

Problematic Internet use, mental health and impulse control in an online survey of adults

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Background and aims: Internet use has become a popular entertainment source and has become highly integrated into daily life. However, some people display problematic or addictive usage of the Internet. The present study attempts to fill current knowledge gaps regarding at-risk/problematic Internet use (ARPIU) and its relation to various health and functioning measures. *Methods:* Online survey data from 755 adults in the United States were analyzed using chi-square and ANOVAs. *Results:* The ARPIU group did not differ from the non-ARPIU group with respect to substance use. Individuals with ARPIU were, however, more likely to report at-risk/problematic engagement in video-game playing and gambling. Compared to the non-ARPIU group, the ARPIU group reported poorer self-control and higher levels of impulsivity and depression. *Conclusions:* ARPIU appears associated with other risk behaviors, particularly those that might be performed on the Internet. Future studies should examine the extent to which the Internet may promote engagement in these risk behaviors and the extent to which preventative interventions targeting better self-control or negative mood states might help a range of non-substance-related addictive behaviors.

Keywords: Internet, substance use, behavioral addiction, self-control, impulsivity, depression

INTRODUCTION

The Internet is widely used for business, academic, and recreational purposes. For example, 44% of U.S. adults go online on a daily basis for non-work-related activities (Pew Research, 2011). The growth in Internet use has sparked debates regarding the extent to which it can or should be considered problematic. While moderate Internet use may enhance one's quality of life by widening social circles and enhancing psychological well-being (Chen, Boase & Wellman, 2002; Sanders, Field, Diego & Kaplan, 2000; Willoughby, 2008), diminished control over Internet use may be problematic and impact negatively on daily function, family relationships and emotional stability (Anderson, 2000; Sanders et al., 2000; Willoughby, 2008). Internet use can displace time required for other important behaviors/activities and may harbor both short-term and long-term negative consequences (Huston, Wright, Marquis & Green, 1999), particularly as behaviors may become habitual or compulsive over time (Brewer & Potenza, 2008; Chambers, Bickel & Potenza, 2007). While research on Internet use is gradually emerging, few studies have examined psychosocial and behavioral correlates of Internet use.

The terms "problematic Internet use" (PIU) or "Internet addiction" have been proposed to define Internet use that significantly interferes with daily functioning; however, there are no formal, widely accepted criteria (e.g., in the *Diagnostic and statistical manual*) for defining PIU. This has likely contributed to variations in prevalence estimates that have ranged from approximately 1% to over 18% (Aboujaoude, Koran, Gamel, Large & Serpe, 2006; Bakken, Wenzel, Götestam, Johansson & Oren, 2009; Ni, Yan, Chen & Liu, 2009; Niemz, Griffiths & Banyard, 2005).

Despite the lack of universally accepted diagnostic instruments, most definitions of PIU generally contend that Internet use is "problematic" when there exist excessive and poorly controlled urges to use the Internet, a maladaptive obsession with the Internet, and feeling moody or irritable during Internet use abstinence (Aboujaoude et al., 2006; Chen, Weng & Su, 2003; Ko, Yen, Chen, Chen & Yen, 2005; Shapira et al., 2003; Young, 1999). These features of PIU resemble the diagnostic criteria for substance use disorders (SUDs) (Potenza, 2006). Indeed, similarities between PIU and SUDs have led to the consideration of PIU as a non-substance or "behavioral" addiction. Consistent with this conceptualization, frequent co-occurrence between PIU and SUDs (particularly alcohol) has been reported (Bai, Lin & Chen, 2001; Lam, Peng, Mai & Jing, 2009; Yen, Ko, Yen, Chen & Chen, 2009). For example, adolescents with alcohol-use problems appear more likely to have PIU and low self-esteem, poor family function and less life satisfaction (Ko et al., 2008). Additional similarities between PIU and SUDs may involve possible endophenotypes relating to impaired impulse control, consistent with observed shared biological features (Kim et al., 2011; Ko, Liu et al., 2009; Weinstein & Lejoyeux, 2010; Zhou, Yuan, Yao, Li & Cheng, 2011). For example, individuals expressing PIU or SUDs show high novelty-seeking behavior and low reward dependence (Ko, Yen, Yen, Chen & Chen, 2012). Other characteristics associated with SUDs such as impulsivity

