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ORIGINAL ARTICLE

Evaluation of the Substance Use Risk Profile Scale (SURPS) in a Recreational Video Game Playing Population

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Abstract

The Substance Use Risk Profile Scale (SURPS) identifies four personality dimensions related to reinforcement-specific patterns of substance use. Gaming literature has identified similar personalities and game-related reinforcement properties as core risk factors of problematic play. Given similarities, we investigated whether the SURPS model could be confirmed in a recreational video game playing population as a predictive model of problematic gaming. We recruited participants through gaming forums and Amazon Mechanical Turk to complete an online survey that focused on the SURPS and indicators of problematic gaming. Confirmatory factor analysis indicated that the SURPS is a valid instrument measuring four distinct personality dimensions with minor modifications. Regression analyses did not confirm all four at-risk personality dimensions as predictors of problematic play. The Impulsive personality was a significant predictor of lifetime frequency and problematic gaming, whereas the Hopelessness personality was a significant predictor of time spent playing. Future studies will need to assess this model using outcome variables grouped based on reinforcement-related gaming taxonomy.

Keywords Substance Use Risk Profile Scale · Video games · Confirmatory factor analysis · Internet gaming disorder

Prior to the publication of the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5), the American Psychiatric Association Substance Use Disorder (APA SUD) workgroup evaluated whether non-substance addictive-related behaviors, such as gambling and internet gaming, should be included as diagnostic entities (APA, 2013, Petry & O'Brien, 2013). Significant overlap was identified between gambling and SUDs with respect to their etiology, comorbidity, and treatment (Petry, 2006), which led to a new category in the DSM-5 termed Substance Use and Addictive Behaviours, which includes gambling disorder (APA, 2013). Internet gaming was not included due to limited evidence supporting inclusion within this new category (Petry & O'Brien, 2013). However,

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sufficient evidence supported the inclusion of problematic gaming in Sect. 3 of the DSM-5, as a disorder warranting further investigation (APA, 2013). Internet gaming disorder (IGD) was defined as a persistent use of the internet to play video games, leading to significant impairment and/or distress in important areas of one's life, with IGD criteria developed to closely parallel SUD criteria. A main objective of inclusion of IGD in Sect. 3 was to stimulate research to better understand core characteristics of problematic video game play, such as etiological risk factors.

A substance use risk model has been developed and validated in community and clinical populations (Castellanos-Ryan et al., 2013, 2016; Conrod et al., 2000; Schlauch et al., 2015; Woicik et al., 2009). The model was developed based on personality types theorized to be more vulnerable to problematic use of substances with different reinforcement properties (Conrod et al., 1998; Koob, 2004). Inhibited personality types appear to have more problematic forms of substance use motivated by negative reinforcement (e.g., coping with negative affect or self-medication with anxiolytics or alcohol), whereas Disinhibited personality types appear to have more problematic forms of substance use motivated by positive reinforcement (e.g., getting high and/or feeling good via stimulants and polysubstance use). Identification of these personality types (Conrod et al., 2000) and replication via factor analysis, with a large battery of personality and substance use measures administered in a community sample of substance users (Woicik et al., 1999), led to the development of the Substance Use Risk Profile Scale (SURPS). The SURPS consists of four personality risk dimensions. Inhibited personality types include Hopelessness (H; disposition towards negative emotions) and Anxiety Sensitivity (AS; anxious temperament and fear of physical arousal sensations). Disinhibited personality types include Sensation Seeking (SS; needing stimulation/reward and risk-taking) and Impulsivity (IMP; rapid decision-making and failure to regulate impulsive behaviors). These at-risk personality dimensions have been found to identify individuals at highest risk of specific patterns of problematic substance use (Castellanos-Ryan et al., 2013; Jurk et al., 2015; Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009).

