Video Gaming in a Hyperconnected World: A Cross-sectional Study of Heavy Gaming,

Problematic Gaming Symptoms, and Online Socializing in Adolescents

Michelle Colder Carras, Ph.D., Antonius J. Van Rooij, Ph.D., Dike Van de Mheen, Ph.D.,
Rashelle Musci, Ph.D., Qian-Li Xue, Ph.D., and Tamar Mendelson, Ph.D.

Drs. Michelle Colder Carras, Tamar Mendelson, and Rashelle Musci are with the Department of
Mental Health, Johns Hopkins Bloomberg School of Public Health in Baltimore, Maryland,
USA; Drs. Antonius Van Rooij and Dike Van de Mheen are with IVO Addiction Research
Institute in Rotterdam, The Netherlands and Erasmus MC, University Medical Center in
Rotterdam, The Netherlands. Dr. Van Rooij is also with iMinds-MICT-Ghent University,
Department of Communication Sciences in Belgium and Dr. Van de Mheen is with Maastricht
University, Department of Health Promotion in Maastricht, The Netherlands. Dr. Qian-Li Xue is
with the Department of Medicine, School of Medicine, Johns Hopkins University, Baltimore,
Maryland and the Center on Aging and Health, Johns Hopkins Medical Institutions, Baltimore,
Maryland.

Abstract

Aims: Examining online social interactions along with patterns of video gaming behaviors and game addiction symptoms has the potential to enrich our understanding of disorders related to excessive video game play.

Methods: We performed latent class analysis in a sample of 9733 adolescents based on heavy use of games, social networking and instant messaging, and game addiction symptoms. We used latent class regression to determine associations between classes, psychosocial well-being and friendship quality.

Results: We identified two types of heavy gaming classes that differed in probability of online social interaction. Classes with more online social interaction reported fewer problematic gaming symptoms than those with less online social interaction. Most adolescents estimated to be in heavy gaming classes had more depressive symptoms than normative classes. Male non-social gamers had more social anxiety. Female social gamers had less social anxiety and loneliness, but lower self-esteem. Friendship quality attenuated depression in some male social gamers, but strengthened associations with loneliness in some male non-social gamers.

Conclusions: In adolescents, symptoms of video game addiction depend not only on video game play but also on concurrent levels of online communication, and those who are very socially active online report fewer symptoms of game addiction.

1. Introduction

Youth in the United States are part of a "hyperconnected" world where constant digital multitasking leads to a new type of social environment that has benefits but also detractions (Anderson & Rainie, 2012). Most adolescents in the U.S. and other developed countries play video games (Lenhart, 2008; Müller et al., 2014), and while low to moderate levels of gaming may be beneficial for some adolescents (Hofferth & Moon, 2012; Przybylski, 2014), excessive video game play may lead to problems for others. This concern led to the inclusion of Internet Gaming Disorder (IGD) in the Emerging Measures section of the Diagnostic and Statistical Manual for Mental Disorders 5 (American Psychiatric Association, 2013). Although the primary focus of IGD is online gaming, many online behaviors have been associated with addiction-like problems, and because multiple behaviors can occur simultaneously, it is not simple to distinguish which behaviors may result in problematic use (Kuss, Griffiths, Karila, & Billieux, 2013). Despite decades of research, questions remain about how best to distinguish "engaged" (positive and non-pathological heavy gaming) from problematic gaming (PG), which has been conceptualized as a loss of control over gaming associated with problems and the potential for clinically significant harm (Van Rooij, 2011). Debate continues as to the appropriateness of IGD as a potential disorder, as well as the applicability of substance addiction criteria and theory to problems related to video gaming (Griffiths et al., 2016).

Most previous studies of PG and psychosocial well-being have used both generalized (Internet) and specific (video gaming) scales of problematic use to measure PG (King, Haagsma, Delfabbro, Gradisar, & Griffiths, 2013), potentially overlooking the contribution of person-level factors such as reasons for using games and other media, personality traits, and demographic characteristics as well as social factors such as friendship quality, contact with friends and

playing with others (Billieux et al., 2015; Desjarlais & Willoughby, 2010; Elson, Breuer, & Quandt, 2014; Kardefelt Winther, 2014b). Indeed, previous studies in representative samples have found that individual-level factors such as gender (Kaess et al., 2014), age (Scharkow, Festl, & Quandt, 2014), and education level (Rehbein, Kliem, Baier, Mossle, & Petry, 2015), as well as social-level factors such as friendship quality (Van Rooij, 2011) and relationships with parents (Mößle & Rehbein, 2013) modify relationships between PG and well-being.