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(Cao, Su, Liu & Gao, 2007; Lee et al., 2012; Zhou et al., 2010) and impaired self-control (Kim, Namkoong & Ku, 2008; Mehroof & Griffiths, 2010) appear linked to PIU, as does depression (Dowling & Quirk, 2009; Liu, Desai, Krishnan-Sarin, Cavallo & Potenza, 2011; van Rooij, Schoenmakers, Vermulst, van den Eijnden & van de Mheen, 2010; Yen, Ko, Yen, Wu & Yang, 2007). Although preliminary evidence links Internet use with these characteristics, relatively few studies to date have directly investigated their relationship. Moreover, most studies have focused on adolescents, resulting in a gap in understanding such possible relationships in adults.

Existing data suggest that PIU frequently co-occurs with not only SUDs, but also other psychiatric conditions including impulse-control, mood and personality disorders (Bernardi & Pallanti, 2009; Dowling & Brown, 2010; Dowling & Quirk, 2009; Mazhari, 2012). PIU may preferentially co-occur with conditions related to the content browsed on the Internet (e.g., gambling, pornography or gaming), leading some to argue that the content to which the Internet facilitates access is the concern (Griffiths, 2000). Nonetheless, the extent to which other conditions associated with impaired impulse regulation co-occur with PIU is poorly understood.

To address the current gaps in understanding, the present study investigated individuals with and without features of PIU on measures of health and functioning. We hypothesized that features of PIU would be associated with: (1) SUDs including alcohol use and smoking, (2) features of behavioral addictions including problem gambling and problematic video gaming, and (3) psychological constructs associated with SUDs such as impaired self-control and impulsivity, and (4) depression. We also explored the hypothesis that correlations would exist amongst questions assessing PIU and across PIU and problematic video gaming, particularly with respect to analogous questions assessing aspects of each.

METHODS

Participants

Participants were 755 adults from the United States who responded to online advertisements seeking volunteers to anonymously complete questionnaires regarding health behaviors as described previously (Grilo, Masheb & White, 2010; White & Grilo, 2011). Participants completed questionnaires gathering basic demographic information and a series of self-report measures through the online data gathering website SurveyMonkey (<http://www.surveymonkey.com>). The sample consisted of 92 males and 663 females; mean age was 33.60 years ($SD = 12.33$). The racial/ethnic distribution was as follows: 78.94% Caucasian ($n = 596$), 5.70% African-American ($n = 43$), 6.09% Hispanic ($n = 46$), 5.30% Asian ($n = 40$), and 3.97% Other ($n = 30$).

Procedure

Advertisements were placed on Craigslist Internet classified ads with links to the questionnaire on SurveyMonkey. Participants provided informed consent prior to partaking in the questionnaires; no personal identifying information was collected. Participants who completed the questionnaire were

given the option of entering a lottery draw for a 50 USD gift certificate. The study received approval from Yale's institutional review board.

Creation of study groups

At-risk/problematic Internet users (ARPIU): Using questions based on items from the Minnesota Impulsive Disorder Interview, a valid and reliable instrument used to screen for impulse control disorders (Grant, 2008; Grant, Levine, Kim & Potenza, 2005), six questions were used to assess ARPIU as previously (Liu et al., 2011): (1) Have you ever tried to cut back on your Internet use?, (2) Has a family member ever expressed concern about the amount of time you use the Internet?, (3) Have you ever missed school, work, or important social activities because you were using the Internet?, (4) Do you think you have a problem with excessive Internet use?, (5) Have you ever experienced an irresistible urge or uncontrollable need to use the Internet?, and (6) Have you ever experienced a growing tension or anxiety that can only be relieved by using the Internet? Given the absence for formal criteria for PIU, a liberal threshold was employed and individuals who endorsed one or more of the six PIU questions were classified as having ARPIU. Those who endorsed none of the six questions were classified as non-ARPIU.