Kuss and Griffiths (2012) performed a systematic review of 58 studies within the video game literature published after 2000 and developed a conceptual framework to better understand the full continuum of etiology, risk factors, pathology, and consequences associated with the development of IGD. Similar to the SURPS model, they identified personality traits (introversion, neuroticism, and impulsivity) as core risk factors. They also reviewed literature on the structural characteristics of games and identified that games with positive reinforcement properties (e.g., monetary reward) were more strongly associated with persistent play (Chumbley & Griffiths, 2006). Other studies have identified that negative reinforcement properties (e.g., need to rectify skill-related inadequacies in the game) were associated with problematic play (King et al., 2018). In their review, both personality and reinforcement properties were considered core risk factors associated with the development of problematic video game play (Kuss & Griffiths, 2012). However, there has been much debate in the video game literature regarding optimal indicators of problematic video game play. Gaming severity has been correlated with a number of possible indicators, such as amount of time spent playing (Van Rooij et al., 2011), age (Triberti et al., 2018), frequency and type of play (Esposito et al., 2020; Triberti et al., 2018), and number of questionnaire items endorsed based on DSM-5 diagnostic criteria for IGD (Tejeiro et al., 2016). However, more intensive use (e.g., time spent playing) has not always been found to be an accurate indicator of problematic play (Griffiths, 2010). Additionally, there is no determined cut-off score for questionnaires based on DSM-5 IGD criteria that can reliably identify problematic video game play (Tejeiro et al., 2016). As such, problematic video

game playing should be considered a continual construct, best captured using a number of possible indicators.

Importantly, the video game literature has also identified emerging adulthood (e.g., ages 18–29) as an important and often less researched stage of development, whereby individuals maybe at heightened risk for developing problematic video game use (Coyne et al., 2020), as this age is associated with greater potential functional impairment (e.g., unemployment, financial loss, relationship strain) compared to child and adolescent populations. Uniquely different from adulthood, emerging adulthood is associated with a number of challenging developmental tasks: identity explorations, role instability (e.g., marital status, income, jobs), self-focus and drive (e.g., drive for career at the expense of other aspects of one's life), feeling in-between adolescence and adulthood, less accountability, and more freedom (e.g., limited oversight and family responsibilities, flexible school schedules), which place these individuals at high risk for substance dependence (Arnett, 2005). Despite this, there has only been a limited amount of research exploring risk factors associated with problematic video game use specific to an emerging adult population. Given similar personality risk factors identified for SUD and IGD (Kuss & Griffiths, 2012; Woicik et al., 2009), we examined if the SURPS four-factor personality structure could be confirmed in a recreational video game playing population as a predictive model of indictors of problematic video game play in an emerging adult population. We also included an exploratory investigation to determine whether SURPS personality dimensions are differentially associated with lifetime frequency of play across different gaming genres (e.g., games with different structural characteristics and reinforcement properties). Study findings will allow for a better understanding of risk factors associated with the development of problematic gaming.

Materials and Methods

Participant Recruitment

This study was an online survey recruiting eligible participants ages 18–29, living in North America, and having played video games on average at least one time per week for at least 1 year. Advertisements were posted on community online video game discussion forums and Amazon Mechanical Turk (MTurk; www.mturk.com). Participants were paid $2 for completing the survey through MTurk and participants recruited from community online video game discussion forums (e.g., Sandbox Gaming, Midgard Gaming, Facebook Gaming, Kijiji, Honeybee) were provided the opportunity to enter a draw for 1 of 10 $100 gift cards. The study was approved by the Interdisciplinary Committee on Ethics in Human Research (ICEHR) at Memorial University.

Measures

The Substance Use Risk Profile Scale (SURPS) is a 23-item measure using a 4-point Likert scale (strongly disagree to strongly agree) and is composed of four personality risk dimensions: Hopelessness (H), Anxiety Sensitivity (AS), Impulsivity (I), and Sensation Seeking (SS). The measure has adequate to good internal consistency across subscales (Jurk et al., 2015; Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009). Convergent and discriminate validity was demonstrated with substantial correlations with

personality measures of similar lower-order personality traits (e.g., Beck Hopelessness Scale, 1.7-Impulsivness and Venturesomeness scales, and Anxiety Sensitivity Index), and weaker correlations with measures of broad personality dimensions (e.g., NEO Five-Factor Inventory, see Woicik et al., 2009). The SURPS predicted problematic alcohol and drug use at baseline, 12 months, and 18 months (Castellanos-Ryan et al., 2013; Krank et al., 2011; Woicik et al., 2009).

