

See discussions, stats, and author profiles for this publication at: https://www.researchgate.net/publication/311289587

Video Gaming in a Hyperconnected World: A Cross-sectional Study of Heavy Gaming, Problematic Gaming Symptoms, and...

Article in Computers in Human Behavior · December 2016

DOI: 10.1016/j.chb.2016.11.060

CITATIONS 5		reads 429	
6 author	's , including:		
	Michelle Colder Carras Johns Hopkins Bloomberg School of Public He 23 PUBLICATIONS 715 CITATIONS SEE PROFILE		Antonius J. van Rooij Trimbos-instituut 93 PUBLICATIONS 1,433 CITATIONS SEE PROFILE
	Dike van de Mheen Tilburg University 143 PUBLICATIONS 1,708 CITATIONS SEE PROFILE		R. Musci Johns Hopkins Bloomberg School of Public He 42 PUBLICATIONS 164 CITATIONS SEE PROFILE

Some of the authors of this publication are also working on these related projects:



Monitor Internet & Youth (IVO) View project

Treatment of addiction in general practice View project

All content following this page was uploaded by Michelle Colder Carras on 03 December 2017.

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.

© 2016. This manuscript version is made available under the CC-BY-NC-ND 4.0 license: <u>http://creativecommons.org/licenses/by-nc-nd/4.0/</u> In press in Computers in Human Behavior, 12/2016.

Declaration of interests: This research was supported by the National Institute on Drug Abuse Training Grant T32DA007292 and the National Institute of Mental Health Training Grant 5T32MH014592-39. The authors declare no competing interests.

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 addictionlike 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 $\alpha >$.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 selfreported 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).

	Ma	ales	Fen	nales	
	(n=4	753)	(n=4980)		
	No. ,	% or	No. , % or		2
	Mea	n, SD	Mec	ın, 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%	

Table 1: Descriptive statistics by sex in analysis sample

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).

	Problematic (1.3%)		At-risk (10.3%)			Latent Class ^a 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: Psychosoci	al covariate.	s 0.22	0.42	0.40	0.00	0.00	0.00	0.10	0.77	0.47	0.07	0.01	0.26	0.14	0.01
Depression	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
Social anxiety	1.21	0.32	0.00	0.01	0.08	0.00	0.85	0.17	0.00	0.55	0.06	0.00	0.40	0.12	0.00
Solidi all Xiety	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
Sen-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: Psychosoci	al covariate.	s and frie	endship qu	ality ^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 High OLF / High	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
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

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

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).

	Latent Class ^a								
	Α	t-risk (4	.2%)	Social Engaged (13.4%					
	b	SE	p-value ^b	b	SE	p-value			
Model 1: Psychosocia	l covariate	es							
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: Psychosocia	l covariate	es and frie	endship qua	<i>lity^c</i>					
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			

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

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 selfesteem, 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 ingame 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 wellbeing. 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 selfreport, 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.

References

- American Psychiatric Association. (2013, May). PsychiatryOnline | Diagnostic and Statistical Manual of Mental Disorders, 5th Edition | Substance-Related and Addictive Disorders. Retrieved April 5, 2014, from zotero://attachment/14996/
- Anderson, J., & Rainie, L. (2012, February 29). Millennials will benefit and suffer due to their hyperconnected lives. Retrieved from http://www.pewinternet.org/2012/02/29/millennials-will-benefit-and-suffer-due-to-their-hyperconnected-lives/
- Asparouhov, T., & Muthén, B. O. (2014a, March 4). Residual Associations in Latent Class and Latent Transition Analysis. Muthén & Muthén. Retrieved from http://www.statmodel.com/download/LLAssoc.pdf
- Asparouhov, T., & Muthén, B. O. (2014b, August 5). Auxiliary Variables in Mixture Modeling: 3-Step Approaches Using Mplus. Muthén & Muthén. Retrieved from http://www.statmodel.com/examples/webnotes/webnote15.pdf
- Billieux, J., Thorens, G., Khazaal, Y., Zullino, D., Achab, S., & Van der Linden, M. (2015). Problematic involvement in online games: A cluster analytic approach. *Computers in Human Behavior*, 43, 242–250. https://doi.org/10.1016/j.chb.2014.10.055
- Brunborg, G. S., Mentzoni, R. A., & Froyland, L. R. (2014). Is video gaming, or video game addiction, associated with depression, academic achievement, heavy episodic drinking, or conduct problems? *Journal of Behavioral Addictions*, *3*(1). https://doi.org/10.1556/JBA.3.2014.002
- Caplan, S., Williams, D., & Yee, N. (2009). Problematic internet use and psychosocial well-being among MMO players. *Computers in Human Behavior*, *25*(6), 1312–1319. https://doi.org/10.1016/j.chb.2009.06.006
- Charlton, J. P., & Danforth, I. D. W. (2007). Distinguishing addiction and high engagement in the context of online game playing. *Computers in Human Behavior*, *23*(3), 1531–1548.