Assessments and measures

At-risk/problematic video-gaming (ARPVG): Using questions based on items from the Minnesota Impulsive Disorder Interview, six questions were used to assess ARPVG as previously (Desai, Krishnan-Sarin, Cavallo & Potenza, 2010). Individuals endorsing one or more of the six problematic-video-game-playing questions were classified as having ARPVG. Those who did not report video-game playing or endorsed none of the six questions were classified as non-ARPVG.

At-risk/problematic gambling (ARPG): ARPG was assessed with the 12-item Massachusetts Gambling Screen (MAGS), a validated instrument that queries the 10 inclusionary criteria for pathological gambling (Shaffer, LaBrie, Scanlan & Cummings, 1994). Individuals were classified as ARPG if they had ever endorsed one or more of the DSM-IV criteria, as has been done previously (Potenza et al., 2011; Rahman et al., 2012). Those who did not report gambling or endorsed none of the MAGS questions were classified as non-ARPG.

Alcohol Use Disorders Identification Test (AUDIT): The AUDIT (Babor, Fuente, Saunders & Grant, 1989), a validated alcohol use screen (Bohn, Babor & Kranzler, 1995), uses ten items to assess alcohol consumption, alcohol dependence, and alcohol-related problems in the past 12 months. The range of possible scores on the AUDIT is 0 to 40; higher scores indicate problematic alcohol use. A score of 8 or more was used to define hazardous drinking, and scores of 13 or more in women and 15 or more in men were used to define probable alcohol dependence, as has been done previously (Allen, Reinert & Volk, 2001; Johnson, Lee, Vinson & Seale, 2012).

Smoking status: A smoking history questionnaire assessed number of years smoked, age of smoking onset, highest smoking frequency, greatest number of cigarettes per day, quit date (if applicable), and number and length of quit attempts. Based on these responses, patients were catego-

Table 1. Demographic data

	Non-ARPIU	ARPIU	Test statistics
<i>n</i>	364	391	
Gender (<i>n</i> , % male)	38 (10.5%)	54 (13.8%)	$\chi^2(1, N = 755) = 1.93, p = .16$
Age, years (mean, \pm SD)	34.5 (12.6)	32.8 (12.0)	$F(1, 649) = 1.591, p = .07$
Race/ethnicity (<i>n</i> , %)			$\chi^2(1, N = 755) = 3.87, p = .05$
Caucasian	298 (81.9%)	298 (76.21%)	
African-American	19 (5.22%)	24 (6.14%)	
Hispanic	21 (5.77%)	25 (6.39%)	
Asian	10 (2.75%)	30 (7.67%)	
Other	16 (4.40%)	14 (3.58%)	

Notes: ARPIU = At-risk/problematic Internet use; Non-ARPIU = Non-at-risk/problematic Internet use; Chi-square for race/ethnicity is for Caucasian versus non-Caucasian.

rized as current daily smokers, former daily smokers, or never-smokers.

Brief Self-Control Scale (BSCS): The BSCS is a 13-item measure of self-control pertaining to control over thoughts, emotion control, impulse control, performance regulation, and habit breaking (Tangney, Baumeister & Boone, 2004). Items are scored on a Likert scale (1 – *not at all*, to 5 – *very much*) with higher summed scores representing better self-control. The BSCS is strongly associated with the full self-control scale and is validated against a number of other scales and inventories including the Symptom Checklist 90 (SCL-90) and the Anger Response Inventory (Carver, Sinclair & Johnson, 2010; Galliot, Schmeichel & Baumeister, 2006; Schmeichel & Zell, 2007; Tangney et al., 2004).

Barratt Impulsiveness Scale (BIS-11): The BIS-11 (Patton, Stanford & Barratt, 1995) is a 31-item measure that investigates impulsivity dimensions in three domains (attentional, motor, and non-planning). Items are scored on a Likert scale (1 – *rarely/never*, to 4 – *almost always/always*) with higher summed scores indicating greater impulsivity.