The Problematic Video Game Playing Scale (PVP; Tejeiro & Morán, 2002; Tejeiro et al., 2016) is a 9-item scale with yes/no item responses. The scale is composed of a single factor structure that measures problematic video game playing. It is based on DSM-IV-TR criteria for substance dependence and pathological gambling and has acceptable internal consistency with scores moderately correlated with other measures of dependence (Gossop et al., 1995).

Lifetime frequency of video game play was assessed using a modified version of the Adolescent Alcohol and Drug Involvement Scale (AADIS, Moberg, 2003), which is a self-report measure of substance use. Frequency questions were based on a 7-point Likert scale (never played to several times in a day) and were adapted to measure video game play, assessing frequency of online gaming for the following: massive multiplayer online role-playing games (MMORPG), other role-playing games (ORG), first-person shooter (FPS) games, action adventure, sports, simulation, strategy, and gambling (Elliott et al., 2012). Lifetime frequency of video game involvement was computed by summing frequency of play across each game type. We included an additional question to assess the average number of hours spent playing video games per week in the past year.

Analyses

Analyses were run using SPSS and Amos Software 26.0 (www.ibm.com). We used confirmatory factor analyses (CFA) to determine if the four-factor structure holds in a recreational video game playing population, based on testing the fit of data to the model developed by Woicik et al. (2009). Model fit was determined based on multiple goodness-of-fit-indices: chi-square (χ^2, $p > 0.05$) and the ratio of the χ^2 to degrees of freedom (χ^2/df; < 2, but < 3 is an acceptable fit) assessed absolute fit; Bentler comparative fit index (CFI, ≥ 0.95 to ≥ 0.90; Hu & Bentler, 1999) and non-formed fit index (NNFI;≥ 0.95 to ≥ 0.90; Hu & Bentler, 1999) assessed relative fit; root mean square error of approximation (RMSEA; RMSEA < 0.06; Hu & Bentler, 1999) was a non-centrality based estimate of error with 90% confidence intervals and a significance test of the probability of close fit (PCLOSE ≥ 0.05; Hu & Bentler, 1999); and the standardized root mean square residual (SRMR, < 0.08 acceptable model fit; Hu & Bentler, 1999) assessed discrepancies between the sample covariance matrix and model covariance matrix. If model fit was found to be adequate to poor, we re-specified the model based on factor loadings, standardized residual covariances, and modification indices (Byrne, 2009). We inspected the model for standardized residual covariances > 2.58 and modification indices > 15.

Composite scores were computed for each of the subscales of the SURPS; means, standard deviations, inter-subscale correlations, and internal consistency were assessed. Multigroup analysis was used to assess model equivalence across gender. Multiple regression was used to confirm whether the four at-risk personalities predicted problematic gaming as

measured indicators of problematic gaming (PVP total, lifetime frequency of video game involvement, and average weekly hours of play).

We undertook an exploratory investigation to determine whether these personality dimensions were differentially associated with lifetime frequency of play across different gaming genres (e.g., different structural characteristics and reinforcement properties). Association between the four-factor structure and lifetime frequency across each game type was explored with partial correlations, controlling for the remaining SURPS subscales. This allowed for post hoc identification of specific patterns of game-related preferences.

Results

Participant Characteristics

A total of 585 participants completed the survey. Participant data was reviewed and removed from the data set based on the following criteria: outlier scores above three standard deviations, incongruent scores (e.g., average hours of video game play per week exceeding the number of hours in a week), no variability in participant responses, and missing data on core outcome variables. A total of 470 participants were included in the final data set. There were no significant group differences between those recruited from community video game forums ($n=226$) and those recruited from the MTurk platform ($n=244$) on core demographic variables and indicators of problematic video game play (average weekly hours and problematic play). However, participants recruited from the MTurk platform had significantly greater lifetime video game involvement ($p<0.001$). The average age of the sample was 23 years old and was primarily composed of Caucasian males with higher levels of socioeconomic status (SES), education, and employment (for information on sociodemographics, lifetime frequency of video game involvement, and indicators of problematic video game playing, see Tables 1, 2, and 3).

