfaction. Respondents' life satisfaction was measured

using the five-item Satisfaction With Life Scale (SWLS) developed by Diener et al. (1985). Construct validity of the SWLS has been indicated by strong correlations with ten other measures of subjective well-being (Diener et al., 1985). Examples of items are "I am satisfied with my life" and "In most ways my life is close to my ideal." Response categories ranged from 1 (*totally disagree*) to 5 (*totally agree*). The items were averaged to create the scale scores. The scale was unidimensional, explaining 60% of the variance in wave 1, and 68% in wave 2. Cronbach's alpha for this scale was .81 (M = 3.61, SD = .71) in the first wave and .87 (M = 3.61, SD = .77) in the second wave.

Social competence. The items of this scale were based on earlier instruments measuring social skills and interpersonal competence among adolescents (e.g., Buhrmester, Furman, Wittenberg, & Reis, 1988; Inderbitzen & Foster, 1992). Validity of this scale was indicated by correlations with the number of adolescent peer relationships and interpersonal competence in young adulthood (Buhrmester et al., 1988). The four items in this scale were: (1) "Starting a conversation with a stranger," (2) "Expressing my feelings to someone else," (3) "Introducing myself to someone I have not met before," and (4) "Talking to someone about something I feel ashamed of." Response options ranged from 1 (I find this very hard) to 5 (I find this very easy). The items were averaged to create the scale scores. EFA indicated this scale was unidimensional, explaining 56% of the variance in wave 1, and 57% in wave 2. Cronbach's alpha for this scale was .75 in the first wave (M = 3.07, SD = .72) and .75 in the second wave (M = 3.10, SD = .73).

Self-esteem. Adolescents' self-esteem was measured using the six-item self-esteem scale (Rosenberg, Schooler, & Schoenbach, 1989). This measure implies feelings of self-acceptance, self respect and generally positive self-evaluation. Convergent validity of this scale has been indicated by strong correlations with the Global Self-Worth Scale (Hagborg, 1993).

Sample items are: "I am able to do things at least as well as other people" and "I feel that I have a number of good qualities." Response categories ranged from 1 (*totally disagree*) to 5 (*totally agree*). The items were averaged to create the scale scores. EFA indicated the scale was unidimensional, explaining 45% of the variance in wave 1, and 59% in wave 2. Cronbach's alpha for this scale was .75 (M = 3.98, SD = .59) in the first wave, and .82 (M = 3.99, SD = .65) in the second wave.

Data Analysis

The relation between each indicator of well-being and pathological use of games was examined using autoregressive cross-lagged panel models. These models were tested with structural equation modeling (SEM), using AMOS 7.0. Autoregressive effect models eliminate a considerable proportion of potentially confounding variance and increase the validity of the influence of specific predictors at time 1 on outcomes at time 2 (Schlüter, Davidov, & Schmidt, 2006). For all constructs, item parcels served as indicators. It is advised to use item parcels rather than individual items to estimate latent constructs because (a) item parcels lead to more parsimonious models, (b) reduce the chances for double loadings to occur, and (c) diminish the impact of the various sources of sampling error. In general, item parcels are also less likely to violate the assumption of normal distribution than individual items (e.g., Little, Cunningham, Shahar, & Widaman, 2002). The items from each scale were distributed over two parcels using the factorial algorithm (see Rogers & Schmitt, 2004, for a description of this procedure). However, item parceling should only be used if the underlying construct is unidimensional (Little et al., 2002). Exploratory factor analyses (see Measures) indicated that all constructs under investigation met this condition.

Because SEM does not accept missing cases, we only included respondents who had played games in both waves and had fully completed

both questionnaires (N = 543). We first removed all respondents from our sample (N = 851) who indicated that they never played games (N = 169). In a second step, we removed another 131 respondents who only played games in one of either two waves. In wave 1, out of 649 game-playing respondents, 98 (14%) stopped playing in wave 2. Conversely, out of 584 players in wave 2, 6% did not play games in wave 1 (N = 33). After the analyses with our original sample (N = 543), we examined whether the results from our autoregressive models differed when we included respondents who only played games during one of the waves (N = 131). For this purpose, we changed the missing scores on the game addiction scale to be 1 (which indicates 'never'), for the wave in which these respondents did not play. We then compared the models with the original sample to models with the extended sample (N = 669). 5 respondents had to be deleted due to missing data on psychosocial variables). Our models indicated no fundamental changes in effect sizes or significance of the results between the two samples.

