

**Published as: Smohai, M., Urbán, R., Griffiths, M.D., Király, O, Mirnics, Z., Vargha, A. & Demetrovics, Z. (2016). Online and offline video game use in adolescents: Measurement invariance and problem severity. *American Journal of Drug and Alcohol Abuse*, doi.org/10.1080/00952990.2016.1240798**

## ABSTRACT

*Background:* Despite the increasing popularity of videogame playing, little is known about the similarities and differences between online and offline videogame players. However, the characteristics of online and offline gaming might predispose different pattern of problematic use. *Objectives:* The aims of this study were to (i) test applicability and the measurement invariance of the previously developed Problematic Online Gaming Questionnaire (POGQ) in both online and offline gamers; and (ii) examine the differences between online and offline gamers in the dimensions of problematic use. *Methods:* A total of 1,964 adolescent videogame players were recruited. Information on videogame use habits were collected and all gamers were administered the POGQ. Those gamers who played at least sometimes in an online context were considered as “online gamers” and “offline gamers” were those who played videogames exclusively offline. *Results:* Confirmatory factor analysis supported the measurement invariance across online and offline videogame players. According to the multiple indicators multiple causes (MIMIC) model, online gamers were more likely to score higher on overuse, interpersonal conflict, and social isolation subscales of the POGQ. *Conclusion:* The results of the present study suggest that online and offline gaming can be assessed using the same psychometric instrument. These findings open the possibility for future research studies concerning problematic video game to include participants who exclusively play either online or offline games, or both.

However, the study also identified important structural features about how online and offline gaming might contribute differently to problematic use. These results provide important information and ideas that could be utilized in parental education and prevention program about the possible detrimental consequences of online vs. offline video game use.

## **Introduction**

Videogame playing has become a very popular activity across various age groups (1). However, some people who play videogames heavily develop dysfunctional symptoms and mental health problems such as depression, anxiety, social phobias, and lower school performance (2-5). Videogames can be classified by the medium in which they are played (i.e., online versus offline) and as a consequence may lead to different types of playing behavior. For instance, while offline games are usually played alone and have a predetermined end-point, online games are often endless and played interactively and simultaneously with many other gamers and include competition and cooperation (6), as well as team obligations and responsibilities (7). In the recent years, examination of offline videogame players has received much less empirical attention, although problematic use may also be present among this group (8). Several studies have explicitly noted the role of structural characteristics in problematic gaming (9) that may also be important in the case of online vs. offline games. Indeed, some studies have compared the addictive potential of online vs. offline games based on their distinct structural characteristics and found that online games were more popular, more attractive, and had a stronger association with problematic use than offline games (eg. 10-12).

The fifth edition of the Diagnostic and Statistical Manual of Mental Disorders (13) proposed a possible new diagnostic category of Internet Gaming Disorder in

Section 3 ('Emerging Measures and Models') (3,14). In accordance with this, an emerging consensus suggests that pathological videogame playing is commonly defined by (i) withdrawal, (ii) loss of control, and (iii) conflicts associated with occupational/educational duties and/or relationships. Additionally, some conceptualizations also add further dimensions such as cognitive salience, tolerance, escape, euphoria, relapse, and deception (15).

However, to date, there has been a psychometric and conceptual weakness in the literature regarding the demonstrated measurement invariance between online and offline videogame players, although it is a prerequisite for assessing both groups using the same problematic online video game use questionnaire and for making psychometrically sound comparisons (16). At present, there are two major measurement approaches in assessing pathological and problematic videogame playing (6,15). One group of instruments has been specifically developed exclusively for online videogame players. The second group of assessment instruments do not differentiate between gamer type (i.e., online or offline game players). Furthermore, neither of these approaches has tested the potentially different psychometric properties including factor structure or measurement invariance. An overview of the existing measures and assessment approaches of problematic video gaming is available elsewhere (15,17).

Given these shortcomings, the aim of the present study was to (i) test the measurement invariance of the Problematic Online Gaming Questionnaire (an instrument with good psychometric properties used to assess problematic online gaming; 18) between online and offline gamers; and (ii) examine the relationship between the medium of videogame playing (i.e., online vs. offline gaming) and the dimensions of problematic use controlling for playing time and gender.