Confirmatory Factor Analysis

The four-factor model developed by Woicik et al. (2009) was assessed using a CFA. The chi-square for this model was significant ($\chi^2_{(224)}=768.18$, $p<0.001$). The ratio of the model chi-square to degrees of freedom was greater than 3 ($\chi^2/df=3.43$), suggesting an unacceptable model fit. The CFI (CFI=0.85) and NNFI (NNFI=0.80) were less than the recommended 0.90 to 0.95. The RMSEA was 0.07, suggesting adequate fit, but was significantly greater than the preferred value, as indicated by the test of close fit ($p<0.001$; 90% CI 0.07 to 0.08). The SRMR was 0.08, which was greater than the recommended value of <0.08. The model fit indices indicated adequate to poor fit; therefore, we investigated factor loadings, residual errors, and modification indices to determine whether model-re-specification would improve model fit.

Consistent with findings from three previous studies (Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009), miss-specified error covariances were identified for the H items (two pairings: item 1 with item 4; item 7 with item 23); therefore, we set these error terms to covary. Also consistent with previous findings, modification indices suggested that item 17 ("I am a failure") could cross load onto factor AS and IMP (Schlauch et al., 2015), and item 16 ("I am interested in experience for its own sake, even if it is illegal") could cross load onto SS and IMP and might be better re-specified as IMP (Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009). Items 16 and 17 were removed

Table 1 Sociodemographic information

	M	*SD*
Age	23.93	2.64
	%	*n*
Gender		
Male	57.2	269
Female	38.5	181
Other	4.3	20
Ethnicity		
Caucasian	70.2	330
Non-Caucasian	29.8	140
SES*		
Lives comfortably	40.4	189
Meets basic needs with a little extra	41.0	192
Just meets basic needs	16.5	77
Don't meet basic needs	2.1	10
Education*		
Graduated university/college	46.7	219
Some university/college	33.0	155
High school level	14.7	69
Certificate/apprenticeship	3.2	15
Other	2.3	11
Employment		
Full-time	44.5	209
Part-time	21.9	103
Self-employed	6.2	29
Unemployed	22.8	107
Other	4.7	22

*Two participants did not report their SES, while one participant did not report their level of education

from the model because they did not adequately discriminate among factors (Schlauch et al., 2015). Unique to this study and sample population, modification indices also suggested that item 21 ("It scares me that I am unable to focus on a task") could cross load onto factor AS and IMP, and that the model would be improved by removal of this item. In a previous study (Schlauch et al., 2015), item 21 did not load within the intended four-factor structure, rather it loaded as a single item on a fifth Sensation factor. Therefore, it was removed from the current analysis.

For the re-specified model, the chi-square for this model was significant ($\chi^2_{(162)} = 329.68$, $p < 0.001$). However, this test is known to be overly sensitive to sample size. Therefore, we looked for convergence across other indices of model fit. The ratio of the model chi-square to degrees of freedom was < 3 ($\chi^2/df = 2.04$), suggesting an acceptable model fit. The CFI (CFI = 0.95) and the NNFI (NNFI = 0.90) indicated good and adequate fit of the model, respectively. The RMSEA was 0.05 (90% confidence interval [CI] 0.04–0.06, PCLOSE = 0.67) and SRMR was 0.06, also suggesting good fit of the model. There was relative convergence across these indices to suggest that this was a good fitting model (see Table 4 for information about factor loadings in the re-specified model). Model fit indices were comparable for participants recruited from the community and Amazon Mechanical Turk.

Table 2 Video game play information

	% lifetime frequency of video game involvement								
	Never	Tried but stopped	Several times yearly	Several times monthly	Weekends only	Several times weekly	Daily	Several times in a day	Friedman's rank
MMORPG	16.8	34.8	15.1	9.2	5.3	7.7	6.8	4.3	4.84
ORPG	15.0	14.1	22.0	17.7	4.9	16.2	7.5	2.6	5.70
FPS	9.8	21.0	15.2	12.2	6.4	17.8	13.1	4.5	6.01
Action adventure	5.6	10.5	24.6	23.5	6.0	17.3	10.7	1.9	6.51
Sports	23.0	31.1	18.0	9.7	3.0	6.4	5.8	3.0	4.74
Simulation	13.5	21.0	23.4	13.5	7.5	11.6	6.2	3.2	5.42
Strategy	25.9	19.7	19.1	14.1	6.0	8.6	3.9	2.8	4.76
Gambling	55.1	16.5	11.1	3.8	5.3	4.1	2.6	1.5	3.42
Other games	68.2	2.2	1.9	3.8	2.9	6.7	8.9	5.4	3.61

