

## ORIGINAL ARTICLE

## A Review and Meta-Analysis Examining Conceptual and Operational Definitions of Problematic Internet Use

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*This study examined different conceptual and operational definitions of problematic Internet use (PIU). 3 perspectives of PIU are described along with a meta-analytic review (K = 112) conducted to explore the implications stemming from how PIU is measured. The results offer evidence to support the construct validity of measures developed from the impulse control disorder and relationship resource deficits traditions but raise questions about substance dependence measures of PIU. Additionally, there were small but noteworthy differences in the associations between PIU and key antecedents and outcomes that could be attributed to PIU measurement tradition. Suggestions for developing a more robust body of scholarship on PIU are offered.*

**Keywords:** Problematic Internet Use, Time Online, Loneliness, Depression, Substance Dependence, Impulse Control Disorder, Relational Resource Deficits, Meta-Analysis.

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Widespread adoption of the Internet in the United States during the 1990s sparked questions about the effects of Internet use. Several early reports highlighted the potential of using the Internet to overcome traditional communication barriers of time and space (e.g., Baym, 1997; Sproull & Kiesler, 1991). More recent research continues to demonstrate that the Internet can be a valuable resource for keeping in contact with close friends and family members, maintaining healthy relationships, and extending social networks (Baym, 2015; Rainie & Wellman, 2012). A handful of studies, however, brought notoriety to the Internet's potentially dissocializing effects (e.g., Nie & Erbring, 2002; Stoll, 1995; Turow, 1999). The deleterious consequences of Internet use have remained a long-standing topic of interest among scholars and the broader public (e.g., Bilton, 2013; St. George, 2008).

An active area of study stems from Young's (1996) report where she suggested the possibility of an "Internet addiction." This notion follows a tradition of media

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effects research examining the “addictive” properties of media, such as television (Kubey, 1996; McIlwraith, 1998) and video games (Fisher, 1994; Griffiths, 1992). Young described this phenomenon as difficulties regulating Internet use that result in detrimental outcomes for the user. From this starting point, research examining this general topic, referred to in this report as problematic Internet use (PIU), has grown considerably. A recent meta-analysis reported that over 350 studies have examined PIU (Tokunaga & Rains, 2010).

PIU, sometimes called Internet addiction, compulsive Internet use, pathological Internet use, or deficient self-regulation (among several other terms), represents a pattern of uncontrolled Internet consumption (Caplan, 2002; LaRose, 2001). Communication scholars have been interested in PIU as a media selection process and as a media effect (Tokunaga, 2015). Additionally, the antecedents and outcomes commonly associated with PIU, such as loneliness, depression, and social anxiety, underscore the important role of interpersonal communication in the process (Tokunaga & Rains, 2010). PIU is therefore an issue communication scholars are well-positioned to address.

The various terms used in reference to PIU reflect a broader problem involving the presence of several conflicting conceptual and operational definitions of this phenomenon. It has been described as a pathology akin to substance dependence (Kandell, 1998), an impulse control disorder comparable to pathological gambling (Young, 1996, 1998), and an artifact of relational and relationship-building resource deficits (Caplan, 2003; Davis, Flett, & Besser, 2002). These different characterizations gave rise to a large number of PIU measures. At least 29 independently developed measures have been used in research (Tokunaga & Rains, 2010).

The large number of conceptual and operational definitions of PIU creates significant challenges for—and perhaps even barriers to—advancing scholarship on this topic. On a very basic level, scholars might question whether all of these definitions and instruments address the same underlying construct (Tokunaga, 2015). More generally, a cohesive and systematic body of research cannot develop without clear and well-understood conceptual definitions of PIU and effective measures for studying this phenomenon (Davis et al., 2002). In other words, the potential for and value of aggregating this body of literature is limited if results of investigations change as an artifact of the instruments used to measure PIU. Inconsistent conceptual definitions and poorly designed measures undermine the cumulative function of research.

The goal of this project is to examine the different conceptual and operational definitions of PIU used in prior research and investigate the implications of these definitions. First, three perspectives of PIU—as a form of substance dependence, an impulse control disorder, or an artifact of relational resource deficits—are described. Second, commonly used PIU instruments devised in each perspective are evaluated. Third, the results of a meta-analytic review of PIU research are presented. Meta-analysis makes it possible to directly assess the implications of the three different traditions of PIU measures. Studies were grouped into one of three classes by

whether the tool used to measure PIU was modeled after substance dependence, impulse control disorder, or relational resource deficits instruments. The empirical implications of these three traditions of measures were evaluated by examining potential differences in the associations between PIU and three factors to which it has been consistently linked in prior research (i.e., time spent online, loneliness, and depression). Additional analyses were conducted to further explore specific dimensions of these measures that represent mechanisms for operationalizing PIU.