Adolescents who interact online, whether through games or social communication and networking applications, are part of a virtual community that may expand opportunities for friendship and its protective effects on development. Online gaming may help shy adolescents expand their sources of social support (Domahidi, Festl, & Quandt, 2014) and can also provide an important way to keep up with existing friendships (Valkenburg & Peter, 2007) and make new friends and social connections (Kuss & Griffiths, 2011). According to the *social compensation hypothesis* (Valkenburg & Peter, 2007), online media users who have difficulty with real-life social interactions may use online relationships in an attempt to meet their social needs. In contrast, the *augmentation hypothesis* (Kraut et al., 2002) suggests that those who successfully use the Internet for social support are extraverts who apply their friend-making skills to this online arena. Many current video games offer the opportunity for interaction through text or voice chat as a way to coordinate strategies and activities in the game as well as foster the in-game social relationships, groups and teams that promote progress toward mutual in-game goals (Williams, 2006). When game-based communications are extended outside the game, players may experience even more social support (Trepte, Reinecke, & Juechems, 2012). However, adolescents with social anxiety, depression, or low academic achievement may also

use games as a way to compensate, leading to compulsive or problematic use over time

(Brunborg, Mentzoni, & Froyland, 2014; Lemmens, Valkenburg, & Peter, 2011).

      If PG were a construct limited to the traditional domains of addiction, we would expect

severity of addiction-like symptoms to aggregate with an increase in gaming behaviors

independently of online social behavior, and this is in fact described in the entry for Internet

gaming disorder in DSM 5 (American Psychiatric Association, 2013). This situation would

support a syndrome indicative of discrete and unidimensional gaming disorder, or possibly

quantitative levels of disorder. In contrast, examining combinations of behaviors and symptoms

may provide greater explanatory power for characterizing underlying subgroups along multiple

related dimensions (Lanza & Rhoades, 2013), which may help determine whether an addiction-

like disorder is associated only with video game play or is, in fact, a construct requiring

additional content assessing media-based social interaction in order to ensure adequate

specificity of measurement. To investigate this, we used latent class analysis to identify

subgroups (classes) of adolescent gamers based on the intersection between types of gameplay,

social interaction and symptoms of PG. We hypothesized that: 1) classes characterized by high

levels of PG would also have the lowest levels of online social interaction; 2) these classes would

differ with respect to psychosocial well-being, 3) classes characterized by high online social

interaction will have better online friendship quality, and 4) consistent with the social

compensation and augmentation hypotheses, classes with high-quality online or offline

friendships will have lower associations with negative well-being.

2. Methods

      The Monitor Internet and Youth study (Meerkerk, Van Den Eijnden, & Van Rooij, 2006)

is a yearly cross-sectional school-based survey designed to measure technology use and

psychosocial well-being in the Netherlands. The study uses stratified sampling to enhance representativeness by region, urbanicity and education level. We aggregated data from the 2009-12 study years combined for the current cross-sectional study. The final sample contained 439 classes from thirty schools. Non-response was mainly at the classroom level. Average response rates per class were 93% (2009), 93% (2010), 92% (2011) and 86.5% (2012).

Measures of self-reported problematic video game use, video game, and social Internet use were used to identify unique groups of individuals in latent class analysis. The *Video game Addiction Test (*VAT) assesses self-reported frequency of problematic symptoms of online and offline video games based on traditional addiction domains (Van Rooij, Schoenmakers, Van Den Eijnden, Vermulst, & Van De Mheen, 2012) using a 5-point interval scale. The VAT demonstrated a single factor structure with factor loadings ranging from .62 to .78 and excellent reliability (Cronbach's alpha=0.93) in a previous study using the MIY sample (Van Rooij et al., 2012). While the 14 items on the VAT do not cover the IGD criteria on a one-to-one basis, the instrument was found to be strongly associated with the IGD criteria: a clinical study with a sample of 32 problematic gamers (as confirmed by a treatment professional) showed both an elevated average VAT score in this group (symptoms endorsed an average of "Sometimes", vs. "Never" to "Seldom" in general population samples) and 91% positive identification using the nine proposed DSM-5 IGD criteria and the suggested cut-off criteria of five out of nine (Van Rooij, Schoenmakers, & Van De Mheen, 2015).

Youth were also asked how many days per week and hours per day they used instant messaging, social networking, and three types of games: multiplayer online games, browser games, and offline games played on a console. We dichotomized use into high (four or more hours per day for six or seven days per week) or low (any other use, including no use) to more

precisely identify those whose gaming may be problematic, in alignment with both clinical qualitative findings and local and international population samples (Jap, Tiatri, Jaya, & Suteja, 2013; Romer, Bagdasarov, & More, 2013; Van Rooij, Kuss, et al., 2013).