Beck Depression Inventory (BDI): The BDI (Beck, 1961), 21-item version, assesses depression severity. Each question has a set of at least four possible answer choices, ranging in intensity; a higher score reflects more severe depression. The BDI is widely used and has excellent reliability and validity (Beck, Steer & Garbin, 1988; Sharp & Lipsky, 2002).

Statistical analysis

Chi-square tests were utilized to evaluate the category variables (AUDIT hazardous drinking, AUDIT probable dependence, daily smoking status, ARPVG and ARPG) and one-way ANOVAs were used to test for group differences on continuous variables (BSCS, BIS-11 and BDI). Exploratory analyses using two-tailed Pearson correlations were conducted to examine the extent to which specific inclusionary features were related to both ARPIU and ARPVG. An alpha level of 0.05 was adopted for all statistical analyses.

RESULTS

Sample demographics are presented in Table 1. More than half (51.79%) of the respondents endorsed one or more of the 6 measures assessing at-risk/problematic Internet use

(ARPIU). Ethnicity, gender and age were comparable across ARPIU and non-ARPIU groups (all $p > .05$).

A summary of the endorsement of individual questions relating to specific domains of PIU is presented in Table 2. Within the ARPIU group, 4.3% endorsed all six features, 7.4% endorsed five features, 10.5% endorsed four features, 14.0% endorsed three features, 23.0% endorsed two features and 40.8% endorsed one feature. Binomial correlations (Table 3) revealed that all six features were positively associated with each other (all $p < .001$), suggesting the features are interrelated. However, some features appeared more strongly related (e.g., urges to use the Internet and tension/anxiety relieved by Internet use, with $r = 0.63$) and others less strongly related (attempted cutting back on Internet use and tension/anxiety relieved by Internet use, with $r = 0.20$).

The number of hours spent on the Internet was significantly associated with all six features of PIU (all $p < .05$). Moreover, hours spent on the Internet was positively correlated with the number of features of ARPIU endorsed ($r = .421, p < .001$).

Table 2. Summary of the endorsement of specific features of PIU within the ARPIU group

Questions used to assess problematic Internet use	<i>n</i> (%)
Have you ever tried to cut back on your Internet use?	242 (61.7)
Has a family member ever expressed concern about the amount of time you use the Internet?	127 (32.4)
Have you ever missed school, work, or important social activities because you were using the Internet?	83 (21.2)
Do you think you have a problem with excessive Internet use?	118 (30.1)
Have you ever experienced an irresistible urge or uncontrollable need to use the Internet?	204 (52.0)
Have you ever experienced a growing tension or anxiety that can only be relieved by using the Internet?	142 (36.2)

Health and impulse control measures

Health and impulse control measures for individuals with and without ARPIU are presented (Table 4). With regard to SUDs, the two groups did not significantly differ in frequencies of either hazardous drinking ($p = .99$), probable dependence drinking ($p = .19$) or daily tobacco smoking ($p = .06$). More individuals in the ARPIU (versus non-ARPIU) group met the criteria for at-risk/problematic video-gaming (ARPVG; $p < .001, \phi = .273$) and at-risk/problematic gam-

Table 3. Pearson correlations between features of problematic Internet use

	Cutting back	Family concern	Missing important events	Self-acknowledge PIU	Urge	Tension/anxiety
Internet hours	.111*	.229**	.232**	.312**	.308**	.286**
Cutting back		.298**	.203**	.318**	.247**	.200**
Family concern			.285**	.355**	.315**	.348**
Missing important events				.376**	.357**	.383**
Self-acknowledge PIU					.457**	.421**
Urge						.634**

Notes: * $p < .01$, ** $p < .001$.

Cutting back ($n = 242$) = Have you ever tried to cut back on your Internet use?

Family concern ($n = 127$) = Has a family member ever expressed concern about the amount of time you use the Internet?

Missing important event ($n = 83$) = Have you ever missed school, work, or important social activities because you were using the Internet?

Self-acknowledge PIU ($n = 118$) = Do you think you have a problem with excessive Internet use?

Urge ($n = 204$) = Have you ever experienced an irresistible urge or uncontrollable need to use the Internet?