This project will advance research on PIU in several ways. By examining the various labels and conceptual definitions of PIU, a framework will be developed to organize and understand this vast and seemingly discordant body of research. Three perspectives that represent distinct conceptual and operational definitions of PIU will be identified. Identifying and isolating consistencies and inconsistencies in conceptual definitions, which represent specific areas of agreement and disagreement about what PIU is and what it is not, will offer insights into the core features of PIU and the instruments devised in these traditions. Such an effort will help to guide communication researchers attempting to navigate scholarships on PIU. Finally, a clearer understanding of PIU and its core characteristics would benefit practitioners working in cognate disciplines such as those who are charged with evaluating whether to include Internet addiction in future revisions of the American Psychiatric Association's *Diagnostic and Statistical Manual of Mental Disorders* (Petry & O'Brien, 2013).

### Three traditions of conceptual and operational definitions

Three perspectives of thinking about and studying PIU have emerged in the rapidly growing body of scholarship on this topic.<sup>1</sup> This phenomenon has been conceptualized as a pathology related to substance dependence (Kandell, 1998), an impulse control disorder similar to pathological gambling (Young, 1996, 1998), and an artifact of relational and relationship-building resource deficits (Caplan, 2003; Davis et al., 2002). In the following sections, the three perspectives are explained to highlight the similarities and differences among them. The implications of the three perspectives are then considered to provide a foundation for the research questions of this study.

#### PIU as substance dependence

In the substance dependence tradition, PIU is considered to be analogous to a chemical addiction and is defined as a dependence on the Internet "characterized by (a) an increasing investment of resources on Internet-related activities, (b) unpleasant feelings (e.g., anxiety, depression, emptiness) when offline, (c) an increasing tolerance to the effects of being online, and (d) denial of the problematic behaviors" (Kandell, 1998, p. 11). The hallmark of any dependence is an uncontrolled use of a substance despite attempts to curb its use. Tolerance and withdrawal are also important dimensions of the substance dependence perspective (Babor, 1992). Tolerance arises when one's reactivity to a substance diminishes, making it necessary to increase doses of

the stimulus to maintain the effect (Hyman & Malenka, 2001). Withdrawal describes the noxious symptoms (e.g., restlessness, insomnia) that result from the reduction or suspension of a substance. The final dimension of substance dependence is the social, occupational, and recreational problems that prolonged substance use causes in one's life.

In PIU, individuals lose self-control over their Internet use despite the problems that it causes in their lives. Tolerance builds as individuals require greater amounts of Internet use to reach the levels of pleasure or satisfaction achieved in the past (Li & Chung, 2006; Nichols & Nicki, 2004). Withdrawal is marked by feelings of nervousness, agitation, and aggression when Internet use is decreased or discontinued. This perspective recognizes that users are not becoming addicted to the Internet in a manner corresponding to a chemical addiction; rather, they become addicted to and come to crave the euphoric sensations of dopamine release in the reward centers of the brain (Beard, 2005; Kim et al., 2011). Increased engagement with Internet use can cause functional impairment in users' personal relationships or professional performance.

### **PIU as an impulse control disorder**

A second tradition of research on PIU has conceptualized it as a product of inadequate control over impulsive thoughts or feelings. Young (1996) described PIU as an "impulse-control disorder that does not involve an intoxicant" (p. 237). Scholars of this tradition argue that PIU stems from an inability to control impulses involving Internet use, even if the activity knowingly leads to detrimental outcomes (Young, 1998). This failure to control impulses, marked by a tendency to act with less forethought, originates from one's desire to make short-term gains that accompany significant long-term costs (Dickman, 1993; Lesieur & Rosenthal, 1991). The two core components of impulse control disorders, such as pathological gambling, are uncontrolled behaviors and cognitive preoccupation (Grant, Potenza, Weinstein, & Gorelick, 2010).