To assess psychosocial well-being, we used the average of individual items from each of the following scales, all of which have demonstrated good reliability in Dutch adolescents (Cronbach's α >.80 for all scales in this study) (Van Rooij, Schoenmakers, Vermulst, Van den Eijnden, & Van de Mheen, 2011). *Depressive symptoms* were assessed with the Depressive Mood List (Kandel & Davies, 1982). *Loneliness* was measured with the UCLA Loneliness Scale (Russell, Peplau, & Cutrona, 1980). *Social anxiety* was measured with the Social Anxiety Scale Revised (La Greca & Lopez, 1998). *Self-esteem* was assessed with Rosenberg's Self-Esteem Scale (Rosenberg, 1989); negatively worded items were reverse-coded such that a high score indicates good self-esteem. We investigated transformations to better approximate normal distributions, and all scales of psychosocial well-being were log-transformed and standardized in analyses.

Friendship quality was assessed with online and offline versions of the Network of Relationships Inventory (Furman & Buhrmester, 1985; Van Rooij, Schoenmakers, Van Den Eijnden, Vermulst, & Van De Mheen, 2013) on a 5-point scale. Students were told to skip the questions about online friendship quality if they had no friends they spoke to only on the Internet. As the rate of missing values on that scale was high due to this intentional skip pattern, we imputed missing values as "Never" and included a missing indicator in analyses. We categorized the scale into Low (Never, Almost Never or Sometimes), or High (Often to Very Often) and created a composite variable with four categories representing possible combinations of dichotomized online friendship quality (OLF) and real-life friendship quality (RLF).

Control variables. *Gender* was assessed with a binary self-report variable and *year* as the year the survey was administered (2009-2012). *Education level* was coded dichotomously as high (pre-university) or low. *Age* ranged from 13 to 16. *Ethnicity* was coded as Dutch (both parents born in the Netherlands) or non-Dutch.

2.1 Statistical analysis

We first excluded responses that were likely invalid (e.g., the highest values endorsed for each VAT item, yet low self-reported gaming). We used the first observation for students who provided data in multiple years to allow for clustering at the class level. We explored missing data, sample means and distributions and tested for differences by gender in media use and self-reported PG. We used latent class analysis with the six indicators defined above (i.e., continuous VAT score, high use of instant messaging, social networking, multiplayer online games, browser games, and offline games) to test our first hypothesis regarding the potential to identify distinct classes, accounting for clustering at the class level. The optimal number of classes was determined based on the lowest values of Bayesian Information Criterion (BIC) and low bivariate residuals, a significant Lo-Mendell-Rubin test, and classes that appeared meaningful and distinct. Although missing data for observed indicators in latent class analysis is treated with full information maximum likelihood estimation, missing data on covariates is treated by listwise deletion in Mplus (Muthén & Muthén, 2012). To determine how this treatment affected our findings, we performed a sensitivity analysis, limiting results to the part of the sample that had no missing values on covariates.

To assess our remaining hypotheses regarding associations of gaming subgroups with psychosocial wellbeing and friendship quality, we used latent class regression with a 3-step approach (Asparouhov & Muthén, 2014b). We compared changes in associations between latent

classes and psychosocial well-being before and after inclusion of a friendship quality covariate. Our final model included all control variables, the four psychosocial covariates of loneliness, depression, social anxiety and self-esteem and friendship quality. Because of our large multivariable models, we report associations as significant using Bonferroni-corrected p-values. Exploratory analyses were conducted with Stata 13 (StataCorp., 2013) and latent class analyses with Mplus v. 7.3.1 (Muthén & Muthén, 1998).

3. Results

Of the 12,348 students in our sample from 2009-2012, 10,804 had values for gender and classroom, our grouping variables, and had valid data based on consistency checks. However, an additional 9.9% of that subsample had missing data on one or more covariates (other than online friendship quality). This subsample was more likely than the study sample to have higher education level, to be younger, to have better real-life friendship quality, to have less multiplayer online game use and more social anxiety, but a sensitivity analysis (i.e., latent class modeling with two through six classes) using this smaller sample revealed that the chosen numbers of classes were still the best fit and did not change class sizes or structure appreciably, so the smaller subsample (n=9733) was used in all analyses. Of this sample, 48.8% were male and 82.1% were of Dutch background; the average age was 14.1. Use of most video games and social Internet applications differed significantly by gender, as did most psychosocial covariates (Table 1).