## **Material and methods**

### *Sample and procedure*

Secondary school students attending Grade 7 (13-years old) or above were recruited with the help of their computer science teachers. This age group was specifically chosen due to their increased vulnerability regarding problematic video games use suggested by previous empirical research (eg. 18). An invitation letter was sent to 350 secondary schools with the detailed study protocol asking for their support. A total of 47 schools from 33 different cities and villages across Hungary agreed to participate. They forwarded the research team's invitation to the students and secured time during informatics classes to fill out the anonymous and confidential online questionnaire. Eligibility for inclusion was playing videogames at least once a month. After giving informed consent, a total of 1,964 videogame players completed the questionnaire (mean age was 16.0 years [SD = 1.52], and 71.4% were boys).

### *Measures*

Problematic online gaming was assessed by the Problematic Online Gaming Questionnaire (POGQ; 19). The POGQ is a 18-item self-report assessment tool with good psychometric properties according to confirmatory factor analyses and internal consistency analyses (Cronbach alpha's [.73;.87]) (19). The items are measured on a 5-point Likert scale (from "never" to "always/almost always"). POGQ assesses six dimensions of gaming-related problems including preoccupation, overuse, immersion, social isolation (e.g. "How often do you choose gaming over going out with someone?"), interpersonal conflicts, and withdrawal (e.g. "How often do you get irritable or upset when you cannot play?").

Videogame use habits were assessed using the method of Gentile and colleagues (20). Participants were asked the name and type of the five videogames they most usually played (online and/or offline), and the amount of time they spent playing games during four different time periods (morning, afternoon, evening, dawn) on weekdays and weekends. From these responses, a mean average daily amount of game playing time was calculated.

The POGQ only assesses problematic online gaming behavior, without considering offline aspects that can be crucial if a video game player plays offline only. Pathological gaming is not only related to online games, but can also occur in offline games (21). However, the applicability of the POGQ in assessing playing behavior of exclusively offline gamers has yet to be established. Furthermore, to date, the question of applicability to offline gaming has yet to be investigated among other similar measures concerning pathological online game play or online game addiction (e.g., Compulsive Internet Use Scale, Van Rooij et al., 2010; Online Game Addiction Index, Zhou & Li, 2009). Participants who played videogames both online and offline were labeled as online players, because unlike offline-only players they play online at least sometimes, therefore they are familiar with online gaming context. Subsequently these two aforementioned groups were labeled as “regular online” and “exclusively offline” video game players. This latter group does not play online, only offline.

#### *Data analysis*

Statistical analyses were conducted using the statistical package Mplus 7.1 (24). In order to assess the invariance between online and offline gamer players of the POGQ, multigroup confirmatory factor analysis (MGCFA) was performed. A satisfactory degree of fit requires a comparative fit index (CFI) and a Tucker-Lewis

Index (TLI) higher than or close to .95 (25). A standardized root mean square residual (SRMR) value below .08 is considered a good fit (26).

In order to test the association between gamer types by medium (i.e., online/offline) and problematic use, a multiple indicators multiple causes (MIMIC) model controlling for playing time and gender was applied. The MIMIC modeling, a specification of structural equation modeling, can estimate the effects of indicators on simultaneous latent variables when direct effects of grouping variables or other continuous variables on the latent variables are also included. Due to elimination of measurement error, MIMIC model provides more precise estimates of associations between multiple latent variables such as dimensions of problematic online gaming and predictor variables such as age, gender, types of players, and indicators of quantity of playing. Models were estimated using the robust maximum-likelihood method implemented in Mplus (24).

## **Results**

### *Descriptive statistics*

The majority of the participants were male (71,4%, n=1,402), the overall response rate was 68%. The sample comprised more online (83.6%, n=1641) than offline gamers. In Table 1, the demographic characteristics, playing time, and POGQ responses of the online and offline groups are displayed. Correlations among the study variables, and detailed descriptive statistics are reported in Table 2.