- Desjarlais, M., & Willoughby, T. (2010). A longitudinal study of the relation between adolescent boys and girls' computer use with friends and friendship quality: Support for the social compensation or the rich-get-richer hypothesis? *Computers in Human Behavior*, *26*(5), 896–905. https://doi.org/10.1016/j.chb.2010.02.004
- Domahidi, E., Festl, R., & Quandt, T. (2014). To dwell among gamers: Investigating the relationship between social online game use and gaming-related friendships. *Computers in Human Behavior*, *35*, 107–115. https://doi.org/10.1016/j.chb.2014.02.023
- Elson, M., Breuer, J., & Quandt, T. (2014). Know Thy Player: An Integrated Model of Player Experience for Digital Games Research. In rios C. Angelides & H. Agius (Eds.), *Handbook of Digital Games* (pp. 362–387). John Wiley & Sons, Inc. Retrieved from

http://onlinelibrary.wiley.com/doi/10.1002/9781118796443.ch13/summary

- Furman, W., & Buhrmester, D. (1985). Children's perceptions of the personal relationships in their social networks. *Developmental Psychology*, 21(6), 1016–1024. https://doi.org/10.1037/0012-1649.21.6.1016
- Griffiths, M. D., Van Rooij, A. J., Kardefelt-Winther, D., Starcevic, V., Király, O., Pallesen, S., ...
 Demetrovics, Z. (2016). Working towards an international consensus on criteria for assessing internet gaming disorder: a critical commentary on Petry et al. (2014). *Addiction (Abingdon, England)*, *111*(1), 167–175. https://doi.org/10.1111/add.13057
- Hofferth, S. L., & Moon, U. J. (2012). Electronic Play, Study, Communication, and Adolescent Achievement, 2003 to 2008. *Journal of Research on Adolescence: The Official Journal of the Society for Research on Adolescence*, 22(2), 215–224. https://doi.org/10.1111/j.1532-7795.2011.00770.x
- Jap, T., Tiatri, S., Jaya, E. S., & Suteja, M. S. (2013). The development of indonesian online game addiction questionnaire. *PloS One*, *8*(4). https://doi.org/10.1371/journal.pone.0061098

- Kaess, M., Durkee, T., Brunner, R., Carli, V., Parzer, P., Wasserman, C., ... Wasserman, D. (2014).
 Pathological Internet use among European adolescents: psychopathology and self-destructive behaviours. *European Child & Adolescent Psychiatry*. https://doi.org/10.1007/s00787-014-0562-7
- Kandel, D. B., & Davies, M. N. O. (1982). Epidemiology of depressive mood in adolescents: An empirical study. Archives of General Psychiatry, 39(10), 1205–1212. https://doi.org/10.1001/archpsyc.1982.04290100065011
- Kardefelt Winther, D. (2014a). A conceptual and methodological critique of internet addiction research:
 Towards a model of compensatory internet use. *Computers in Human Behavior*, *31*, 351–354.
 https://doi.org/10.1016/j.chb.2013.10.059
- Kardefelt Winther, D. (2014b). Problematizing excessive online gaming and its psychological predictors. *Computers in Human Behavior*, *31*, 118–122. https://doi.org/10.1016/j.chb.2013.10.017
- Khurana, A., & Romer, D. (2012). Modeling the distinct pathways of influence of coping strategies on youth suicidal ideation: a national longitudinal study. *Prevention Science: The Official Journal of the Society for Prevention Research*, *13*(6), 644–654. https://doi.org/10.1007/s11121-012-0292-3
- King, D. L., Haagsma, M. C., Delfabbro, P. H., Gradisar, M., & Griffiths, M. D. (2013). Toward a consensus definition of pathological video-gaming: A systematic review of psychometric assessment tools. *Clinical Psychology Review*, 33(3), 331–342. https://doi.org/10.1016/j.cpr.2013.01.002
- Kraut, R., Kiesler, S., Boneva, B., Cummings, J. N., Helgeson, V., & Crawford, A. M. (2002). Internet paradox revisited. *Journal of Social Issues*, 58(1), 49–74. https://doi.org/10.1111/1540-4560.00248

- Kuss, D., & Griffiths, M. D. (2011). Online social networking and addiction--a review of the psychological literature. *International Journal of Environmental Research and Public Health*, 8(9), 3528–3552. https://doi.org/10.3390/ijerph8093528
- Kuss, D., Griffiths, M. D., Karila, L., & Billieux, J. (2013). Internet Addiction: A Systematic Review of Epidemiological Research for the Last Decade. *Current Pharmaceutical Design*.