Tension/anxiety ($n = 142$) = Have you ever experienced a growing tension or anxiety that can only be relieved by using the Internet?

Table 4. Comparison of ARPIU and non-ARPIU individuals on health and impulse control measures

Variable	Non-ARPIU <i>n</i> (%)	ARPIU <i>n</i> (%)	Test statistic	<i>P</i> value	Effect size
AUDIT hazardous	78 (48.4)	83 (51.6)	$\chi^2 (1, N = 672) = .00$	.99	.001
AUDIT dependence	26 (40.6)	38 (59.4)	$\chi^2 (1, N = 671) = 1.73$	.19	.051
Smoking status			$\chi^2 (2, N = 703) = 5.77$	.06	.091
Never smoker	217 (45.0)	265 (55.0)			
Former daily	69 (55.2)	56 (44.8)			
Current daily	52 (54.2)	44 (45.8)			
At-risk/problematic video-gaming (ARPVG)	21 (18.1)	95 (81.9)	$\chi^2 (1, N = 692) = 51.74$	< .001	.273
At-risk/problematic gambling (ARPG)	60 (37.7)	99 (62.3)	$\chi^2 (1, N = 512) = 6.18$	.013	.110
	Mean ($\pm SD$)	Mean ($\pm SD$)			
Brief Self-Control Scale (BSCS)	40.66 (± 9.10)	37.65 (± 8.73)	$F (1, 712) = 20.32$	< .001	.028
Barratt Impulsiveness Scale-11 (BIS-11)	63.30 (± 12.26)	65.95 (± 12.55)	$F (1, 670) = 7.64$	.01	.011
Beck Depression Inventory (BDI)	11.13 (± 8.83)	14.98 (± 10.10)	$F (1, 743) = 30.43$	< .001	.039

Notes: ARPIU = At-risk/problematic Internet use; Non-ARPIU = Non-at-risk/problematic Internet use; AUDIT = Alcohol Use Disorders Identification Test

bling (ARPG; $p = .013$, $\phi = .110$). Compared to the non-ARPIU group, the ARPIU group scored lower on the BSCS ($p < .001$, $\pi p^2 = .028$) indicating poorer self-control. The ARPIU group also scored higher on the BIS-11 ($p = .01$, $\pi p^2 = .011$) and BDI ($p < .001$, $\pi p^2 = .039$) suggesting that the ARPIU group was more impulsive and depressed than the non-ARPIU group. Only findings pertaining to ARPVG, BSCS and BDI retained significance following the application of a Bonferroni correction (adjusted alpha level of .0063).

The extent to which specific inclusionary features were related to both ARPIU and ARPVG was examined. Hours spent on the Internet was also positively associated with the number of features of problematic video gaming endorsed ($r = .150$, $p < .01$). Individuals who endorsed specific features of PIU were also more likely to endorse the corresponding feature for problematic video gaming (cutting back: $r = .256$, family concern: $r = .304$, missing important events: $r = .389$, self-acknowledge problematic behavior: $r = .277$, urge: $r = .298$, tension/anxiety: $r = .219$) (all $p < .001$), suggesting a relationship exists across the specific domains queried within each type of behavior.

DISCUSSION

Review of results

Internet use is considered a prevalent aspect of modern society. Despite the pervasiveness of Internet use, little scholarly research has examined the correlates of PIU. The present study represents one of the first in a population-based sample of adults to investigate the relationship between ARPIU and various health and functioning measures. Notably, approximately half of the individuals reported behaviors that can be considered as ARPIU. Contrary to our first hypothesis, no association was found between ARPIU and SUDs. Our findings, however, indicate that individuals with ARPIU were also more likely to have ARPG and ARPVG. ARPIU individuals were also more likely to score poorly on measures of self-control, impulsivity and depression. In addition, further analysis revealed that individual features of ARPIU showed correlations with each other and were related to the corresponding features of problematic video gaming. Implications are discussed below.