To further investigate the validity of removing players who did not play games in either wave, we compared responses from the excluded groups (N = 98 and N = 33) to those from the included group (N = 543). Independent sample t-tests showed that the excluded respondents did not differ from the included respondents on any of the psychosocial variables. However, the group of 98 respondents who stopped playing games in wave 2, spent less time on games per week (M = 3.71, SD = 5.37), t (647) = 7.04, p < .001, and reported lower levels of pathological gaming (M = 1.46, SD = .53), t (647) = 5.17, p < .001, than respondents from wave 1 who kept playing in wave 2. Similarly, the group of 33 respondents who did not play games in wave 1, but started playing games in wave 2, spent less time on games (M = 2.50, SD = 3.28), t (577) = 3.76, p < .001, and showed less signs of pathological gaming (M = 1.29, SD = .41), t (577) = 3.42, p < .001. This indicates that the excluded respondents generally played very little before

they stopped gaming completely, or played only very little once they started playing. More generally, these findings justify excluding this group from the analyses. Furthermore, because the differences found between groups indicate that the missing data are not missing at random, these cases cannot validly be imputed for inclusion in SEM models. In sum, examining only gamers who played games throughout the two waves provides a more accurate reflection of the relations between pathological gaming and psychosocial constructs.

The mean scores on the game addiction scale and some of the psychosocial constructs were not distributed normally, as indicated by a positively or negatively skewed distribution. As a result, the assumption of multivariate normality was not met. Technically, in SEM, multivariate normality is a sufficient but not necessary condition for applying the usual tests of statistical significance. Especially with larger samples, the parameter estimates are not likely to be biased when the normal-distribution assumption is violated (Bollen, 1989, pp. 126–128). Nevertheless**,** in order to examine whether the skewness may have affected the analyses, we assessed the statistical significance of our estimates also with a bootstrap procedure for the structural equation models (Efron & Tibshirani, 1993). This procedure constitutes an alternative to parametric approaches because it estimates values of interest without making assumptions about the distribution type of the variables or the sampling distribution of a particular statistic. As a result, the bootstrap method generally produces more accurate results than parametric tests if the assumption of normal distribution is violated (Valkenburg & Peter, 2009). Therefore, we tested the statistical significance of all analyses reported below not only with traditional parametric tests, but also with the bootstrap method. In the bootstrap procedure, the computer generates a series of samples from the dataset (N = 543). In each bootstrap sample, the parameter of interest is computed. A confidence interval for this parameter

is then computed across all the bootstrap samples. We estimated a 95% bias-corrected confidence interval for all values of interest (1000 bootstrap samples, 543 each). If this confidence interval includes zero, a given estimate is not significant. If the results changed in their statistical significance when assessed with the bootstrap method, it is reported along with the analyses below.

Results

Cross-sectional Psychosocial Correlations with Pathological Gaming

Before any causal relations were tested, we examined whether the correlations between pathological gaming and psychosocial constructs were robust over time. As Table 1 shows, all four psychosocial constructs were significantly correlated with pathological gaming within both waves. All zero-order correlations were in the expected direction; higher loneliness, lower life satisfaction, lower self-esteem, and lower social competence were all related to higher scores on pathological gaming. Pathological gaming was correlated between waves (r = .61, p < .001) and also correlated with most psychosocial constructs between waves in the anticipated direction. Pathological gaming and time spent on games showed a strong correlation between and across waves. However, weekly time spent on games did not show any significant correlation with the psychosocial constructs within waves.