MMORPG, massive multiplayer online role-playing games; *ORPG*, other role-playing games; *FPS*, first-person shooter

Table 3 Indicators of problematic video game play

	Median	Min	Max	Skew
Avg. weekly hours	15.00	1	70	1.19
PVP total score	3.00	0	9	.40
Lifetime involvement	26.00	8	63	.71

Avg. weekly hours, average number of hours playing video games in the past year; *PVP*, Problematic Video Game Playing Scale (Tejeiro & Morán, 2002); Lifetime involvement, sum of frequency of lifetime playing across game types (adapted questions from the AADIS; Moberg, 2003)

Internal Reliability

Composite scores were computed for each of the subscales of the re-specified SURPS model. Means, standard deviations, and interscale correlations are reported in Table 5. Analyses indicate weak interscale correlations and internal reliability analysis indicated adequate to good internal consistency for each of the SURPS subscales (Table 5).

Gender-Based Measurement Invariance

There were significantly more male recreational video game players in this study ($\chi^2 = 17.21$, $p < 0.001$). Males played video games more hours per week on average, $t(384.06) = 6.07$, $p < 0.001$ (male, $M = 20.18$, $SD = 14.20$; female $M = 12.48$, $SD = 11.15$) and had significantly higher scores of problematic video game play (PVP total scores), $t(441) = 2.67$, $p = 0.008$ (male, $M = 3.78$, $SD = 2.30$; female, $M = 3.20$, $SD = 2.18$). Therefore, we assessed gender-based measurement invariance of the SURPS using a multi-group confirmatory factor analysis to assess equivalence across the two gender groups. The multi-group χ^2 index was computed, chi-square, $\chi^2_{(324)} = 510.28$, $p < 0.001$; χ^2/df = 1.58; CFI = 0.93; RMSEA = 0.04, [CI] 0.03–0.04; PCLOSE = 1.00. The initial baseline values indicated that the re-specified model was a good fit to the data across both groups. We tested item equivalence across gender in which all factor loadings in the model were constrained to be equal for both samples. The analysis resulted in a non-significant χ^2 difference test $_{(16)} = 7.02$, $p = 0.97$, CFI = 0.94; RMSEA = 0.04, [CI] 0.03–0.04, PCLOSE = 1.00, indicating that the factor loadings composing the subscales were similar across genders.

Association Between SURPS and Lifetime Frequency of Video Game Play

We explored whether the four-factor structure was differently associated with lifetime frequency of play across different gaming genres using partial correlations that controlled for the remaining SURPS subscales and used a Bonferroni correction to account for multiple comparisons ($p \leq 0.006$). The H personality factor was negatively associated with lifetime frequency of playing sports-related games, $pr = -0.18$, $p < 0.001$, whereas the IMP personality factor was positively associated with lifetime frequency of playing MMORPG, $pr = 0.20$, $p < 0.001$; FPS, $pr = 0.14$, $p = 0.003$; sports, $pr = 0.25$, $p < 0.001$; strategy, $pr = 0.15$, $p = 0.002$; and gambling, $pr = 0.32$, $p < 0.001$. There were no other significant partial correlations.

Table 4 Summary of results for the final four-factor model

	Factor loading	*p*-value
Hopelessness		
1. I am content	.691	< .001
4. I am happy	.828	< .001
7. I have faith that my future holds great promise	.637	< .001
13. I feel proud of my accomplishments	.633	< .001
20. I feel pleasant	.801	< .001
23. I am very enthusiastic about my future	.683	< .001
Anxiety Sensitivity		
8. It's frightening to feel dizzy or faint	.625	< .001
10. It frightens me when I feel my heart beat change	.717	< .001
14. I get scared when I'm too nervous	.658	< .001
18. I get scared when I experience unusual body	.787	< .001
Impulsivity		
2. I often don't think things through before I speak	.731	< .001
5. I often involve myself in situations I later regret	.546	< .001
11. I usually act without stopping to think	.653	< .001
15. Generally, I am an impulsive person	.509	< .001
22. I feel I have to be manipulative to get what I want	.546	< .001
Sensation Seeking		
3. I would like to skydive	.627	< .001
6. I enjoy new and exciting experiences even if they are unconventional	.534	< .001
9. I like doing things that frighten me a little	.791	< .001
12. I would like to learn how to drive a motorcycle	.739	< .001
19. I would enjoy hiking long distances in wild and uninhabited territory	.472	< .001

