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

YVONNE H. C. YAU1, MARC N. POTENZA1,2,3 and MARNEY A. WHITE1,4*

1Department of Psychiatry, Yale University School of Medicine, Connecticut Mental Health Center, New Haven, CT, USA
2Department of Neurobiology, Yale University School of Medicine, New Haven, CT, USA
3Yale Child Study Center, Yale University School of Medicine, New Haven, CT, USA
4Department of Chronic Disease Epidemiology, Yale University School of Public Health, New Haven, CT, USA

(Received: October 10, 2012; revised manuscript received: October 31, 2012; accepted: November 5, 2012)

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 psychological 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 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 & Lejoeux, 2010; Zhou, Yuan, Yao, Lio & 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...
5.30% Asian (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, Cavalllo & 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, Cavalllo & Potenza, 2010). Individuals endorsing one or more of the six problematic-video-gaming-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 (ARP): ARP 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 ARP 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-ARP.

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-
ized 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 ($r = 0.421$, $p < .001$).

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

| Questions used to assess problematic Internet use | n (%) |
|-----------------------------------------------|-------|
| 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-
Compared to the non-ARPIU group, the ARPIU group scored lower on the BSCS (p < .001, \(\phi^2 = .028\)) indicating poorer self-control. The ARPIU group also scored higher on the BIS-11 (p = .01, \(\phi^2 = .011\)) and BDI (p < .001, \(\phi^2 = .039\)) 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 ARPVG 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 ARPGV and ARPG. Furthermore, if a specific feature of ARPIU was endorsed, the same feature was likely to be also endorsed for ARPGV. This was particularly true for missing important events relating to Internet use or video-gaming, suggesting that this feature might closely link ARPIU and ARPGV. 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 (Koepf 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 &
Strengths of this study include a large and geographically diverse 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-
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.

DISCLOSURE OF FINANCIAL RELATIONSHIPS

The authors report no financial conflicts of interest with respect to the content of this manuscript. Dr. Potenza has received financial support or compensation for the following: Dr. Potenza has consulted for and advised Boehringer Ingelheim; has consulted for and has financial interests in Somaxon; has received research support from the National Institutes of Health, Veteran’s Administration, Mohegan Sun Casino, the National Center for Responsible Gaming and its affiliated Institute for Research on Gambling Disorders, and Forest Laboratories, Ortho-McNeil, Oy-ConBiote, Glaxo-SmithKline, and Psyadon pharmaceuticals; has participated in surveys, mailings or telephone consultations related to drug addiction, impulse control disorders or other health topics; has consulted for gambling entities, law offices and the federal public defender’s office in issues related to impulse control disorders; provides clinical care in the Connecticut Department of Mental Health and Addiction Services Problem Gambling Services Program; has performed grant reviews for the National Institutes of Health and other agencies; has guest-edited journal sections; has given academic lectures in grand rounds, CME events and other clinical or scientific venues; and has generated books or book chapters for publishers of mental health texts. Dr. White has received research funding from the NIH/NIMH. Ms. Yau has no conflicts of interest to disclose.