Table 1: Descriptive statistics by sex in analysis sample

	Males (n=4753) No. , % or Mean, SD		Females (n=4980) No. , % or Mean, SD		χ^2/t^a
Latent class indicators					
High use (4+ hours/ day, 6+ days/week)					
Any high use of games	521	11.0%	79	1.6%	369.5**
Instant messaging	345	7.4%	603	12.2%	64.1**
Social networking	247	5.3%	482	9.8%	69.4**
Multiplayer online games	406	8.7%	32	0.6%	357.9**
Browser games	30	0.6%	20	0.4%	2.6
Offline games	170	3.7%	37	0.8%	95.8**
Problematic gaming[b]	1.77	0.69	1.33	0.51	32.0**
Psychosocial covariates[c]					
Loneliness	1.64	0.49	1.60	0.51	4.17**
Depression	2.06	0.67	2.33	0.73	-19.4**
Social anxiety	1.98	0.67	2.13	0.70	-10.6**
Self-esteem	3.36	0.51	3.17	0.58	17.0**
Friendship quality					
Low OLF/High RLF	2,554	53.7%	3,043	61.1%	485.7**
High OLF/High RLF	1,326	27.9%	1,707	34.3%	
Low OLF/Low RLF	744	15.7%	155	9.2%	
High OLF/Low RLF	129	2.7%	75	1.5%	

Note: (a) p-value for continuous variables is for two-tailed t-test with unequal variances using Satterthwaite's d.f.; *=p<.05, **=p<.01. (b) Mean score, standard deviation on Videogame Addiction Test (c) Higher values indicate higher perceived friendship quality and better SE; otherwise, higher values indicate lower psychosocial well-being. Abbreviations: OLF=Online friendship quality, RLF=Real-life friendship quality
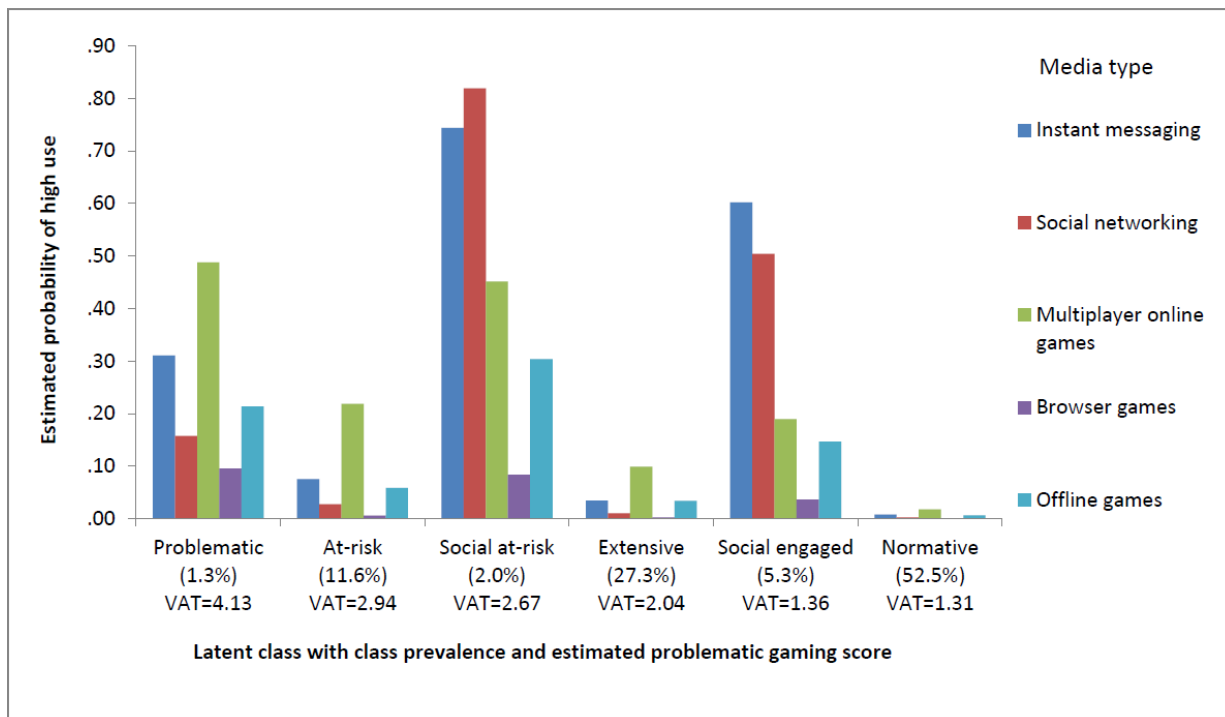
3.1 Hypothesis 1: Qualitative structure of latent classes

For both males and females, we observed that classes could be characterized as generally "social" (e.g., having a greater than 50% chance of having high online social interaction of some kind) and less social heavy gamers, with the classes with more online social interaction having fewer symptoms of PG. Consistent with previous studies of PG that characterized excessive gaming based on average item endorsement (Rehbein, Kleimann, & Mossle, 2010), we labeled classes "problematic" if VAT items were, on average, endorsed at the level of "Often" or above

(i.e., around four out of five), and "at-risk" if VAT items were, on average, not rejected (e.g., average greater than "Seldom", or three out of five). Classes labeled as Engaged had symptoms comparable to the Normative class.