Relationships amongst features of ARPIU

The current findings suggest that some aspects of PIU may more closely relate to one another than do others. Some of these relationships may suggest etiologies and clinical targets for intervention. For example, the close relationship between urges and tension relieved by Internet use suggest that the former may be driving the latter and that the former might be a target for clinical interventions either through behavioral mechanisms (e.g., cognitive-behavioral therapies focusing on managing urges) or pharmacological (e.g., with opioid antagonists like naltrexone). Additionally, the findings may have relevance for the generation of diagnostic criteria for PIU (Ko, Yen, Chen, Yang et al., 2009). For example, in considering the revision of diagnostic criteria for pathological gambling in *DSM-5*, the extent to which the criteria formed a unitary construct was considered. Furthermore, the extent to which this diagnostic construct would be changed by the inclusion/exclusion of specific criteria in part led to the proposed exclusion of the illegal acts criterion and the lowering of the threshold from 5 to 4 criteria (Holden, 2010; Petry, Blanco, Stinchfield & Volberg, 2012). Future studies assessing how the individual features factor are warranted in future investigations, particularly ones with more balanced samples of women and men.

Relationship between ARPIU and SUDs

In contrast to previous PIU studies in adolescents (Ko et al., 2006; Lam & Peng, 2010; Liu et al., 2011) and college students (Yen et al., 2009), no association between ARPIU and either hazardous or dependent alcohol use or daily smoking was observed in the present study. These findings suggest multiple non-mutually-exclusive possibilities. For example, the natures of the samples might differ with respect to age or other relevant characteristics. Additionally, the relatively low threshold used to define ARPIU in the present study may be insufficient in capturing the “addictive” use of the Internet and may not be comparable to SUDs.

Relationship between ARPIU and features of other behavioral addictions

Results from the present study indicate a relationship between ARPIU and both ARPVG and ARPG. Furthermore, if a specific feature of ARPIU was endorsed, the same feature was likely to be also endorsed for ARPVG. This was particularly true for missing important events relating to Internet use or video-gaming, suggesting that this feature might closely link ARPIU and ARPVG. The greater extent to which specific features are common across conditions suggests that these elements might represent or relate to specific intermediary phenotypes that might underlie the conditions and represent potential targets for treatment across conditions. Taken together, our results suggest that behavioral addictions may share common etiologies that contribute to their comorbidity. Researchers have often paralleled PIU with problematic video gaming and problematic gambling as all three may begin with entertainment that stimulates both positive psychological and physical responses (Koepp et al., 1998; Kühn et al., 2011; Li, Zhang, Li, Zhen & Wang, 2010; Tejeiro Salguero & Bersabé Morán, 2002) but may later become dysfunctional. Recent research also indicates

similar neurobiological underpinnings (Comings & Blum, 2000; Ko, Liu et al., 2009; Kühn et al., 2011; Weinstein, 2010) and supports a broader conceptualization of addiction in which the separate disorders may not be independent (Shaffer et al., 2004), but rather, are distinct outward expressions of a common etiology.

There has been debate as to whether PIU represents a primary disorder that may contribute to the development of other disorders or if it represents a secondary disorder arising from other disorders. Internet serves as a medium that delivers and provides access to a variety of content including massively multiplayer online role-playing games (MMORPG) and gambling sites. As such, some have proposed the umbrella term, “pathological technology-use” (Sim, Gentile, Bricolo, Serpelloni & Gulamoydeen, 2012). However, it is useful to consider these disorders as separate entities as they may be associated with different clinical and health-related characteristics (Sussman, Lisha & Griffiths, 2011). Moreover, specific features of the online environment (e.g., social interaction, constant updating, the continuous time-flow that cannot be paused by the user) may create an environment that may be more problematic and/or more addictive than offline settings (Griffiths & Meredith, 2009). Despite controversies regarding its validity as a discrete mental disorder, recent research supports the notion that PIU is a clinically recognizable behavioral syndrome (Ko et al., 2012; Liu et al., 2011) which merits consideration as a diagnosable condition in the forthcoming *DSM-5* (Holden, 2010; Hollander, Kim & Zohar, 2007). The extent to which there exist shared risk factors, either genetic or environmental, that may contribute to the onset or persistence of PIU represents an important knowledge gap. To treat these disorders concurrently might provide benefit to intervention for PIU.