— Table 1 —

— Table 2 —

### *Tests of measurement invariance among online and offline gamer players*

The measurement invariance (equal latent form, equal factor loadings, equal indicator intercepts, equal factor variances, and equal factor correlations) of the POGQ was tested with MGCFA in online and offline gamers. The model fit in gamer types was estimated separately, and yielded an adequate degree of fit in online gamers ( $\chi^2=990.56$ ,  $df=120$ ,  $RMSEA = .064$ ,  $CFI = .92$ ,  $TLI = .90$ ,  $SRMR = .051$ ) and an acceptable fit in offline gamers ( $\chi^2 = 283.76$ ,  $df=120$ ,  $RMSEA = .064$ ,  $CFI = .90$ ,  $TLI = .87$ ,  $SRMR = .059$ ).

Three nested models with increasing constraints in terms of equality of parameters (equality of loadings and equality of loadings and intercepts) were estimated following the usual method in testing measurement equivalence (16). The fit indices are reported in Table 3. First, the configural invariance model was estimated freely in online and offline players together. This unconstrained solution testing the configural invariance fitted the data satisfactorily. In the second model named metric model, the factor loadings were set as equal between the gamer types. The degree of fit ( $\chi^2$ ) did not decrease significantly (Satorra–Bentler scaled  $\chi^2$  difference test =16.91,  $df = 12$ ,  $p > .05$ ). Additionally, the other indices still remained in the acceptable range. In the third model, the item intercepts were set as equal. The degree of fit ( $\chi^2$ ) did not decrease significantly either (Satorra–Bentler scaled  $\chi^2$  difference test = 18.25,  $df = 12$ ,  $p > .05$ ). This analysis therefore supports measurement invariance across online and offline videogame players.

— Table 3 —

*Problematic use among online and offline players: MIMIC model*

In order to examine the relationship between videogame player medium type (online/offline), and problematic use controlling for playing time and gender, a six-factor MIMIC model was constructed (see Fig.1). The left side of the model displays

the measurement model of the six latent factors represented by multiple indicators. On the right side, the model is complemented with the structural part by including multiple causes such as gamer type (online/offline), playing time, age and gender to investigate the effect of these variables on the latent constructs.

The impacts of gamer type, playing time, age and gender on the six different problem factors were estimated simultaneously via standardized partial regression coefficients. The gender difference reflects that boys show higher endorsement in all dimensions of problematic videogame use (ranging from  $\beta = -.13$ ;  $z = -6.62$ ;  $p < .001$  for Withdrawal to  $\beta = -.26$ ;  $z = -12.79$ ;  $p < .001$  for Obsession). Playing time was related positively to all six latent variables (ranging from  $\beta = .31$ ;  $z = 11.44$ ;  $p < .001$  for Overuse to  $\beta = .47$ ;  $z = 20.25$ ;  $p < .001$  for Preoccupation). Controlling for playing time and gender, online players were more likely to score higher on the dimensions of overuse ( $\beta = -.08$ ;  $z = -3.95$ ;  $p < .001$ ), interpersonal conflict ( $\beta = -.05$ ;  $z = -3.14$ ;  $p < .01$ ), and social isolation ( $\beta = -.04$ ;  $z = -2.42$ ;  $p < .05$ ). Offline players were more likely to spend less time in videogames ( $r = -.16$ ;  $p < .001$ ) and a slightly greater proportion of girls played offline than online ( $r = .13$ ;  $p < .001$ ). Age was positively related to playing time ( $r = .08$ ;  $p < .001$ ), but negatively related with all POGQ subscales excluding social isolation. Using four explanatory variables, a relatively large proportion of variance of the latent variables can be explained ( $R^2$  ranged between 19%-29%). Playing time appeared to be a more important predictor for problematic video gaming than gamer type, gender, or age.