We fit between two and seven classes for males. While BIC decreased throughout and entropy was acceptable in all models, only the six-class model had acceptably low residual correlations (average bivariate Pearson residual <15) (Asparouhov & Muthén, 2014a). Aside from a large class considered Normative (52.5%, estimated VAT 1.31), two classes with high levels of gaming (Problematic and Social At-Risk Gamers) and two with moderate levels of gaming (At-Risk and Social Engaged Gamers) showed similar patterns of gaming yet differed by social interaction (Figure 1).
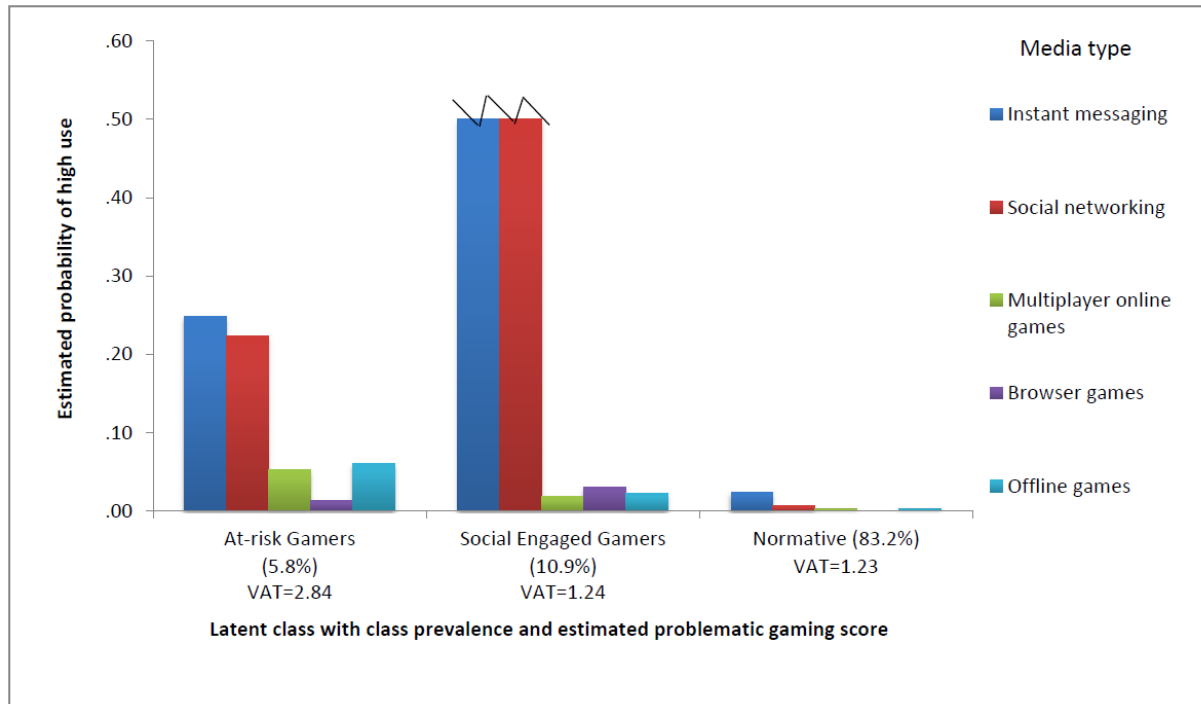
Figure 1: Estimated probabilities of high use[a] by latent class[b], males

Notes: (a) High use defined as 6/7 days per week for 4+ hours per day (b) Normative class had <3% probability of any high media use. VAT=Videogame Addiction Test.

For females, the best-fitting model had three classes (Figure 2), with the Normative class (83.2%) having little likelihood of high media use. The other two classes could again be characterized into social and less social types, and the less social type had higher estimated symptoms of PG.

Figure 2. : Estimated probabilities of high use[a] by latent class[b], females

Note: (a) High use defined as 6/7 days per week for 4+ hours per day. (b) Normative class had <3% probability of high use of any latent class indicator. (c) Probability estimates for instant messaging (0.81) and social networking (0.73) truncated in the Social Engaged Gamers class to better illustrate the distribution of indicators in other classes. VAT=Videogame Addiction Test.

3.2 Hypothesis 2: Associations between latent classes and psychosocial well-being predictors

For males, depression was significantly associated with membership in all non-normative classes (see Table 2), and social classes (Social At-Risk and Social Engaged Gamers) had less depression than their corresponding non-social classes (Bonferroni-corrected p values <.004). Higher values of social anxiety were associated with membership in the At-Risk and Extensive

Gamers classes, and At-Risk Gamers were more likely to be lonely. Of note, lower education

level was associated with Problematic and Social Engaged Gamers, and Social Engaged Gamers

were more likely to be older and non-Dutch (data not shown).