Relationship between ARPIU and psychological constructs

Given that humans have not evolved in the context of the Internet, problems arising from its usage likely involve pre-existing mechanisms. If problematic Internet usage is addictive, one may expect that factors implicated in other addictions (i.e., self-control, impulsivity, and depression) would be associated with PIU. Despite the lack of an association between SUDs and ARPIU, psychological characteristics related to SUDs (i.e., depression, impulsivity, and self-control) were associated with ARPIU. These findings suggest that although individuals at-risk for PIU may not necessarily be addicted to Internet use, they exhibit characteristics that might make them more vulnerable to developing “Internet addiction”.

Both self-control and impulsivity involve a choice between immediate rewards at the expense of later consequences. When individuals spend considerable amounts of time engaging in immediately gratifying Internet activities, they may have less time to invest in other areas of life including social relationships and vocational advancements that may yield larger but more delayed benefits (Huston et al., 1999). Internet behavior is characterized by the rapid response and multiple windows with different activities that can provide immediate reward through social support (Tichon & Shapiro, 2003), achievement (Suler, 1999), and pleasure of control (Leung, 2004). Given that self-control has had long-standing association with SUDs (Baler &

Volkow, 2006; Madden, Petry, Badger & Bickel, 1997; Muraven, Collins & Kristen, 2002), it is perhaps unsurprising that a negative relationship between self-control and PIU has been previously reported (Kim et al., 2008; Mehroof & Griffiths, 2010). The present study extends these findings, supporting the notion that poorer abilities or tendencies to self-control emotion and behavior may be a liability for the development of addictive behaviors (Sher & Trull, 1994; Wills & Stoolmiller, 2002).

Also, consistent with the SUD literature (Dawe & Loxton, 2004; Dawe, Matthew & Loxton, 2004; Kreek, Nielsen, Butelman & LaForge, 2005; Verdejo-García, Lawrence & Clark, 2008) and existing research regarding PIU (Cao et al., 2007; Lee et al., 2012), impulsivity scores were higher among ARPIU than non-ARPIU individuals in the present study. Impulsivity has been associated with both initial use and later development of substance abuse among adolescents (Gullo & Dawe, 2008) and has been suggested to predate the development of substance abuse (Sher & Trull, 1994). However, longitudinal relationships between self-control and impulsivity with PIU have not been thoroughly investigated. Further research is needed to investigate whether these psychological characteristics are potential risk factors for the development of PIU, results of PIU, or both.

Depression was also associated with ARPIU, consistent with existing studies of college students (Dowling & Quirk, 2009) and adolescents (Liu et al., 2011; Yen et al., 2007). A bi-directional relationship appears to exist between PIU and depression. Adolescents with depression appear more likely to become problematic Internet users during a two-year follow-up period (Ko, Yen, Chen, Yeh et al., 2009). Another recent study reported that adolescents exhibiting problematic use of the Internet were 2.5 times more likely to develop depressive symptoms 9 months later than those who did not show PIU features (Lam & Peng, 2010). Additionally, previous research has indicated that the “short” allelic variants of the serotonin transporter gene-linked polymorphic region (SS-5HTTLPR) is associated with both depression (Pezawas et al., 2005) and PIU (Lee et al., 2008); this may represent a shared biological vulnerability for both disorders which contribute to their relationship found in the present study.

Relationships between features of ARPIU and ARPVG

The particularly close relationship observed between ARPIU and ARPVG raises the possibility that many individuals with ARPIU may be using the Internet for video gaming, and this possibility should be assessed in future studies that more accurately assess types and patterns of Internet use and gaming. Furthermore, the correlations between individually corresponding features of ARPIU and ARPVG while statistically significant were typically not as numerically robust as those between individual features of ARPIU. These findings suggest that the individual PIU features may be more closely related than are the individual features across disorders, although this possibility warrants additional direct investigation in larger representative samples.