Table 1 *Correlations within and between Waves 1 and 2 (N=543)*

		Gender	Loneliness		Life Satisfaction		Self-Esteem		Social Competence		Time Spent on Games	
			W1	*W2*	*W1*	*W2*	*W1*	*W2*	*W1*	*W2*	*W1*	*W2*
Loneliness	*W1*	.18[c]	-									
	W2	.15[b]	.48[c]	-								
Life Satisfaction	*W1*	-.07	-.40[c]	-.28[c]	-							
	W2	-.12[b]	-.34[c]	-.49[c]	.46[c]	-						
Self-Esteem	*W1*	-.12[b]	-.49[c]	-.33[c]	.43[c]	.29[c]	-					
	W2	-.22[c]	-.39[c]	-.51[c]	.37[c]	.49[c]	.56[c]	-				
Social Competence	*W1*	-.08	-.38[c]	-.30[c]	.27[c]	.19[c]	.42[c]	.36[c]	-			
	W2	-.09[a]	-.34[c]	-.35[c]	.22[c]	.25[c]	.34[c]	.42[c]	.71[c]	-		
Time Spent on Games	*W1*	-.32[c]	-.07	-.07	.04	.05	.05	.12[b]	.03	.01	-	
	W2	-.32[c]	-.01	-.01	.01	.00	-.04	.07	.00	.03	.56[c]	-
Pathological Gaming	*W1*	-.24[c]	.15[b]	.18[c]	-.17[c]	-.12[b]	-.13[b]	-.06	-.11[b]	-.21[a]	.48[c]	.40[c]
	W2	-.23[c]	.21[c]	.30[c]	-.15[b]	-.23[c]	-.17[c]	-.12[b]	-.07	-.14[b]	.31[c]	.44[c]

Note: Gender is coded; boys 0, girls 1

[a] $p < .05$; [b] $p < .01$; [c] $p < .001$

Causal Relations between Pathological Gaming and Psychosocial Well-Being

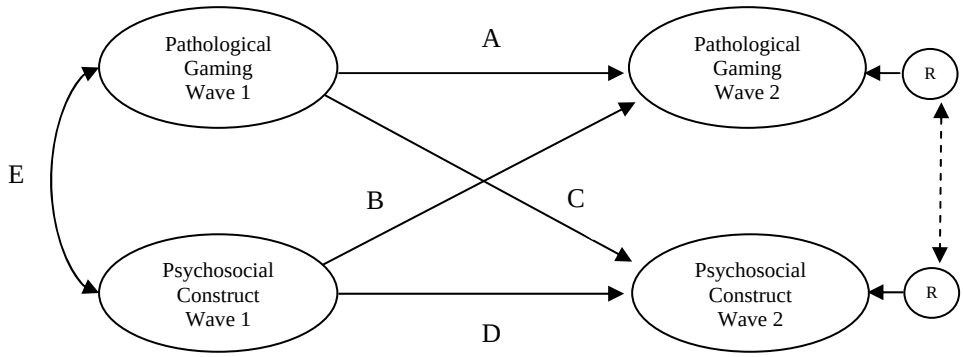
To investigate causal relations between pathological gaming and the four psychosocial constructs, we estimated autoregressive structural equation models (Cole & Maxwell, 2003; Schlüter, Davidov, & Schmidt, 2006) as seen in Figure 1. The ovals represent latent variables, which were estimated from two item-parcels not shown in Figure 1. The two paths marked A and D represent the stability of both pathological gaming and the psychosocial constructs (i.e., loneliness, life satisfaction, self-esteem or social competence) between waves 1 and 2. The two-way path marked E represents the covariance between pathological gaming and the specific psychosocial construct within wave 1. Residual errors of latent constructs in wave 2 (R) were allowed to co-vary. A significant path B would indicate a causal-correlational effect of the psychosocial construct at wave 1 on pathological gaming at wave 2. A significant path C would imply a causal-correlational effect of pathological gaming at wave 1 on that psychosocial construct at wave 2. If both path B and C are significant, the causal-correlational relation between pathological gaming and psychological construct is reciprocal. Table 2 shows the structural weights for paths A through E (as displayed in Figure 1) for all four psychosocial constructs, and the model fit indices for each of the models.

As can be seen in Table 2, loneliness in wave 1 predicted pathological gaming in wave 2 (β = .12, B = .10, SE = .035, p < .01). We found a similar effect for pathological gaming in wave 1 on loneliness in wave 2 (β = .12, B = .17, SE = .061, p < .01), providing evidence of the reciprocal nature of this relation. The negative effects of life satisfaction on pathological gaming (β = -.07, B = -.07, SE = .045, p = .12), and pathological gaming on life satisfaction (β = -.03, B = -.03, SE = .053, p= .47) were both not significant. As expected, social competence in wave 1 negatively predicted pathological gaming in wave 2 (β = -.15, B = -.12, SE = .035, p <

.001), but pathological gaming in wave 1 did not predict social competence in wave 2 (β = .04, *B* = .04, *SE* = .046, *p* = .36). Finally, self-esteem in wave 1 negatively predicted pathological gaming in wave 2 (β = -.10, *B* = -.14, *SE* = .066, *p* < .05), but pathological gaming in wave 1 showed a non-significant positive effect on self-esteem in wave 2 (β = .05, *B* = .05, *SE* = .044, *p* = .22).