Uncontrolled behaviors are akin to the uncontrollable uses of a stimulant. However, while substance dependence involves physiological addictions, impulse control disorders point to psychological dependence (Le Moal & Koob, 2007). Preoccupation is a state of persistent thoughts about the performance of a behavior while away from it. In impulse control disorders, the performance of a behavior is frequently on one's mind, reliving past experiences and planning future encounters. A third important dimension of impulse control disorders is using the behavior as a way to escape problems or aversive mood states (Lesieur & Rosenthal, 1991). Because rewarding behaviors can initiate the release of dopamine in the brain, even in the absence of substances, some individuals develop impulse control disorders on account of the mood alteration generated by the performance of the behavior. A fourth dimension indicative of impulse control disorders is tolerance and withdrawal. The final dimension is negative social and professional outcomes that reliably come after the short-term gains.

In the impulse control disorder perspective, PIU is signaled by individuals who seek gratification from the Internet and lose control of its use over time (Young, 1998). Preoccupation occurs where people cannot stop thinking about the Internet while away from it or what Internet content will be available upon their return (Beard, 2005). Short-term gratifications, such as mood alteration, are sought by those with PIU (Chou & Hsiao, 2000; Yang & Tung, 2007). The use of the Internet to alter moods and gratify other needs results in individuals requiring more and more time online to achieve levels of gratification experienced in the past. These Internet users are also irritable or restless when they are unable to go on the Internet. The short-term gains are followed by long-term losses in the form of declining interpersonal relationships (Chou & Hsiao, 2000), problems at school or work (Kubey, Lavin, & Barrows, 2001; Thatcher, Wretschko, & Fisher, 2008), or general health issues (Niemz, Griffiths, & Banyard, 2005).

### **PIU as an artifact of relational and relationship-building resource deficits**

The third way of studying PIU has been to conceptualize it as the product of deficits in offline relationships and relationship-building resources. This view has some overlap with the substance dependence and impulse control disorder traditions as scholars across the three perspectives uniformly recognize uncontrollability over Internet use as a defining feature of PIU. This perspective deviates from the others in that interpersonal communication efficacy online is considered to be a second critical element in PIU development. As Caplan (2002, p. 556) notes, "PIU occurs when an individual develops problems due to *the unique communicative context of the Internet*" (emphasis in original). A key factor that explains why some Internet users are more likely to develop PIU is a preference for communicating online (Caplan, 2003). Such a preference stems from psychosocial problems (e.g., loneliness, depression), which negatively biases perceptions of one's social competence (Caplan, 2003). Online interactions are argued to be less threatening, more controlled, and of less consequence than offline social interactions (Caplan, 2002; Davis, 2001). These favorable characteristics of online relationships make communicating over the Internet a socially rewarding experience for some.

The third dimension of PIU in the relational resource deficits perspective is preoccupation. From this perspective, maladaptive cognitions about self and the world are considered to be part of the PIU concept. Maladaptive thoughts are guided by ruminations about one's ineffective offline social interactions and the possibility to overcome these deficits over the Internet (Davis, 2001). The propensity to think about online social interactions while away from the Internet or ones that will be available when returning to the Internet is indicative of preoccupation.

The fourth dimension of PIU is mood alteration. Deficits in relationship-building resources produce aversive mood states, causing people to feel isolated and withdrawn (Caplan, 2002; Davis, 2001; Davis et al., 2002). The Internet creates greater opportunities for people with relational resource deficits to be socially efficacious and develop meaningful relationships. Escape from aversive moods by creating

and maintaining successful relationships online becomes an important factor of PIU development in this perspective. Negative consequences are also recognized as part of the PIU process, but these consequences are viewed as outcomes of PIU, not a central dimension of the construct (Caplan, 2003, 2005; Liu & Peng, 2009).

### **Similarities and differences among the traditions**

There are several consistencies among the traditions of studying PIU from the substance dependence, impulse control disorder, and relational resource deficits perspectives. All three traditions share two common assumptions. First, the three traditions are based on an assumption that a core dimension of PIU involves a perceived loss of self-control over Internet use. Second, the three traditions share the assumption that PIU consists of both cognitive and behavioral dimensions.