— Figure 1 —

#### 4. Discussion



In order to compare problematic use in online and offline videogame players, the measurement invariance of self-reported scales of problematic use in both groups must be demonstrated. The first analysis in the present study addressed the measurement invariance of a problem use scale (i.e., the Problematic Online Gaming Questionnaire; 19) in an adolescent sample. The analysis demonstrated configural, metric and scalar invariance of the POGQ, therefore the latent means of the dimensions are comparable since the dimensions have the same meaning psychometrically (16).

Higher scores on the six dimensions of problematic playing and higher total score of problematic use were more associated with online gamers than offline gamers. In relation to gender differences, boys played more than girls. Results of the present study are consistent with previous research that has reported online gaming as being more problematic to players than offline gaming (4,8-12). More specifically, the results revealed that this difference was due to the role of overuse, interpersonal conflicts, and social isolation, while the dimensions of obsession, preoccupation, and withdrawal symptoms did not appear to have explanatory role in this difference.

These differences can be explained by the distinct characteristics of the medium in which the videogame is played. Typically, only online videogames offer continuous new challenges and quests along with sustained social interaction. In addition to the time spent with playing, emotional attachment to an online gamer community may divert attention from the existing real (“offline”) social context. Therefore, real friends and relatives might receive less priority, resulting in interpersonal conflicts, social isolation and loneliness (27-29). The relationships between gamer type medium and obsession, preoccupation, and withdrawal appeared to be explained by the higher gaming time in online players.

The present study is not without limitations. Convenient sampling and a relatively low response rate from gamers of one nationality limit the generalizability of the present results. Self-reported scales may also lead to response biases and problems with social desirability. Finally, it is suggested that future research should examine the percentage of online versus offline play

In conclusion, this study supported the measurement invariance of the POGQ between online and offline videogame players, so the POGQ can be used for assessing problematic video game usage regardless of whether participants are playing video games online and/or offline. This allows the possibility for future research studies concerning problematic video game to include participants who exclusively play either online or offline games, or both. Moreover the present study demonstrated that compared to offline players, online gamers spent more time gaming and show extended overuse, stronger interpersonal conflicts, and increased social isolation due to their videogame playing. Particular structural characteristics of online games (such as games being never-ending and 24/7) might increase the development of problematic video game use. These results provide important information and ideas that could be utilized in parental education and prevention program about the possible detrimental consequences of online vs. offline video game use.

## **References**

1. Griffiths MD, Király O, Pontes HM, Demetrovics Z. An overview of problematic gaming. In *Mental health in the digital age: Grave dangers, great promise*. Starcevic V, Aboujaoude E, eds. Oxford: Oxford University Press, 2015.
2. Brunborg GS, Mentzoni RA, Frøyland LR. Is video gaming, or video game addiction, associated with depression, academic achievement, heavy episodic drinking, or conduct problems? *Journal of Behavioral Addictions* 2014; 3(1):27-32.

3. Király O, Griffiths MD, Demetrovics Z. Internet gaming disorder and the DSM-5: Conceptualization, debates, and controversies. *Current Addiction Reports* 2015; 2:254-262.
4. Kuss DJ, Griffiths MD. Internet Gaming Addiction: A systematic review of empirical research. *International Journal of Mental Health and Addiction* 2012a; 10(2):278-296.
5. van Rooij A, Kuss D, Griffiths MD, Shorter G, Schoenmakers T, van de Mheen D. The (co-) occurrence of problematic video gaming, substance use, and psychosocial problems in adolescents. *Journal of Behavioral Addictions* 2014; 3(3):157-165.
6. Király O, Nagygyörgy K, Griffiths MD, Demetrovics Z. Problematic online gaming. In *Behavioral addictions: Criteria, evidence and treatment*. Rosenberg K, L. Feder L eds. New York, NY: Elsevier, 2014; 61-95.
7. Hsu SW, Wen MH, Wu MC. Exploring user experiences as predictors of MMORPG addiction. *Computers & Education* 2009; 53:990-999.
8. Ferguson CJ, Coulson M, Barnett J. A meta-analysis of pathological gaming prevalence and comorbidity with mental health, academic and social problems. *Journal of Psychiatric Research* 2011; 45(12):1573-1578.
9. King DL, Delfabbro PH, Griffiths, MD. The role of structural characteristics in problem video game playing: A review. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace* 2010; 4(1).
10. Griffiths MD. Videogame addiction: Further thoughts and observations. *International Journal of Mental Health and Addiction* 2008; 6(2):182-185.
11. Kuss DJ, Griffiths MD. Online gaming addiction in children and adolescents: a review of empirical research. *Journal of Behavioral Addictions* 2012b; 1(1):3-22.
12. Lemmens JS, Hendriks SJF. Addictive online games: Examining the relationship between game genres and Internet Gaming Disorder. *Cyberpsychology, Behavior, and Social Networking* 2016; 19(4):270-276.
13. American Psychiatric Association. *Diagnostic and statistical manual of mental disorders - Text Revision*. 5th edition. DC, USA: American Psychiatric Association, 2013.
14. Griffiths MD, King D, Demetrovics Z. DSM-5 internet gaming disorder needs a unified approach to assessment. *Neuropsychiatry* 2014; 4(1):1-4.