La Greca, A. M., & Lopez, N. (1998). Social anxiety among adolescents: Linkages with peer relations and friendships. *Journal of Abnormal Child Psychology*, *26*(2), 83–94. https://doi.org/10.1023/A:1022684520514

- Lanza, S. T., & Rhoades, B. L. (2013). Latent class analysis: an alternative perspective on subgroup analysis in prevention and treatment. *Prevention Science: The Official Journal of the Society for Prevention Research*, 14(2), 157–168. https://doi.org/10.1007/s11121-011-0201-1
- Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). Psychosocial causes and consequences of pathological gaming. *Computers in Human Behavior*, *27*(1), 144–152.
- Lenhart, A. (2008, September 16). Teens, Video Games and Civics | Pew Research Center's Internet & American Life Project. Retrieved November 7, 2013, from

http://www.pewinternet.org/Reports/2008/Teens-Video-Games-and-Civics.aspx

Lenhart, A., Smith, A., Anderson, M., Duggan, M., & Perrin, A. (2015). *Teens, technology and friendships*. Pew Research Center. Retrieved from http://www.pewinternet.org/2015/08/06/teenstechnology-and-friendships/

 Meerkerk, G.-J., Van Den Eijnden, R. J. J. M., & Van Rooij, A. J. (2006). Monitor Internet en Jongeren: Compulsief Internetgebruik onder Nederlandse Jongeren [Monitor Internet and Youth: Compulsive Internet Use Among Dutch Youth] (Factsheet). Rotterdam: IVO. Retrieved from 11/27/2013

- Mößle, T., & Rehbein, F. (2013). Predictors of problematic video game usage in childhood and adolescence. *Sucht: Zeitschrift Für Wissenschaft Und Praxis*, *59*(3), 153–164.
- Müller, K. W., Janikian, M., Dreier, M., Wolfling, K., Beutel, M. E., Tzavara, C., ... Tsitsika, A. (2014).
 Regular gaming behavior and internet gaming disorder in European adolescents: results from a cross-national representative survey of prevalence, predictors, and psychopathological correlates. *European Child & Adolescent Psychiatry*. https://doi.org/10.1007/s00787-014-0611-2
- Muthén, B. O., & Muthén, L. K. (1998). Mplus (Version 7.3).
- Muthén, L. K., & Muthén, B. O. (2012). *Mplus user's guide.* (Seventh). Los Angeles, CA: Muthén & Muthén.
- Przybylski, A. K. (2014). Electronic gaming and psychosocial adjustment. *Pediatrics*, 134(3), e716-722. https://doi.org/10.1542/peds.2013-4021
- Rehbein, F., Kleimann, M., & Mossle, T. (2010). Prevalence and risk factors of video game dependency in adolescence: results of a German nationwide survey. *Cyberpsychology, Behavior and Social Networking*, *13*(3), 269–277.
- Rehbein, F., Kliem, S., Baier, D., Mossle, T., & Petry, N. M. (2015). Prevalence of Internet Gaming Disorder in German adolescents: diagnostic contribution of the nine DSM-5 criteria in a statewide representative sample. *Addiction (Abingdon, England)*. https://doi.org/10.1111/add.12849
- Rehbein, F., & Mößle, T. (2013). Video game and internet addiction: Is there a need for differentiation?
 Sucht: Zeitschrift Für Wissenschaft Und Praxis, 59(3), 129–142. https://doi.org/10.1024/0939-5911.a000245
- Romer, D., Bagdasarov, Z., & More, E. (2013). Older versus newer media and the well-being of United States youth: results from a national longitudinal panel. *The Journal of Adolescent Health:*

Official Publication of the Society for Adolescent Medicine, *52*(5), 613–619.