REFERENCES

Aboujaoude, E., Koran, L. M., Gamel, N., Large, M. D. & Serpe, R. T. (2006). Potential markers for problematic Internet use: A telephone survey of 2,513 adults. CNS Spectr., 11(10), 750–755.
Allen, J. P., Reinert, D. F. & Volk, R. J. (2001). The Alcohol Use Disorders Identification Test: An aid to recognition of alcohol problems in primary care patients. Preventive Medicine, 33(5), 428–433.
Anderson, K. J. (2000). Internet use among college students: An exploratory study. Journal of American College Health, 50(1), 21–26.
Babor, T., Fuente, J., Saunders, J. & Grant, M. (1989). The Alcohol Use Disorders Identification Test: Guidelines for use in primary health care. Geneva: Division of Mental Health, World Health Organization.
Bai, Y. M., Lin, C. C. & Chen, J. Y. (2001). Internet addiction disorder among clients of a virtual clinic. Psychiatric Services, 52(10), 1397.
Bakken, I. J., Wenzel, H. G., Götestam, K. G., Johansson, A. & Oren, A. (2009). Internet addiction among Norwegian adults: A stratified probability sample study. Scandinavian Journal of Psychology, 50(2), 121–127.
Baler, R. D. & Volkow, N. (2006). Drug addiction: The neurobiology of disrupted self-control. Trends in Molecular Medicine, 12(12), 559–566.
Beck, A. T. (1961). Beck Depression Inventory. Philadelphia, PA: Center for Cognitive Therapy.
Beck, A. T., Steer, R. & Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: 25 years of evaluation. Clinical Psychology Review, 8, 77–100.
Bernardi, S. & Pallanti, S. (2009). Internet addiction: A descriptive clinical study focusing on comorbidities and dissociative symptoms. Comprehensive Psychiatry, 50(6), 510–516.
Beutel, M., Brähler, E., Glaesmer, H., Kuss, D. J., Wölfing, K. & Müller, K. W. (2011). Regular and problematic leisure-time Internet use in the community: Results from a German population-based survey. Cyberpsychology, Behavior and Social Networking, 14(5), 291–296.
Block, J. J. (2008). Issues for DSM-V: Internet addiction. The American Journal of Psychiatry, 165(3), 306–307.
Bohn, M. J., Babor, T. & Kranzler, H. (1995). The Alcohol Use Disorder Identification Test (AUDIT). Validation of a screening instrument for use in medical settings. Journal of Studies on Alcohol, 56(4), 423–432.
Brewer, J. A. & Potenza, M. N. (2008). The neurobiology and genetics of impulse control disorders: Relationships to drug addictions. Biochemical Pharmacology, 75(1), 63–75.
Cao, F., Su, L., Liu, T. & Gao, X. (2007). The relationship between impulsivity and Internet addiction in a sample of Chinese adolescents. European Psychiatry, 22(7), 466–471.
Carver, C. S., Sinclair, S. L. & Johnson, S. L. (2010). Authentic and hubristic pride: Differential relations to aspects of goal regulation, affect and self-control. Journal of Research in Personality, 44, 698–703.
Chambers, R. A., Bickel, W. K. & Potenza, M. N. (2007). A scale-free systems theory of motivation and addiction. Neuroscience and Biobehavioral Reviews, 31(7), 1017–1045.
Chen, S. H., Weng, L. C. & Su, Y. J. (2003). Development of Chinese Internet Addiction Scale and its psychometric study. Chinese Journal of Psychology, 45, 279–294.
Chen, W. J., Boase, J. & Wellman, B. (2002). The gloval villagers: Comparing Internet users and uses around the world. In B. Wellman & C. Haythorntwaite (Eds.), The Internet in everyday life (pp. 74–113). Oxford: Blackwell.
Comings, D. E. & Blum, K. (2000). Reward deficiency syndrome: Genetic aspects of behavioral disorders. *Progress in Brain Research, 126*, 325–341.

Dawe, S. & Loxton, N. J. (2004). The role of impulsivity in the development of substance use and eating disorders. *Neuroscience, 28*(3), 343–351.

Dawe, S., Matthew, J. G. & Loxton, N. J. (2004). Reward drive and rash impulsiveness as dimensions of impulsivity: Implications for substance misuse. *Addictive Behaviors, 29*(7), 1389–1405.

Desai, R. A., Krishnan-Sarin, S., Cavallo, D. & Potenza, M. N. (2010). Video-gaming among high school students: Health correlates, gender differences, and problematic gaming. *Pediatrics, 126*(6), 1414–1424.

Dowling, N. A. & Brown, M. (2010). Commonalities in the psychological factors associated with problem gambling and Internet dependence. *Cyberpsychology, Behavior and Social Networking, 13*(4), 437–441.

Dowling, N. A. & Quirk, K. L. (2009). Screening for Internet dependence: Do the proposed diagnostic criteria differentiate normal from dependent Internet use? *CyberPsychology & Behavior, 12*(1), 21–27.