Table 2: Latent class regression in males based on most likely latent class

	Latent Class[a]														
	Problematic (1.3%)			At-risk (10.3%)			Social At-risk (1.8%)			Extensive (26.3%)			Social Engaged (5.1%)		
	b	*SE*	*p-value*[b]	*b*	*SE*	*p-value*	*b*	*SE*	*p-value*	*b*	*SE*	*p-value*	*b*	*SE*	*p-value*
Model 1: Psychosocial covariates															
Loneliness	0.17	0.22	0.43	**0.40**	**0.08**	**0.00**	0.06	0.19	0.77	0.17	0.07	0.01	-0.36	0.14	0.01
Depression	**1.21**	**0.32**	**0.00**	**0.81**	**0.08**	**0.00**	**0.85**	**0.17**	**0.00**	**0.55**	**0.06**	**0.00**	**0.40**	**0.12**	**0.00**
Social anxiety	0.24	0.23	0.29	**0.20**	**0.07**	**0.00**	-0.11	0.15	0.46	**0.40**	**0.06**	**0.00**	-0.21	0.11	0.05
Self-esteem	-0.44	0.17	0.01	-0.24	0.09	0.01	-0.17	0.18	0.34	-0.08	0.10	0.42	-0.26	0.17	0.12
Model 2: Psychosocial covariates and friendship quality[c]															
Loneliness	0.13	0.23	0.57	**0.45**	**0.09**	**0.00**	0.13	0.21	0.54	**0.22**	**0.07**	**0.00**	-0.27	0.14	0.04
Depression	**1.17**	**0.32**	**0.00**	**0.78**	**0.08**	**0.00**	**0.82**	**0.17**	**0.00**	**0.54**	**0.06**	**0.00**	0.35	0.12	0.00[d]
Social anxiety	0.24	0.22	0.28	**0.22**	**0.07**	**0.00**	-0.10	0.15	0.53	**0.40**	**0.06**	**0.00**	-0.23	0.11	0.04
Self-esteem	-0.42	0.17	0.02	-0.25	0.09	0.01	-0.14	0.19	0.46	-0.09	0.10	0.36	-0.30	0.17	0.07
Missing OLF	-0.89	0.55	0.10	**-0.55**	**0.16**	**0.00**	-0.67	0.57	0.24	**-0.45**	**0.13**	**0.00**	-0.25	0.23	0.28
Low OLF/ Low RLF	-0.35	0.48	0.47	-0.13	0.18	0.47	-0.10	0.53	0.86	-0.37	0.16	0.02	-0.55	0.35	0.11
High OLF/ Low RLF	**1.81**	**0.55**	**0.00**	0.66	0.40	0.10	1.42	0.72	0.05	0.02	0.44	0.96	1.29	0.52	0.01
High OLF /High RLF	0.64	0.39	0.11	**0.58**	**0.15**	**0.00**	0.93	0.40	0.02	0.13	0.14	0.36	0.62	0.24	0.01

Notes: (a) Latent class regressions comparing to Normative class (55.4%). (b) Bold indicates significance at Bonferroni-adjusted p-value for that model (varies by model): Model 1 p<.004, Model 2: p< .003. (c) Model 2 friendship quality logistic regression coefficients are compared to reference category of Low OLF/High RLF. (d) p=.004. OLF=Online friendship quality, RLF=Real-life friendship quality.

In females, depression was also a significant predictor of both non-normative classes (Table 3). Lower self-esteem was associated with Social Engaged Gamers, but Social Engaged Gamers were also found to have less social anxiety and loneliness. Lower education level, non-Dutch ethnicity, and older age were associated with Social Engaged Gamers, and cohort effects were found for 2011 for both classes and 2012 for Social Engaged Gamers (data not shown).

Table 3: Latent class regression in females based on most likely latent class

		Latent Class[a]				
	At-risk (4.2%)			Social Engaged (13.4%)		
	b	*SE*	*p-value*[b]	*b*	*SE*	*p-value*
Model 1: Psychosocial covariates						
Loneliness	0.07	0.11	0.53	**-0.37**	**0.07**	**0.00**
Depression	**0.79**	**0.15**	**0.00**	**0.56**	**0.08**	**0.00**
Social anxiety	0.17	0.10	0.11	**-0.26**	**0.08**	**0.00**
Self-esteem	-0.19	0.08	0.02	**-0.29**	**0.06**	**0.00**
Model 2: Psychosocial covariates and friendship quality[c]						
Loneliness	0.04	0.11	0.69	**-0.34**	**0.07**	**0.00**
Depression	**0.74**	**0.15**	**0.00**	**0.53**	**0.08**	**0.00**
Social anxiety	0.17	0.10	0.10	**-0.26**	**0.08**	**0.00**
Self-esteem	-0.15	0.08	0.07	**-0.28**	**0.06**	**0.00**
Missing OLF	-0.72	0.27	0.01	-0.07	0.19	0.72
Low OLF/ Low RLF	0.45	0.44	0.31	-0.34	0.41	0.41
High OLF/ Low RLF	1.07	0.46	0.02	0.12	0.49	0.80
High OLF /High RLF	0.64	0.24	0.01	**0.64**	**0.16**	**0.00**

Notes: (a) Latent class regressions comparing class to Normative class (82.4%). (b) Bold indicates significance at Bonferroni-adjusted p-value for that model (varies by model): Model 1: p<.004, Model 2: p< .003. (c) Model 2 friendship quality logistic regression coefficients are compared to reference category of Low OLF/High RLF. OLF=Online friendship quality, RLF=Real-life friendship quality.