Next, we applied the bootstrap procedure to all four models. The bias-corrected 95% confidence interval for the regression coefficients indicated that the effect of self-esteem wave 1 on pathological gaming wave 2 was not significant when bootstrapped (*B* = -.08, *SE* = .048, *C.I.* = .01 - .14, *p* = .12). All other significant causal paths from Table 2 (i.e., loneliness, and social competence) remained significant when the bootstrap method was applied.

Figure 1. Autoregressive model of the causal relationships between pathological gaming and psychosocial constructs at wave 1 and wave 2.



Note: Structural weights for paths A through E and model fit indices for each of the four psychosocial constructs are displayed in Table 2

Table 2. *Regression Weights, Covariances and Model Fit Indices of Figure 1*

	Paths in Figure 1 (Standardized Betas)					Model Fit Indices		
	Path A	Path B	Path C	Path D	Path E	χ^2 (df=14)	CFI	RMSEA (CI)
Loneliness	.66 [c]	.12 [b]	.12 [b]	.50 [c]	.18 [c]	31.26	.99	.048 (.03-.07)
Life Satisfaction	.68 [c]	-.07	-.03	.53 [c]	-.20 [c]	26.44	.99	.040 (.02-.06)
Social Competence	.72 [c]	-.15 [c]	.04	.91 [c]	-.16 [a]	35.89	.99	.054 (.03-.08)
Self-Esteem	.67 [c]	-.09 [a]	.05	.71 [c]	-.20 [c]	27.50	.99	.042 (.02-.07)

Note: [a] $p < .05$; [b] $p < .01$; [c] $p < .001$

CI = Confidence Interval

Gender Analyses

The zero-order correlations from Table 1 indicated that gender influenced time spent on games, most psychosocial indicators of well-being, and pathological gaming. Across waves, male gamers spent an average of 13.6 hours (*SD* = 10.7) per week on games, which is much more than female gamers, who spent an average of 5.5 hours (*SD* = 5.6) per week on games, t (542) = 9.06, $p < .001$. Similarly, boys' mean game addiction scores (*M* = 1.85, *SD* = .57) were higher than girls' game addiction scores (*M* = 1.52 *SD* = .64), t (542) = 6.39, $p < .001$. Gender also influenced adolescent well-being. Specifically, girls indicated that they were lonelier (t (542) = 4.70, $p < .05$) and had lower self-esteem (t (542) = 4.71, $p < .05$) than adolescent boys across waves. Because of these gender differences, our next aim was to examine whether gender moderated the psychosocial causes and consequences of pathological gaming. To do so, we performed multi-group analysis (Jaccard & Wan, 1996) to test whether observed differences in the structural weights are statistically significant between genders.

First, we estimated a model, in which we did not pose any cross-group constraints, i.e., we allowed the causal paths (B and C) to vary between male and female adolescents. In a subsequent model, we constrained, one at a time, each causal path to be equal across genders. Finally, we tested whether the fit of the constrained model differed from the fit of the unconstrained model. A significant change in the model fit indicates that the constrained path differed between male and female adolescents. Although boys generally showed stronger effects than girls, multi-group analyses indicated no significant chi-square changes across gender in any of the models. Thus, gender did not have a significant moderating effect on the psychosocial causes and consequences of pathological gaming.

Discussion

The present study is one of the first to examine the psychosocial causes and consequences of pathological gaming among adolescents in a longitudinal design. Our causal analyses yielded two main findings. First, lower psychosocial well-being was generally an antecedent of pathological gaming. Specifically, diminished social competence, increased loneliness, and lower self-esteem (which fell below significance when bootstrap was applied) predicted an increase in pathological gaming six months later. The second main finding was a reciprocal relation between loneliness and pathological gaming, indicating that loneliness is both a cause and a consequence. Although adolescent boys are much more likely to show signs of pathological gaming than girls, the psychosocial causes and consequences were similar for both genders. Thus, adolescent gamers with pre-existing psychosocial vulnerabilities, such as loneliness, low social competence, and low self-esteem, are more likely to become pathologically involved with games, and pathological gaming will increase adolescent gamers' feelings of loneliness.