Noteworthy inconsistencies among the three traditions of PIU research can also be ascertained. Each of the three traditions highlights a unique feature of PIU that is not considered or has received significantly less attention in the other two traditions (Meerkerk, van den Eijnden, Vermulst, & Garretsen, 2009). Preoccupation is explained as a central dimension of PIU in the impulse control disorder and relational resource deficits traditions but not in the substance dependence tradition. These two perspectives also consider mood alteration to be an important component of the PIU construct. The substance dependence and impulse control traditions include tolerance and withdrawal as a dimension of PIU, which is not part of the construct from the resource deficits perspective. The substance dependence and impulse control disorder perspectives also explain that negative outcomes are a necessary component for PIU to exist, whereas the relational resource deficits perspective recognizes outcomes as a construct empirically distinguishable from PIU. The relational resource deficits tradition departs from the other two perspectives in that it emphasizes the relational elements involved with PIU. The PIU construct is interpreted as a social phenomenon wherein one's interpersonal efficacy online is a key part of PIU development.

### **Implications of the three traditions for research on problematic internet use**

The conceptual similarities and differences across the three traditions of PIU research raise important theoretical and empirical questions about the large body of scholarship on this topic amassed over the past two decades. An initial question involves the operational definitions of PIU and the degree that measures are faithful to the perspectives from which they were developed. The presumption is that scholars working from these different perspectives devised instruments that include certain dimensions of PIU while leaving others out. There has been no attempt, however, to systematically examine the different classes of measures and determine whether the dimensions of PIU represented (i.e., uncontrolled Internet use, preoccupation, tolerance/withdrawal, mood alteration, interpersonal efficacy online, negative outcomes) comport with the assumptions of the tradition out of which they were born.

Investigating this issue is critical to better understand the operational definitions of PIU and establish the construct validity of PIU measures within each of the three traditions. The following research question is proposed to address this issue.

RQ1: To what degree do the measures within each tradition represent and omit the different dimensions of PIU in a manner consistent with the assumptions of their tradition?

A second question involves the implications of differences in the way PIU is operationally defined. The emphasis placed on certain elements of PIU in some classes of instruments but not others can lead to inconsistent findings across the body of research. Instruments from one tradition of measures might be more or less sensitive to the variables with which PIU is thought to be associated than other measures. Accordingly, the magnitude of the associations between PIU and its antecedents and outcomes may be tied to the different ways PIU has been operationalized.

The potential implications of differences in PIU research, depending on the way PIU was operationally defined, are significant. Any differences of this nature could create substantial problems for making generalizations across the body of scholarship on this topic. In effect, researchers would be limited to drawing conclusions within the different classes of substance dependence, impulse control disorder, and relational resource deficits measures. More broadly, inconsistent findings stemming from differences in the traditions of measures would suggest that beyond being different, the measures — and the conceptual traditions they represent — may be fundamentally incompatible.

Meta-analysis offers an effective means of comparing potential differences in research results stemming from discrepant traditions of PIU measures. Meta-analysis is a method of aggregating results across a body of scholarship (Hedges & Olkin, 1985; Hunter, Schmidt, & Jackson, 1982; Lipsey & Wilson, 2001). A weighted estimate of the relationship between two variables from a single study is computed and then combined across a sample of studies. A noteworthy element of meta-analysis, of relevance to this project, is the potential to explain inconsistent findings across a body of research. Meta-analysis makes it possible to examine moderator variables that might account for systematic differences in the results.

Prior research has demonstrated robust associations between PIU and three other variables: time spent online, loneliness, and depression. In their meta-analysis, Tokunaga and Rains (2010) reported a weighted mean correlation of  $r = .39$  between PIU and time spent online among a sample of 46 studies, a correlation of  $r = .33$  between PIU and loneliness among 19 studies, and a correlation of  $r = .37$  between PIU and depression among 23 studies. Their findings suggested that research examining the associations between PIU and time spent online, loneliness, and depression offers a stable and reliable context for exploring the three classes of operational definitions of PIU. If the three traditions of PIU measures are incompatible, then differences among the associations across the three classes of PIU measures would be expected. No differences in the relationships between PIU and these variables would suggest that the conceptual differences among the three traditions

are less significant, and the results across the large body of PIU scholarship can be aggregated.

RQ2: Are there differences in the associations between PIU and (a) time spent online, (b) loneliness, and (c) depression based on whether PIU is operationalized from the substance dependence, impulse control disorder, or relational resource deficits tradition?

The final question involves the specific reasons why different classes of operational definitions for PIU might lead to inconsistent associations with time spent online, loneliness, and depression. In addition to testing for general inconsistencies across the three traditions of PIU measures, understanding what specific dimensions of these measures are likely to be responsible for such differences is important. The three traditions vary in the degree to which PIU dimensions are represented and omitted. As previously noted, although all three traditions involve a perceived loss of control over Internet use, other dimensions like preoccupation, tolerance/withdrawal, mood alteration, interpersonal efficacy online, and negative outcomes are included in some traditions but not others. An analysis focused on identifying the specific dimensions of PIU that result in stronger or weaker associations between PIU and key antecedents and outcomes could uncover important insights into why research results differ among these traditions.