15. King DL, Haagsma MC, Delfabbro PH, Gradisar M, Griffiths MD. Toward a consensus definition of pathological video-gaming: a systematic review of psychometric assessment tools. *Clinical Psychology Review* 2013; 33(3):331-342.
16. Vandenberg RJ, Lance CE. A review and synthesis of the measurement invariance literature: suggestions, practices, and recommendations for organizational research. *Organizational Research Methods* 2000; 3(1):4-70.
17. Király O, Nagygyörgy K, Koronczai B, Griffiths MD, Demetrovics Z. Assessment of problematic internet use and online video gaming. In *Mental Health in the Digital age: Grave dangers, great promise*. Aboujaoude E, Starcevic V, eds. Oxford: Oxford University Press, 2015.
18. Lemola S, Brand S, Vogler N, Perkinson-Gloor N, Allemand M, Grob A. Habitual computer game playing at night is related to depressive symptoms. *Personality and Individual Differences* 2011; 51(2):117–122.
19. Demetrovics Z, Urbán R, Nagygyörgy K, Farkas J, Griffiths MD, Pápay O, Oláh A. The development of the Problematic Online Gaming Questionnaire (POGQ). *PLoS ONE* 2012; 7(5):e36417.
20. Gentile DA, Lynch PJ, Linder JR, Walsh DA. The effects of violent video game habits on adolescent hostility, aggressive behaviors, and school performance. *Journal of Adolescence* 2004; 27(1):5-22.
21. Lemmens JS, Hendriks SJ. Addictive Online Games: Examining the Relationship Between Game Genres and Internet Gaming Disorder. *Cyberpsychology, Behavior, and Social Networking* 2016; 19(4):270-276.
22. Van Rooij AJ, Schoenmakers TM, van de Eijnden RJJM, van de Mheen D. Video Game Addiction Test: Validity and psychometric characteristics. *Journal of Adolescent Health* 2010; 47(1):51-57.
23. Zhou Y, Li Z. (2009). Online game addiction among Chinese college students: Measurement and attribution. *Studies in Health Technology and Informatics* 2004; 144:149–154.
24. Muthén LK, Muthén BO. *Mplus User's Guide*. Seventh Edition. Los Angeles, CA: Muthén & Muthén, 1998-2012.
25. Brown TA. *Confirmatory factor analysis for applied research*. New York: Guilford Press, 2006.
26. Kline RB. *Principles and practice of structural equation modeling (3rd ed.)*. New York, NY: Guilford Press, 2011.

27. Chappell D, Eatough V, Davies M, Griffiths MD. “EverQuest – It’s just a computer game right?” An interpretative phenomenological analysis of online gaming addiction. *International Journal of Mental Health and Addiction* 2006; 4(3):205-216.
28. Wood RT, Griffiths MD, Parke A. Experiences of time loss among videogame players: an empirical study. *CyberPsychology & Behavior* 2007; 10(1):38-44.
29. Young KS. Understanding online gaming addiction and treatment issues for adolescents. *American Journal of Family Therapy* 2009; 37:355–372.