It has been suggested that these psychosocially vulnerable gamers are particularly susceptible to pathological involvement with *online* games (Ng & Wiemer-Hastings, 2006; Smyth, 2007). Online multiplayer games can provide players with a virtual community where lonely adolescents with low self-esteem and diminished social skills may avoid their real-life deficiencies through virtual contacts and achievements. This may lead to situations where players prefer contact with fellow online players over socializing with "real" people (e.g., Charlton & Danforth, 2007; Smyth, 2007). Although playing online games may temporarily reduce negative feelings associated with social deficiencies, pathological gaming does little to facilitate the development or maintenance of real-life contacts. In fact, pathological gaming binges will likely lead to displacement of real-world social interaction (Griffiths & Davies, 2005), which may deteriorate existing

relationships, thereby isolating this already vulnerable group even more. In turn, this could explain how pathological involvement increased feelings of loneliness among adolescent gamers.

In general, our study shows that lower psychosocial well-being is more likely to be a cause than a consequence of pathological gaming. Our longitudinal analyses thereby confirmed the causal interpretations from most cross-sectional studies that assumed that well-being is an antecedent of pathological gaming (e.g., Chak and Leung, 2004; Ko et al., 2005; Parsons, 2005). However, our findings question interpretations from other cross-sectional studies, which suggested a detrimental *effect* of online game addiction on, for instance, the development of social skills (e.g., Chiu, Lee, & Huang, 2004; Lo, Wang, Fang, 2005).

In light of these causal interpretations, some researchers have expressed doubts whether pathological gaming actually presents a primary condition in itself, or whether it is merely symptomatic of other underlying conditions or problems (e.g., Wood, 2008; Shaffer, Hall, & Van der Bilt, 2000). Since our findings indicate that pathological gaming is generally a consequence of decreased psychosocial well-being, we could argue that this behavior is a symptom of pre-existing psychosocial vulnerabilities. However, the finding that pathological gaming also causes an increase in loneliness suggests that pathological gaming is not merely a symptom, but may present a genuine (primary) problem in itself that elicits at least one negative psychosocial consequence.

Because social incompetence, loneliness, and low self-esteem increase pathological gaming, addressing these psychosocial problems should reduce the chances of adolescents developing this type of pathological behavior. Therefore, treatment and prevention might focus on activities that stimulate the development of social skills that help build self-esteem, and improve social contacts in a non-gaming environment. Preventing or controlling pathological gaming is of particular importance

during adolescence, because this is a pivotal time in which youth face many developmental tasks that could form the basis of their life and career satisfaction in adulthood. Furthermore, since all sorts of addictions and dependencies identified in adults commonly start in adolescence or young adulthood (Wagner & Anthony, 2002), it seems advisable that parents handle signs of pathological gaming as soon as they arise.

Nevertheless, it is important that we do not overstate the dangers of playing computer and video games. Our study indicated that adolescents' time spent playing video games was not related to their psychosocial well-being. Therefore, playing games does not decrease well-being, nor does lower well-being necessarily lead to increased use of games. However, some adolescents with pre-existing psychosocial vulnerabilities are more easily drawn into pathological involvement with this form of recreation. For these adolescents, virtual achievements and contacts may become more important than real-life experiences, causing them to forgo real-life interaction and participation in social activities which could isolate this already vulnerable group even more.

Regarding the effect of self-esteem on pathological gaming, the change from significant to non-significant when a bootstrap was applied should be interpreted with caution as two different tests of significance resulted in different outcomes. This could indicate that our measure of self-esteem was not robust, or simply that the uneven distribution of both self-esteem and pathological gaming affected the generalizability of our results. However, contrary to self-esteem, the uneven distribution of pathological gaming scores was expected, and possibly inherent to all sorts of pathological behavior, as the majority of the population is not expected to show signs of behavioral disorders. It is also important to note that our findings pertain only to Dutch adolescents. Although recent studies have shown similar patterns of pathological game use among adolescents in Germany (Batthyány, Müller, Benker, & Wölfling, 2009), and in the US

(Gentile, 2009), further research is needed to verify if the psychosocial causes and consequences for adolescents in other western and non-western countries are similar to those found among adolescent gamers in the Netherlands. Future research could also examine how family circumstances play into pathological gaming and how pathological gamers progress into young adulthood, when they are expected to become independent from their parents, find employment or attend higher education.

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