RQ3: Are there differences in the associations between PIU and (a) time spent online, (b) loneliness, and (c) depression based on whether or not the PIU measure evaluates preoccupation, tolerance/withdrawal, mood alteration, interpersonal efficacy online, and negative outcomes?

## Method

A meta-analytic review was conducted to answer the research questions. In the following sections, the procedures of the meta-analysis are described in detail. Information about the search and selection of research reports, operationalization of variables, effect size extraction, corrections for study artifacts, computation for the weighted mean effect sizes, and moderator tests is provided.

### Literature search and selection criteria

An extensive literature search was undertaken to find research reports that measured PIU and time spent online, loneliness, and/or depression. The literature search, which included reports completed prior to 2013, followed a three-step approach for gathering relevant empirical studies. First, the *Academic Search Premier*, *Business Source Premier*, *Computer Source*, *Communication and Mass Media Premier*, *ERIC*, *Medline*, *Psychology and Behavioral Sciences Collection*, and *Psych-Info* electronic databases in EbscoHost were searched for journal publications and conference papers. Google Scholar, JSTOR, LexisNexis, WorldCat, and All Academic databases were also used to search for journal articles, convention papers, and conference proceedings. ProQuest's Dissertation and Theses database was used

to identify doctoral dissertations and master's theses. The search terms included "problematic Internet use" and variations such as "pathological Internet use," "PIU," "Internet addiction," "Internet overuse," "excessive Internet use," and "Internet dependency."

Second, the references of review articles on PIU (e.g., Byun et al., 2009; Carli et al., 2012; Chou, Condrón, & Belland, 2005; Morahan-Martin, 2005; Widyanto & Griffiths, 2006) were checked against the list of citations derived from the first step of the literature search to identify any missing reports. Several meta-analyses examining the relationship between PIU and psychosocial problems (Carli et al., 2012; Cheng & Li, 2014; Ho et al., 2014; Koo & Kwon, 2014) were also consulted for relevant reports. Third, an e-mail was sent to PIU researchers soliciting any relevant unpublished manuscripts or identifying any published manuscripts missed in the initial two steps of the literature search. The literature search yielded over 450 reports that addressed the topic of PIU in some way.

All research reports were screened on two criteria. First, the relationship between PIU and time spent using the Internet, loneliness, and/or depression must have been estimated. Second, a correlation coefficient or data making it possible to calculate the correlation (i.e., means and standard deviations, *t* statistic, *F* statistic) must have been reported.

Reports providing only frequency data (e.g., Bakken, Wenzel, Gotestam, Johansson, & Oren, 2009; Ko, Yen, Chen, Chen, & Yen, 2008) were excluded from the analysis. A small number of cases that met the preceding criteria were also excluded. Ten research reports (e.g., Meerkerk et al., 2009; Rotunda, Kass, Sutton, & Leon, 2003; Song, 2003) measured PIU with an instrument that was informed by more than one of the three traditions of PIU, making it impossible to use them to test the second research question.<sup>2</sup> Reports of empirically tested treatment methods of Internet addiction (e.g., Winkler, Dörsing, Rief, Shen, & Glombiewski, 2013) were also not included in the analysis.

Lastly, any data that appeared in an earlier report were excluded (e.g., Alavi, Maracy, Jannatifard, & Eslami, 2011; Alavi et al., 2012; Caplan, 2002, 2003). A total of 112 empirical research reports met the selection criteria of this project; 91 cases were journal publications, 16 were master's theses or doctoral dissertations, and 5 were conference papers or proceedings. Table 1 presents summary information, such as sample sizes and instruments used to measure PIU, of the reports included in the meta-analyses.