https://doi.org/10.1016/j.jadohealth.2012.11.012

- Rosenberg, M. (1989). Society and the adolescent self-image. Middletown, Conn.: Wesleyan University Press.
- Russell, D., Peplau, L. A., & Cutrona, C. E. (1980). The revised UCLA Loneliness Scale: Concurrent and discriminant validity evidence. *Journal of Personality and Social Psychology*, *39*(3), 472–480. https://doi.org/10.1037/0022-3514.39.3.472
- Scharkow, M., Festl, R., & Quandt, T. (2014). Longitudinal patterns of problematic computer game use among adolescents and adults-a 2-year panel study. *Addiction (Abingdon, England)*. https://doi.org/10.1111/add.12662
- Shen, C., & Chen, W. (2015). Social Capital, Coplaying Patterns, and Health Disruptions. *Comput. Hum. Behav.*, 52(C), 243–249. https://doi.org/10.1016/j.chb.2015.05.053

StataCorp. (2013). Stata statistical software: Release 13. College Station, TX: StataCorp LP.

- Trepte, S., Reinecke, L., & Juechems, K. (2012). The social side of gaming: How playing online computer games creates online and offline social support. *Computers in Human Behavior*, *28*(3), 832–839. https://doi.org/10.1016/j.chb.2011.12.003
- Valkenburg, P. M., & Peter, J. (2007). Online communication and adolescent well-being: Testing the stimulation versus the displacement hypothesis. *Journal of Computer-Mediated Communication*, 12(4), 1169–1182. https://doi.org/10.1111/j.1083-6101.2007.00368.x

Valkenburg, P. M., & Peter, J. (2011). Online communication among adolescents: an integrated model of its attraction, opportunities, and risks. *The Journal of Adolescent Health: Official Publication of the Society for Adolescent Medicine*, *48*(2), 121–127. https://doi.org/10.1016/j.jadohealth.2010.08.020 Van Rooij, A. J. (2011). *Online video game addiction: Exploring a new phenomenon*. Erasmus University, The Netherlands. Retrieved from

http://repub.eur.nl/res/pub/23381/110511_Rooij,%20Antonius%20Johannes%20van%20-%20Online%20Video%20Game%20Addiction.%20Thesis%20print.pdf

Van Rooij, A. J., Kuss, D. J., Griffiths, M., Shorter, G. W., Schoenmakers, T. M., & Van de Mheen, D. (2013, June). *The (Co-)Occurrence of Problematic Video Game Play, Substance Use, and Psychosocial Problems in Adolescents*. Presented at the International Communications Association
 Conference, London. Retrieved from http://www.icahdq.org/conf/2013/program.asp

- Van Rooij, A. J., Schoenmakers, T. M., & Van De Mheen, D. (2015). Clinical validation of the C-VAT 2.0 assessment tool for gaming disorder: A sensitivity analysis of the proposed DSM-5 criteria and the clinical characteristics of young patients with "video game addiction." *Addictive Behaviors*. https://doi.org/10.1016/j.addbeh.2015.10.018
- Van Rooij, A. J., Schoenmakers, T. M., Van Den Eijnden, R. J. J. M., Vermulst, A. A., & Van De Mheen, D.
 (2012). Video game Addiction Test: Validity and psychometric characteristics. *Cyberpsychology, Behavior, and Social Networking*, 15(9), 507–511. https://doi.org/10.1089/cyber.2012.0007
- Van Rooij, A. J., Schoenmakers, T. M., Van Den Eijnden, R. J. J. M., Vermulst, A. A., & Van De Mheen, D. (2013). Friendship quality matters for multiplayer gamers: The role of online and real-life friendship quality in the relationship between game addition and psychological well-being in a sample of adolescent online gamers. In *Multiplayer: The Social Aspects of Digital Gaming* (pp. 215–227). Abingdon, Oxon: Routledge.
- Van Rooij, A. J., Schoenmakers, T. M., Vermulst, A. A., Van den Eijnden, R. J. J. M., & Van de Mheen, D. (2011). Online video game addiction: identification of addicted adolescent gamers. *Addiction* (*Abingdon, England*), 106(1), 205–212. https://doi.org/10.1111/j.1360-0443.2010.03104.x

- Williams, D. (2006). From Tree House to Barracks: The Social Life of Guilds in World of Warcraft. *Games* and Culture, 1(4), 338–361. https://doi.org/10.1177/1555412006292616
- Zurko, M. (2011). Friendship during adolescence: The necessity for qualitative research of close relationships. *Polish Journal of Applied Psychology*, *9*(1), 21–38.