Feigelson, M. E. & Dwight, S. A. (2000). Can asking questions by computer improve the candidness of responding? A meta-analytic perspective. *Consulting Psychology Journal: Practice and Research, 52*(4), 248–255.

Galliot, M. T., Schmeichel, B. J. & Baumeister, R. F. (2006). Self-regulatory processes defend against the threat of death: Effects of self-control depletion and trait self-control on thoughts and fears of dying. *Journal of Personality and Social Psychology, 91*, 49–62.

Grant, J. E. (2008). *Impulse Control Disorders*. New York, NY: Norton and Co.

Grant, J. E., Levine, L., Kim, D. & Potenza, M. N. (2005). Prevalence of impulse control disorders in adult psychiatric patients. *American Journal of Psychiatry, 162*, 2184–2188.

Griffiths, M. D. (2000). Does Internet and computer “addiction” exist? Some case study evidence. *CyberPsychology & Behavior, 3*, 211–218.

Griffiths, M. D. & Meredith, A. (2009). Videogame addiction and its treatment. *Journal of Contemporary Psychotherapy, 39*(4), 247–253.

Grilo, C. M., Masheb, R. M. & White, M. A. (2010). Significance of overevaluation of shape/weight in binge-eating disorder: Comparative study with overweight and bulimia nervosa. *Obesity, 18*(3), 499–504.

Gullo, M. J. & Dawe, S. (2008). Impulsivity and adolescent substance use: Rashly dismissed as “all-bad”? *Neuroscience and Biobehavioral Reviews, 32*, 1507–1518.

Holden, C. (2010). Behavioral addictions debut in proposed DSM-V. *Science, 327*(5968), 935.

Hollander, E., Kim, S. & Zohar, J. (2007). OCSDs in the forthcoming DSM-V. *CNS Spectrums, 12*(5), 320–323.

Huston, A. C., Wright, J. C., Marquis, J. & Green, S. B. (1999). How young children spend their time: Television and other activities. *Developmental Psychology, 35*(4), 912–925.

Johnson, J. A., Lee, A., Vinson, D. & Seale, J. P. (2012). Use of AUDIT-based measures to identify unhealthy alcohol use and alcohol dependence in primary care: A validation study. *Alcoholism: Clinical and Experimental Research. [E-pub ahead of print.] doi: 10.1111/j.1530-0277.2012.01898.x*

Kallen, E. (1989). *Label Me Human: Minority rights of stigmatized Canadians*. Toronto, Canada: University of Toronto Press.

Kim, E. J., Namkoong, K., Ku, T. & Kim, S. J. (2008). The relationship between online game addiction and aggression, self-control and narcissistic personality traits. *European Psychiatry, 23*(3), 212–218.

Kim, S. H., Baik, S.-H., Park, C. S., Kim, S. J., Choi, S. W. & Kim, S. E. (2011). Reduced striatal dopamine D2 receptors in people with Internet addiction. *NeuroReport, 22*(8), 407–411.

Ko, C.-H., Liu, G.-C., Hsiao, S., Yen, J.-Y., Yang, M.-J., Lin, W.-C., Yen, C.-F. & Chen, C.-S. (2009). Brain activities associated with gaming urge of online gaming addiction. *Journal of Psychiatric Research, 43*(7), 739–747.

Ko, C.-H., Yen, J.-Y., Chen, C.-C., Chen, S.-H., Wu, K. & Yen, C.-F. (2006). Tridimensional personality of adolescents with Internet addiction and substance use experience. *Canadian Journal of Psychiatry, 51*(14), 887–894.

Ko, C.-H., Yen, J.-Y., Chen, C.-C., Chen, S.-H. & Yen, C.-F. (2005). Proposed diagnostic criteria of Internet addiction for adolescents. *The Journal of Nervous and Mental Disease, 193*(11), 728–733.

Ko, C.-H., Yen, J.-Y., Chen, C.-S., Yeh, Y.-C. & Yen, C.-F. (2009). Predictive values of psychiatric symptoms for Internet addiction in adolescents: A 2-year prospective study. *Archives of Pediatrics & Adolescent Medicine, 163*(10), 937–943.