Factor loadings, unstandardized estimates

Validity of the SURPS

Multiple multivariate regression analyses were run to assess whether the four at-risk personality structures predicted lifetime video game involvement, problematic video game play (PVP total scores), and average hours of weekly video game play. Results indicated that the IMP personality composite score predicted increased lifetime video game

Table 5 Means, standard deviations, and correlations among the SURP subscales

	1	2	3	4	*M*	*SD*	Cronbach's α
1. H	–				12.13	3.61	.87
2. AS	.23***	–			10.34	2.77	.79
3. IMP	.10*	.20***	–		13.02	3.34	.73
4. SS	− .21***	− .22***	.27***	–	10.29	3.06	.77

***$p < .001$; **$p < .01$; *$p < .05$

H, Hopelessness; *AS*, Anxiety Sensitivity; *IMP*, Impulsivity; *SS*, Sensation Seeking

involvement and problematic video game play (PVP total score). The AS personality composite score predicted reduced, and the H personality composite score predicted increased weekly average hours of video game play in the past year (see Table 6).

Discussion

Confirmatory factor analysis indicated that the SURPS is a valid instrument measuring four distinct personality dimensions. However, there were several modifications made to the model. These modifications were consistent with changes made in previous studies (Krank et al., 2011; Schlauch et al., 2015; Woicik et al., 2009). It should be noted that there has been criticism that the SURPS is not an empirically supported model, partly due to re-specifications necessary to achieve model fit (Blanchard et al., 2020). Therefore, these modifications should result in some caution when interpreting the SURPS as a good fitting model in this population. The results warrant further replication in samples with varying characteristics (e.g., youth), especially populations at risk for meeting clinical criteria for IGD.

Regression analyses did not confirm all four at-risk personality dimensions as predictors of problematic play across multiple indicators. However, results may differ in a clinical sample. In this study, the IMP personality predicted higher scores of problematic video game play and lifetime frequency of video game involvement. The H personality predicted increased average weekly hours of play but was not associated with more problematic play (PVP total score). Average number of hours of play may not be a strong indicator of problematic play, rather time of day (e.g., daytime play rather than being at work or school) may be considered a better outcome variable (Triberti et al., 2018). Finally, the AS personality predicted decreased average weekly hours of video game play, which is consistent with the substance use literature, which has identified a negative association between the AS personality and substance consumption (Morris et al., 2005).

The failure to identify all four at-risk dimensions as predictors of broad indicators of problematic play may indicate that personality is not an etiological risk factor. Alternatively, this model may be better suited to predict reinforcement-specific patterns of gaming rather than broad indicators. Future studies will need to assess this model using outcome variables grouped based on reinforcement-related gaming taxonomy. The current study was limited in this respect, as it is only recently that the field has started to move toward identifying and classifying the different design elements and reward mechanics (positive and negative) that contribute and define the addictive aspects of different game types (Elliott et al., 2012). As the field develops and is better able to accurately classify these types of games, we can then better determine etiological risk.

Finally, the results identified only a limited number of patterns of game-related preferences that could be considered post hoc. Only the IMP personality was associated with increased lifetime frequency of play for gambling, MMORPG, FPS, sports, and strategy games. MMORPG, action, role-playing, sports, and FPS games have been found to be preferentially associated with IGD and problematic gaming because they stimulate the behavioral activation system (Na et al., 2017). In the SUD literature, the IMP personality is prone to more problematic use of substances with positive-reinforcement properties (e.g., stimulants; Woicik et al., 2009). Consistent with the SURPS model, the IMP personality may be prone to develop more problematic play associated with these types of games because they preferentially incorporate reward and positive reinforcement.