### **Operationalization of the study variables**

Research reports that measured PIU with an instrument from one of the three traditions were included in the meta-analysis. In the reports, PIU could have been measured in a generalized form (e.g., Caplan, 2002; Ceyhan & Ceyhan, 2008; Davis et al., 2002) or specific form (e.g., Charlton & Danforth, 2007). Davis (2001, p. 192) defined generalized PIU as "spending abnormal amounts of time on the Internet ... wasting time with no directive purpose" and specific PIU as the "overuse and

**Table 1** Description of Research Reports Included in the Meta-Analyses

| Author(s) <sup>a</sup>                               | Sample Size | PIU-<br>Time<br>Online <i>r</i> | PIU-<br>Loneliness<br><i>r</i> | PIU-<br>Depression<br><i>r</i> | Substance<br>Dependence | Impulse<br>Control Disorder | Relational<br>Resource<br>Deficits |
|--|-------------|---------------------------------|--------------------------------|--------------------------------|-------------------------|-----------------------------|------------------------------------|
| Adalier and Balkan (2012)                            | 126         | .26                             |                                | .56                            |                         | IADQ                        |                                    |
| Akin and Iskender (2011)                             | 300         |                                 |                                | .74                            |                         |                             | OCS                                |
| Alavi et al. (2012)                                  | 250         |                                 |                                | .46                            |                         | IADQ & IAT                  |                                    |
| Ang, Chong, Chye, and Huan (2012)                    | 1098        |                                 | .30                            |                                |                         |                             | GPIUS                              |
| Armstrong, Phillips, and Saling (2000)               | 50          | .81                             |                                |                                | IRABI                   |                             |                                    |
| Aslanbay, Aslanbay, and Çobanoğlu (2009)             | 313         | .49                             |                                |                                |                         | IAT                         |                                    |
| Barke, Nyenhuis, and Kröner-Herwig (2012)            | 1882        | .64                             |                                |                                |                         | IAT                         |                                    |
| Blau (2011)  | 2884        | .48                             |                                |                                |                         | IADQ                        |                                    |
| Bulut Serin (2011)                                   | 411         |                                 | .04                            |                                |                         |                             | OCS                                |
| Canan, Ataoglu, Nichols, Yildirim, and Ozturk (2010) | 292         |                                 |                                | .57                            | IAS                     |                             |                                    |
| Canan, Ataoglu, Ozcetin, and Icmeli (2012)           | 1028        | .99 <sup>b</sup>                |                                |                                | IAS                     |                             |                                    |
| Canbaz, Sunter, Peksen, and Canbaz (2009)            | 810         | .99 <sup>b</sup>                |                                |                                |                         | IAT                         |                                    |
| Cao and Su (2006)                                    | 128         | .74                             |                                |                                |                         | IADQ                        |                                    |
| Caplan (2002)  | 386         |                                 | .19                            | .28                            |                         |                             | GPIUS                              |
| Casale and Fioravanti (2011)                         | 157         | .26                             | .40                            | .26                            |                         |                             | GPIUS                              |
| Ceyhan and Ceyhan (2008)                             | 529         |                                 | .51                            |                                |                         |                             | CCG                                |
| Ceyhan et al. (2007)                                 | 1658        |                                 | .29                            | .32                            |                         |                             | CCG                                |
| Chak and Leung (2004)                                | 722         | .31                             |                                |                                |                         |                             | PIUS                               |
| Chang and Man Law (2008)                             | 410         | .05                             |                                |                                |                         |                             | PIUS                               |