3.3 Hypothesis 3: Associations between latent classes and friendship quality

Compared to the reference group of those high in real-life friendship quality but low in online friendship quality (the most common category), males having both good online *and* real-life friendships were significantly more likely to be At-Risk Gamers, while those with high-quality online friendships but *low* quality real-life friendships were more likely to be Problematic Gamers (Bonferroni-corrected p values <.003). For females, the only statistically significant finding was that those with high quality friendships on- and offline were more likely to be Social Engaged Gamers.

3.4 Hypothesis 4: Associations between latent classes and psychosocial well-being while accounting for friendship quality

For males, adding friendship quality to the model with covariates (Model 2; Table 2) produced changes in effects for Social Engaged Gamers, who were now no longer more likely from a statistical standpoint to report higher values of depression than the Normative class (Bonferroni-corrected p-value=.004, required p value <.003), and for Extensive Gamers, who were now significantly more likely to report more loneliness (Bonferroni-corrected p value=.001). For females, adding friendship quality to the model had no effect on psychosocial covariates (Model 2, Table 3).

4. Discussion

Using a data-driven, person-centered approach, we found support for our first hypothesis, that including information about online social interaction provided a meaningful way to distinguish subgroups of heavy gamers into those reporting more or fewer problems. Using this approach, gamers could be separated into social and non-social classes, with social classes reporting fewer or no feelings of problematic use at equivalent levels of play. This pattern was true for both sexes, although the overall magnitude of game use and distress was much lower in

females than males and fewer classes were distinguished. These findings do not support the idea

of PG as a discrete addiction-like disorder, as symptoms and gaming behaviors were not

independent of social interaction, and suggest that the proposed IGD may be more complex than

expected. Rather, our results support the notion that social interactions may separate problematic

gamers from "engaged gamers" who have an active online social life and experience few

symptoms of problematic use at high levels of play (Charlton & Danforth, 2007). Engaged

adolescent gamers might thus represent a group whose heavy gaming may be part of their active

participation in a digital community. This implies that the current proposed criteria for IGD (and

the recently proposed IGD-11 diagnosis Gaming Disorder) will lack specificity due to inadequate

content validity, as the criteria do not assess the social interaction that is associated with more

normative gaming. Failing to address this in future iterations of criteria will muddy the

association between truly pathological gaming and related risk factors, comorbidities and course

of disorder, as the group of individuals who test as disordered by these criteria will actually

include many who are not.

Consistent with our second study hypothesis, we found differences in well-being across

gaming subgroups, such that non-social classes were associated with lower levels of

psychosocial well-being. Importantly, before friendship quality was taken into account, all heavy

gaming classes in both boys and girls were associated with more depressive symptoms. One

possible explanation for this is heavy gamers feel depressed, and their heavy gaming does not

relieve symptoms (Caplan, Williams, & Yee, 2009). It may be that depressive symptoms in the

setting of heavy gaming represent a level of dysregulation that is not amenable to any benefits of

social interaction.

Associations between social classes and well-being differed between males and females. While male social gamers had no significant associations with well-being other than depression, female Social Engaged gamers reported less loneliness and social anxiety than average adolescents did. When combined with high online social interaction, heavy gaming may thus be a way for female adolescents to successfully reduce loneliness and social anxiety by making new friends or extending their real-life friendships without developing feelings of PG (Domahidi et al., 2014). However, this class also showed lower self-esteem, suggesting that social support received online may not be associated with better self-worth for this group. Girls in this group may correspond to the "unregulated escapers" found by Billieux and colleagues in a cluster analysis of adult online gamers (Billieux et al., 2015). This group, which had more females than other groups in the cluster analysis, was found to have more negative affect and lower self-esteem, and cited social motivations as their primary reason for playing online games. It is also possible that girls with low self-esteem are drawn to social networking use (Kuss & Griffiths, 2011) and later come into contact with online games (Rehbein & Mößle, 2013). This is more consistent with the pattern of game and social Internet use found here.