Ko, C. H., Yen, J. Y., Chen, S. H., Yang, M. J., Lin, H. C. & Yen, C. F. (2009). Proposed diagnostic criteria and the screening and diagnostic tool of Internet addiction in college students. *Comprehensive Psychiatry, 50*, 378–384.

Ko, C. H., Yen, J. Y., Liu, S. C., Huang, C. F. & Yen, C. F. (2009). The associations between aggressive behaviors and Internet addiction and online activity in adolescents. *Journal of Adolescent Health, 44*, 598–605.

Ko, C. H., Yen, J. Y., Yen, C. F., Chen, C. S. & Chen, C. C. (2012). The association between Internet addiction and psychiatric disorder: A review of the literature. *European Psychiatry, 27*(1), 1–8.

Ko, C.-H., Yen, J.-Y., Yen, C.-F., Chen, C.-S., Weng, C.-C. & Chen, C.-C. (2008). The association between Internet addiction and problematic alcohol use in adolescents: The problem behavior model. *CyberPsychology & Behavior, 11*(5), 571–576.

Koepp, M. J., Gunn, R. N., Lawrence, A. D., Cunningham, V. J., Dagher, A., Jones, T., Brooks, D. J., Bench, C. J. & Grasby, P. M. (1998). Evidence for striatal dopamine release during a video game. *Nature, 393*(6682), 266–268.

Kreek, M. J., Nielsen, D. A., Butelman, E. R. & LaForge, K. S. (2005). Genetic influences on impulsivity, risk taking, stress responsivity and vulnerability to drug abuse and addiction. *Nature Neuroscience, 8*(11), 1450–1457.

Kühn, S., Romanowski, A., Schilling, C., Lorenz, R., Mörsen, C., Seiferth, N., Banaschewski, T., Barbot, A., Barker, G. J., Büchel, C., Conrod, P. J., Dalley, J. W., Flor, H., Garavan, H., Ittermann, B., Mann, K., Martinot, J-L., Paus, T., Rietschel, M., Smolka, M. N., Ströhle, A., Walaszek, B., Schumann, G., Heinz, A. & Gallinat, J. (2011). The neural basis of video gaming. *Translational Psychiatry, 1*, e53. doi: 10.1038/tp.2011.53

Lam, T. L. & Peng, Z.-W. (2010). Effect of pathological use of the Internet on adolescent mental health: A prospective study. *Archives of Pediatrics & Adolescent Medicine, 164*(10), 901–906.

Lam, L. T., Peng, Z. W., Mai, J. C. & Jing, J. (2009). Factors associated with Internet addiction among adolescents. *CyberPsychology & Behavior, 12*(5), 551–555.

Lee, H. W., Choi, J. S., Shin, Y. C., Lee, J. Y., Jung, H. Y. & Kwon, J. S. (2012). Impulsivity in Internet addiction: A comparison with pathological gambling. *Cyberpsychology, Behavior and Social Networking, 15*, 2152–2723.

Lee, Y. S., Han, D., Yang, K. C., Daniels, M. A., Na, C., Kee, B. S. & Renshaw, P. F. (2008). Depression like characteristics of 5HTTLPR polymorphism and temperament in excessive Internet users. *Journal of Affective Disorders, 1–2*, 165–169.
Leung, L. (2004). Net-generation attributes and seductive properties of the Internet as predictors of online activities and Internet addiction. *CyberPsychology & Behavior, 7*(3), 333–348.

Li, D., Zhang, W., Li, X., Zhen, S. & Wang, Y. (2010). Stressful life events and problematic Internet use by adolescent females and males: A mediated moderation model. *Computers in Human Behavior, 26*(5), 1199–1207.

Liu, T. C., Desai, R. A., Krishnan-Sarin, S., Cavallo, D. A. & Potenza, M. N. (2011). Problematic Internet use and health in adolescents: Data from a high school survey in Connecticut. *The Journal of Clinical Psychiatry, 72*(6), 836–845.