Table 1 Continued

| Author(s) <sup>a</sup>                                  | Sample Size | PIU-Time Online <i>r</i> | PIU-Loneliness <i>r</i> | PIU-Depression <i>r</i> | Substance Dependence | Impulse Control Disorder | Relational Resource Deficits |
|---|-------------|--------------------------|-------------------------|-------------------------|----------------------|--------------------------|------------------------------|
| Charlton and Danforth (2007)                            | 26          | .54                      |                         |                         |                      | GCQ                      |                              |
| Cheung and Wong (2011)                                  | 719         |                          |                         | .30                     | CIAS                 |                          |                              |
| Choi (2001)   | 346         | .34                      |                         |                         |                      | IADQ and VAS             |                              |
| Choi et al. (2009)                                      | 2336        | .48                      |                         |                         |                      | IAT                      |                              |
| Chou, Chou, and Tyan (1998)                             | 104         | .31                      |                         |                         | IRABI                |                          | PIUS                         |
| Çuhadar (2012)  | 1235        | .22                      |                         |                         |                      |                          | OCS                          |
| Davis (2003) (Study 3)                                  | 211         |                          | .23                     | .32                     |                      |                          | OCS                          |
| Davis et al. (2002)                                     | 211         | .31                      | .36                     | .22                     |                      |                          | OCS                          |
| DeLonga et al. (2011)                                   | 49          |                          | .60                     | .52                     | IAS                  |                          |                              |
| Dowling and Quirk (2009)                                | 424         | .82                      | .58                     |                         |                      | IADQ                     |                              |
| Durkee et al. (2012)                                    | 11956       | .33                      |                         |                         |                      | IADQ                     | OCS                          |
| Ebrahimi and Sadeghi (2011)                             | 114         |                          |                         | .99 <sup>b</sup>        |                      |                          |                              |
| Engelberg and Sjöberg (2004)                            | 41          |                          | .37                     |                         |                      | IAT                      |                              |
| Esen and Siyez (2011)                                   | 700         |                          | .27                     |                         |                      | IAT                      |                              |
| Fisoun, Floros, Siomos, Geroukalis, and Navridis (2012) | 1221        | .60                      |                         |                         |                      | IAT                      |                              |
| Fortson, Scotti, Chen, Malone, and Del Ben (2007)       | 411         | .44                      |                         | .16                     | DSM-IV-SD-A          |                          |                              |
| Fu, Chan, Wong, and Yip (2010)                          | 208         |                          |                         | .52                     |                      | IADQ                     | GPIUS2                       |
| Gámez-Guadix, Orue, Smith, and Calvete (2013)           | 126         | .44                      |                         | .26                     |                      |                          |                              |
| Goulet (2002)   | 430         | .34                      | .37                     |                         | IDS and IUS          |                          |                              |

Table 1 Continued

| Author(s) <sup>a</sup>                                       | Sample Size | PIU-Time Online <i>r</i> | PIU-Loneliness <i>r</i> | PIU-Depression <i>r</i> | Substance Dependence | Impulse Control Disorder | Relational Resource Deficits |
|--|-------------|--------------------------|-------------------------|-------------------------|----------------------|--------------------------|------------------------------|
| Ha et al. (2007)   | 452         | .51                      |                         | .46                     |                      | IAT                      |                              |
| Hardie and Tee (2007)  | 96          | .90                      | .33                     |                         |                      | IAT                      |                              |
| He, Liu, Guo, and Zhao (2011)                                | 28          | .96                      |                         |                         |                      | IAT                      |                              |
| Hinic, Mihajlovic, and Dukic-Dejanovic (2010)                | 100         |                          |                         | .06                     |                      | IAT                      |                              |
| Huang (2004)   | 1119        | .36                      | .21                     | .05                     |                      | IAT                      |                              |
| Hughes (1999)  | 295         |                          | .35                     |                         |                      | IAT                      |                              |
| Iacovelli and Valenti (2009)                                 | 37          |                          |                         | .66                     |                      | IAT                      |                              |
| Jang, Hwang, and Choi (2008)                                 | 912         | .23                      |                         | .87                     |                      | IAT                      |                              |
| Jenaro, Flores, Gomez-Vela, Gonzalez-Gil, and Caballo (2007) | 323         |                          |                         | .36                     |                      | DSM-IV-PG-A              |                              |
| Johansson and Gotestam (2004)                                | 3237        | .50                      |                         |                         |                      | IADQ                     |                              |
| Kelley and Gruber (2010)                                     | 278         |                          |                         | .30                     |                      | PIUQ1                    |                              |
| Khazaal et al. (2008)  | 195         | .56                      |                         |                         |                      | IADQ                     |                              |
| Kheirkhan, Ghabeli Juibary, Gouran, and Hashemi (2008)       | 1856        | .36                      |                         |                         |                      | IAT                      |                              |
| Kim and Davis (2009) (Pretest-1)                             | 70          | .54                      |                         |                         |                      | IAT                      |                              |
| Kim and Davis (2009) (Pretest-2)                             | 70          | .82                      |                         |                         |                      |                          | GPIUS                        |
| Kim and Davis (2009) (Study 1)                               | 315         | .49                      |                         |                         |                      | IAT                      |                              |
| Kim and Haridakis (2009)                                     | 203         | .47                      | .26                     |                         |                      | IAT                      |                              |
| Kim et al. (2006)  | 1573        |                          |                         | .18                     |                      | IAT                      |                              |
| Koc (2011)   | 174         |                          |                         | .51                     |                      | IADQ                     |                              |