The classes with the least amount of online social interaction in males, At-Risk and Extensive Gamers, were associated with social anxiety. In addition, At-Risk boys reported more loneliness, supporting the idea that patterns of heavy gaming in the absence of heavy online social interaction may be a maladaptive way to cope (Kardefelt Winther, 2014a). This suggests that boys with social anxiety who game heavily in the absence of significant online social interaction may have a less adaptive pattern of use and might be at greater risk of problems with gaming. This could also reflect motivations for gaming such as gaming to escape or to garner in-game achievements, which may be tied to unmet psychological needs (Kardefelt Winther,

2014b). A previous cluster analytic study found that clusters characterized by either or both of these motivations had more impulsivity or problems with self-regulation and higher levels of PG symptoms (Billieux et al., 2015). If this is the case, treatment and prevention efforts should focus on helping less-social gamers to develop additional coping skills.

We found support for our third hypothesis, that classes with high online social interaction would have better friendship quality, only in females, where Social Engaged gamers were found to have higher-quality friendships both on-and offline compared to the Normative class. In fact, some classes that were less active on social networking and instant messaging reported high online friendship quality, either in the presence of low-quality real-life (male Problematic Gamers) or high quality real-life (male At-Risk Gamers) friendships. As Problematic Gamers did have some online social interaction, they may have spent significant time developing social relationships. Previous studies have shown that social motivations for video game play are associated with more PG symptoms (Kuss et al., 2013) as well as a greater sense of community online (Shen & Chen, 2015), which may alleviate some problems but contribute to others (Kardefelt Winther, 2014b). Further studies should include motivation for play and could investigate the potential for interactions between social anxiety, social motivation and friendship quality. Another unexpected finding is that At-Risk Gamers, who reported low levels of online social interaction, felt both online and real-life friendships to be high quality. This may reflect the subjective nature of self-reports of friendship quality by adolescents (Zurko, 2011), but it is also possible that this group uses another form of online interaction such as voice chat to develop relationships. However, that possibility would not be consistent with this subgroup's report of more loneliness and social anxiety. The subjective experience of online friendships is thus an important topic for further study.

We found support for our fourth hypothesis that associations between gaming subgroups and psychosocial indicators would change when friendship quality was considered, only for males. For male Social Engaged Gamers, the association between depression and heavy gaming classes was no longer significant when friendship quality was included. Since boys (and girls) seek social support online (Lenhart, Smith, Anderson, Duggan, & Perrin, 2015; Valkenburg & Peter, 2007, 2011), male Social Engaged gamers may be successfully pursuing a pattern that improves their well-being. Although female Social Engaged Gamers had similar findings and were significantly more likely to have high-quality online and offline friendships, they showed no difference in depression as a result. This finding is puzzling; females seek relief from depression in social support (Khurana & Romer, 2012), so the finding of good-quality friendships both on and offline suggests that girls may have access to additional social support through online friendships and thus the potential to relieve symptoms. Others have suggested that the relationship between depression and heavy Internet and game use is complex (Romer et al., 2013); further studies could examine depression using more complex modeling techniques, including changes over time. The effect of loneliness on membership in the Extensive Gamers class was strengthened by accounting for friendship quality. It is possible that this represents inconsistent mediation—a suppression effect—or some more complicated relationship. While this study attempted to include multiple predictors of PG, there are many potential interrelations between well-being variables, friendship quality and problems related to gaming that may require testing specific hypotheses regarding mediation and moderation.

Limitations of our study include our use of cross-sectional data, which means we were unable to draw conclusions about causal relationships between gaming and psychosocial well-being. An alternative explanation could be that interactions between the proposed gaming

disorder and social factors could be driving our findings. In addition, because our data are self-report, they may reflect social desirability or recall biases.

Our findings indicate that PG may not be a discrete combination of gaming behaviors and addiction-like symptoms as suggested by the proposed IGD diagnosis, but rather a construct that cannot be separated from concurrent online social interaction. This suggests that including data on social Internet interactions and friendship quality in analyses of problems related to gaming is necessary for understanding of adolescents' problematic gaming and psychosocial well-being. For some adolescents, heavy gaming combined with a highly engaged online social life may seem excessive but ultimately be useful. Adolescent heavy gamers who spurn online social interactions, on the other hand, may have lower emotional functioning in more domains, which may indicate underlying pathology. In this case, it may be helpful for clinicians to address reasons for heavy gaming in conjunction with techniques such as motivational interviewing to promote behavior change (Van Rooij, 2011). Future longitudinal research can build on these findings to advance our understanding of trajectories of gaming and psychosocial well-being across subgroups, ultimately contributing to strategies for preventing or treating problems related to excessive media use. In addition, as stated above, further discussion of potential disorders related to video gaming should include discussion of social or non-social gaming patterns and the importance of distinguishing adaptive from maladaptive gaming through assessment of functional impairment or distress not only in a clinical diagnosis, but also in self-report scales. Evaluating concurrent online social interactions in the consideration of preventive interventions may also help identify those who may be at higher risk of problems in order to target prevention efforts, which might address enhancing the development of social skills and promoting activities to enrich social participation.

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