Madden, G. J., Petry, N. M., Badger, G. J. & Bickel, W. K. (1997). Impulsive and self-control choices in opioid-dependent patients and non-drug-using control patients: Drug and monetary rewards. *Experimental and Clinical Psychopharmacology, 5*(3), 256–262.

Mazhari, S. (2012). Association between problematic Internet use and impulse control disorders among Iranian university students. *Cyberpsychology, Behavior and Social Networking, 15*(5), 270–273.

Mehroof, M. & Griffiths, M. D. (2010). Online gaming addiction: The role of sensation seeking, self-control, neuroticism, aggression, state anxiety, and trait anxiety. *Cyberpsychology, Behavior and Social Networking, 13*(3), 313–316.

Morahan-Martin, J. M. & Schumacker, P. (2000). Incidence and correlates of pathological Internet use. *Computers in Human Behavior, 16*, 13–19.

Mottram, A. J. & Fleming, M. J. (2009). Extraversion, impulsivity, and online group membership as predictors of problematic Internet use. *CyberPsychology & Behavior, 12*(3), 319–321.

Muraven, M., Collins, R. L. & Kristen, N. (2011). Problematic Internet use and health in adolescents: Data from a high school survey in Connecticut. *The Journal of Clinical Psychiatry, 72*(6), 836–845.

Pew Research (2011). Who's online: Internet user demographics (Adults). Retrieved from http://pewinternet.org/Static-Pages/Trend-Data-(Adults)/Online-Activities-Daily.aspx

Poelen, E. A. P., Scholte, R. H. J., Engels, R. C. M. E., Boomsma, D. I. & Willemsen, G. (2005). Prevalence and trends of alcohol use and misuse among adolescents and young adults in the Netherlands from 1993 to 2000. *Drug and Alcohol Dependence, 79*, 413–421.

Potenza, M. N. (2006). Should addictive disorders include non-substance-related conditions? *Addiction, 101*(1), 142–151.

Potenza, M. N., Wareham, J. D., Steinberg, M. A., Rugle, L. J., Cavallo, D., Krishnan-Sarin, S. & Desai, R. A. (2011). Correlates of at-risk/problem Internet gambling in adolescents. *Journal of the American Academy of Child and Adolescent Psychiatry, 50*(2), 150–159.

Rahman, A. S., Pilver, C. E., Desai, R. A., Marvin, S. A., Rugle, L. J., Krishnan-Sarin, S. & Potenza, M. N. (2012). The relationship between age of gambling onset and adolescent problematic gambling severity. *Journal of Psychiatric Research, 46*(5), 675–683.

Sanders, C. E., Field, T. M., Diego, M. & Kaplan, M. (2000). The relationship of Internet use to depression and social isolation among adolescents. *Adolescence, 35*, 237–242.

Schmeichel, B. J. & Zell, A. (2007). Trait self-control predicts performance on behavioral tests on self-control. *Journal of Personality, 75*, 744–756.

Shaffer, H. J., LaBrie, R., Scanlan, K. M. & Cummings, H. M. (1994). Pathological gambling among adolescents: Massachusetts Gambling Screen (MAGS). *Journal of Gambling Studies, 10*, 339–362.

Shaffer, H. J., LaPlante, D. A., LaBrie, R., Kidman, R. C., Donato, A. N. & Stanton, M. V. (2004). Toward a syndrome model of addiction: Multiple expressions, common etiology. *Harvard Review of Psychiatry, 12*, 367–374.

Shapira, N. A., Lessig, M. C., Goldsmith, T. D., Szabo, S. T., Lazoritz, M., Gold, M. S. & Stein, D. J. (2003). Problematic Internet use: Proposed classification and diagnostic criteria. *Depression and Anxiety, 17*(4), 207–216.

Sharp, L. K. & Lipsky, M. S. (2002). Screening for depression across the lifespan: A review of measures for use in primary care settings. *American Family Physician, 66*(6), 1001–1009.

Sher, K. J. & Trull, T. J. (1994). Personality and disinhibitory psychopathology: Alcoholism and antisocial personality disorder. *Journal of Abnormal Psychology, 103*, 92–102.