Table 6 Relationships between the SURPS and indicators of problematic gaming

	Estimate	SE	*p*-value	β	R^2
Lifetime video game involvement					
H	−0.78	0.93	.403	−0.04	
AS	−1.98	1.08	.066	−0.20	
SS	0.66	0.84	.433	0.06	
IMP	5.66	1.31	< .001	0.31	0.07
PVP total score					
H	0.29	0.22	.175	0.07	
AS	0.26	0.25	.289	0.07	
SS	0.01	0.20	.942	0.01	
IMP	1.98	0.32	< .001	0.45	0.15
Hours playing (weekly average)					
H	5.41	1.51	< .001	0.21	0.03
AS	−4.11	1.72	.017	−0.17	0.02
SS	0.32	1.35	.814	0.02	
IMP	2.85	2.04	.157	0.12	

Estimates, unstandardized estimates; *SE*, standard errors; β, standardized estimates; *H*, Hopelessness; *AS*, Anxiety Sensitivity; *IMP*, Impulsivity; *SS*, Sensation Seeking; R^2, proportion of variance from part correlations for significant predictors

Limitations and Future Studies

There are some potential limitations to consider in this study. First, our use of retrospective self-report (e.g., average weekly hours and lifetime frequency) might have led to measurement error. Additionally, personality types might be prone to specific patterns of response bias. For example, AS personality types might be more prone to socially desirable responding, underestimating problematic play. Secondly, our study might be susceptible to self-selection bias, whereby those with more at-risk personalities may be less likely to engage in our research. For example, AS personality types might be less likely to engage in online discussion forums and H personality types might be less likely to be motivated to compete an online survey. Third, we assessed lifetime frequency of play and did not assess age of onset, current frequency of play, and future risk, which may also have contributed to our inability to replicate the pattern. Fourth, we assessed time spent playing (e.g., average number of hours spent playing); however, time of day spent playing may have been a more valuable indicator of problematic play (Triberti et al., 2018). Fifth, we used the MTurk platform for recruitment which may introduce biases, such as self-selection (e.g., technologically oriented and more likely to play games), sample representativeness (e.g., lower proportion of female respondents, higher proportion of employed and college educated individuals, and less racially diverse individuals; Walters et al., 2018), data quality (e.g., fast or low effort responding), and socially desirable responding (e.g., to maintain employment). Finally, the SURPS literature has identified both the reinforcement properties and motives for substance use as critical variables in their model. In the current study, the IMP personality appears to have more problematic video game playing in association with games with positive reward mechanics. Future research needs to confirm whether the enhancement motive (e.g., attain immediate reward) is a proximal cause that mediates the association between the IMP personality and more problematic forms of game play (e.g.,

gambling, MMORPG). The ability to identify which personality and gaming motives are associated with the development of more problematic forms of gaming will lead to better identification, monitoring, and screening efforts. Another worthy consideration is the protective effects that video games might have for those with at-risk personalities. One study found increased gaming was associated with being social, having more friends, developing romantic partnerships, and increased sense of self-expression (Cole & Griffiths, 2007). Researchers within the field (Przybylski et al., 2010) have discussed self-determination theory (Deci & Ryan, 2000), suggesting that individuals are intrinsically motivated to engage in video game play in order to achieve basic psychological needs of competence, autonomy, and relatedness. Importantly, identification of the presence or absence of a need's fulfillment deficit (Scerri et al., 2019) may be a critical moderator that should be incorporated into future risk models. It is possible that the H personality may have played more hours per week in order to gain important benefits (e.g., reward, social connection), which protected against other negative outcomes, such as social isolation and substance use. Models will need to consider fulfillment of needs, positive and negative consequences associated with play, and motives for play along with the reinforcement properties of the game to better determine risk. Lastly, it might be beneficial for future research investigating at-risk personalities and problematic gaming to include additional analyses to better understand how different demographic variables (e.g., marital status, social supports, comorbid mental health concerns) may influence these associations.

Author Contribution LW was responsible for analyzing the data and writing all sections of the manuscript. NH, JR, and JF were responsible for providing guidance in conceptualization, data analysis, and preparation of the manuscript.

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Declarations

Informed Consent All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

Conflict of Interest The authors declare no competing interests.

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