Limitations and future directions

The present study has a number of strengths and limitations that should be considered when interpreting the findings. Strengths of this study include a large and geographically di-

verse sample within the United States and the use of multiple well-validated measures to examine psychological and behavioral correlates. Limitations include the reliance on a series of online questionnaires; as such, the sample only consisted of Internet users which may have contributed to our high prevalence of at-risk users. Secondly, the gender composition of our sample was predominantly female and may not be reflective of Internet users overall. Gender differences pertaining to impulsivity and depression have been reported (Kallen, 1989; Poelen, Scholte, Engels, Boomsma & Willemsen, 2005), and these findings appear to be reflected in Internet users and video-game players (Desai et al., 2010; Ko, Yen, Liu et al., 2009; Liu et al., 2011; Yau, Crowley, Mayes & Potenza, 2012). Additionally, other constructs (e.g., measures of aggression) are expressed to different degrees in females and males, and measures of aggression appear differentially linked to severity levels of Internet use and video-game playing in females and males (Desai et al., 2010; Ko, Yen, Liu et al., 2009; Liu et al., 2011; Yau et al., 2012). Future studies involving larger samples with sizable and balanced samples of both women and men should examine the extent to which the current findings and measures in other domains (like those relating to aggression) pertain to women, men, or both. Moreover, some data suggest that the proportion of Internet users is slightly higher among men than among women, with men being more likely to be problematic Internet users (Bakken et al., 2009; Morahan-Martin & Schumacker, 2000; Mottram & Fleming, 2009), although this gender gap appears to be fading (Pew Research, 2011). Thirdly, the self-report methodology is subject to biases (e.g., recall bias). The present study, does however, benefit from using computer-based questionnaires which is thought to improve the candidness of responses, particularly to questions regarding sensitive behaviors (Feigelson & Dwight, 2000).

Furthermore, the present study did not account for the different context of Internet use. Because of its diverse nature, PIU has been proposed to separate into three subtypes (Block, 2008): excessive gaming, sexual preoccupation and e-mail/text messaging. This segregation may itself have limitations as the use of the Internet for social networking has increased significantly in recent years and thus may represent a fourth subtype in this model. As the Internet is a heterogeneous construct, the context of Internet use may differ on a range of dimensions and engage different cognitive, behavioral and affective systems, and thus may affect different processing systems. Relationships between individual differences and choices of subtypes may be bidirectional, with certain types of people attracted to particular contexts of Internet use and particular contexts of Internet use fostering certain attributes or experiences. Further research is needed to investigate these potential relationships.

In addition, although a strength of the study lies in the use of criteria based upon the negative consequences that Internet use may have rather than on the basis of frequency, the extent to which the at-risk group in the present study represents a group with tendencies to develop an addiction is unknown. The current lack of a standard definition of PIU limits the field and existing data may best be considered exploratory. A consensus of the behavioral patterns underlying PIU and an assessment tool that establishes multiple forms of reliability and validity is needed to better assess PIU.

Finally, results pertaining to the relationships between ARPIU and ARPG and impulsivity failed to remain signifi-

cant when a more stringent alpha level was applied. Caution must therefore be taken when generalizing results from this study; these data should be treated as informative but preliminary.

CONCLUSIONS

Internet use among the general population appears to be increasingly common (Beutel et al., 2011; Pew Research, 2011). However, the topic of PIU is relatively novel and as such, the relevant research is still in its infancy and aims at a moving target. While it is difficult to draw long-lasting conclusions, the present findings contribute to the discussion on the proposed unified concept of “Addiction and Related Disorders” in the upcoming *DSM-5*. Keeping the limitations in mind, the present findings suggest that individuals with ARPIU are more likely to demonstrate at-risk/problematic levels of gaming and gambling and possess characteristics that may make them more vulnerable to developing PIU. However, further studies, particularly longitudinal ones, are needed to replicate and extend the present findings. The present results emphasize the need to develop valid and reliable diagnostic criteria for PIU that consider normative and dysfunctional Internet use behaviors. Regardless of whether PIU is formally conceptualized within an addiction framework, the current data suggest that this cluster of behaviors and cognitions pertaining to Internet use is associated with clinically significant features. It is therefore important that ARPIU be examined further in order to develop appropriate prevention and treatment strategies.

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