Sim, T., Gentile, D. A., Bricolo, F., Serpelloni, G. & Gulamoydeen, F. (2012). A conceptual review of research of pathological use of computers, video games, and the Internet. *International Journal of Mental Health and Addiction, 10*(1), 3–56.

Suler, J. R. (1999). To get what you need: Healthy and pathological Internet use. *CyberPsychology & Behavior, 2*(5), 385–393.

Sussman, S., Lisha, N. & Griffiths, M. (2011). Prevalence of the addictions: A problem of the majority or the minority? *Evaluation & the Health Professions, 34*(1), 3–56.

Tangney, P. J., Baumeister, R. F. & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades and interpersonal success. *Journal of Personality, 72*, 272–322.

Tejeiro Salguero, R. A. & Bersabé Morán, R. M. (2002). Measuring problem video game playing in adolescents. *Addiction, 97*(12), 1601–1606.

Tichon, J. G. & Shapiro, M. (2003). The process of sharing social support in cyberspace. *CyberPsychology & Behavior, 6*(2), 161–170.

van Rooij, A. J., Schoenmakers, T. M., Vermulst, A. A., van den Eijnden, R. J. J. M. & van de Mheen, D. (2010). Online video game addiction: Identification of addicted adolescent gamers. *Addiction, 106*, 205–212.

Verdejo-García, A., Lawrence, A. J. & Clark, L. (2008). Impulsivity as a vulnerability marker for substance-use disorders: Review of findings from high-risk research, problem gamblers and genetic association studies. *Neuroscience & Biobehavioral Reviews, 32*(4), 777–810.

Weinstein, A. M. (2010). Computer and video game addiction – A comparison between game users and non-game users. *The American Journal of Drug and Alcohol Abuse, 36*, 268–276.

Weinstein, A. M. & Lejoeux, M. (2010). Internet addiction or excessive Internet use. *The American Journal of Drug and Alcohol Abuse, 36*(5), 277–283.
Problematic Internet use

White, M. A. & Grilo, C. M. (2011). Diagnostic efficiency of DSM-IV indicators for binge eating episodes. *Journal of Consulting and Clinical Psychology, 79*(1), 75–83.

Willoughby, T. (2008). A short-term longitudinal study of Internet and computer game use by adolescent boys and girls: Prevalence, frequency of use, and psychosocial predictors. *Developmental Psychology, 44*(1), 195–204.

Wills, T. A. & Stoolmiller, M. (2002). The role of self-control in early escalation of substance use: A time-varying analysis. *Journal of Consulting and Clinical Psychology, 70*(4), 986–997.

Yau, Y. H. C., Crowley, M. J., Mayes, L. C. & Potenza, M. N. (2012). Are Internet use and video-game-playing addictive behaviors? Biological, clinical and public health implications for youth and adults. *Minerva Psichiatrica, 53*, 153–170.

Yen, J.-Y., Ko, C.-H., Yen, C.-F., Wu, H.-Y. & Yang, M.-J. (2007). The comorbid psychiatric symptoms of Internet addiction: Attention deficit and hyperactivity disorder (ADHD), depression, social phobia, and hostility. *The Journal of Adolescence Health, 41*(1), 93–98.

Young, K. S. (1999). Internet addiction: Symptoms, evaluation and treatment. In L. VandeCreek & T. Jackson (Eds.), *Innovations in clinical practice: A source book* (Vol. 17, pp. 19–31). Sarasota, FL: Professional Resource Press.

Zhou, Y., Lin, F. C., Du, Y. S., Qin, L. G., Zhao, Z. M., Xu, K. R. & Lei, H. (2011). Grey matter abnormalities in Internet addiction: A voxel-based morphometry study. *European Journal of Radiology, 79*, 92–95.

Zhou, Z.-H., Yuan, G.-Z., Yao, J.-J., Li, C. & Cheng, Z.-H. (2010). An event-related potential investigation of deficient inhibitory control in individuals with pathological Internet use. *Acta Neuropsychiatrica, 22*(5), 228–236.