**Table 1** Continued

| Author(s) <sup>a</sup>                     | Sample Size | PIU-<br>Time<br>Online <i>r</i> | PIU-<br>Loneliness<br><i>r</i> | PIU-<br>Depression<br><i>r</i> | Substance<br>Dependence | Impulse<br>Control Disorder | Relational<br>Resource<br>Deficits |
|--|-------------|---------------------------------|--------------------------------|--------------------------------|-------------------------|-----------------------------|------------------------------------|
| LaRose et al. (2003)                       | 465         | .54                             |                                | .38                            |                         | ADD, IAT, VAS               |                                    |
| Lee (2009)                                 | 54          | .42                             |                                |                                |                         | IAT                         |                                    |
| Lee et al. (2012)                          | 1511        |                                 |                                | .99 <sup>b</sup>               |                         | IAT                         |                                    |
| Lin, Ko, and Wu (2008)                     | 4456        | .35                             |                                |                                | CIAS                    |                             |                                    |
| Lin, Ko, and Wu (2011)                     | 3616        | .38                             |                                | .42                            | CIAS                    |                             |                                    |
| Lu et al. (2011)                           | 146         |                                 |                                | .39                            |                         | IAT                         |                                    |
| Matsuba (2006)                             | 203         | .36                             | .25                            |                                |                         | PUS                         |                                    |
| Milani, Osualdella, and Di Blasio (2009)   | 98          | .43                             |                                |                                |                         | IAT                         |                                    |
| Montag et al. (2011)                       | 610         |                                 |                                | .29                            |                         | IAT                         |                                    |
| Montag, Jurkiewicz, and Reuter (2010)      | 201         | .66                             |                                |                                |                         | IAT                         |                                    |
| Morahan-Martin and Schumacher (2000)       | 277         | .83                             | .76                            |                                |                         | PUS                         |                                    |
| Morrison and Gore (2010)                   | 1319        | .67                             |                                | .55                            |                         | IAT                         |                                    |
| Mottram and Fleming (2009)                 | 272         | .41                             |                                |                                |                         | IAT                         |                                    |
| Mueller et al. (2011)                      | 387         |                                 |                                | .53                            |                         | IADQ                        |                                    |
| Munteanu, Costea, Palos, and Jinaru (2009) | 185         |                                 |                                | .99 <sup>b</sup>               |                         | IADQ                        | OCS                                |
| Nalwa and Anand (2003)                     | 39          |                                 | .46                            |                                |                         |                             |                                    |
| Ngai (2007)                                | 988         | .43                             |                                |                                |                         | IAT                         |                                    |
| Ni, Yan, Chen, and Liu (2009)              | 3557        |                                 |                                | .40                            |                         | IAT                         |                                    |
| Nichols (2011)                             | 164         |                                 |                                | .25                            | IAS                     |                             |                                    |
| Nichols and Nicki (2004)                   | 207         | .13                             | .34                            |                                | IAS                     |                             |                                    |
| Odact and Kalkan (2010)                    | 493         | .20                             | .21                            |                                |                         |                             | OCS                                |

Table 1 Continued

| Author(s) <sup>a</sup>                                     | Sample Size | PIU-Time Online <i>r</i> | PIU-Loneliness <i>r</i> | PIU-Depression <i>r</i> | Substance Dependence | Impulse Control Disorder | Relational Resource Deficits |
|--|-------------|--------------------------|-------------------------|-------------------------|----------------------|--------------------------|------------------------------|
| Oforu (1999)   | 144         | .48                      | .24                     |                         |                      | IADQ and SOGS-A          |                              |
| Oh (2003)  | 450         |                          |                         | .49                     |                      | IAT                      |                              |
| Okeke (2007)   | 117         |                          | .09                     |                         |                      | PUS                      |                              |
| Ozcan and Buzlu (2007)                                     | 730         | .48                      | .37                     | .39                     |                      |                          | OCS<br>PIUS                  |
| Ozturk and Kaymak Ozmen (2011)                             | 453         | .63                      |                         |                         |                      |                          |                              |
| Park et al. (2011)   | 102         |                          |                         | .15                     | K-Scale              | IADQ                     |                              |
| Parsons (2005)   | 513         |                          | .61                     |                         |                      |                          | OCS                          |
| Pawlak (2002)  | 204         |                          | .24                     |                         |                      | IAT                      |                              |
| Pawlikowski, Altstotter-Gleich, and Brand (2013) (Study 1) | 584         | .46                      |                         |                         |                      |                          |                              |
| Pawlikowski et al. (2013) (Study 2)                        | 465         | .43                      |                         |                         |                      | IAT                      |                              |
| Pawlikowski et al. (2013) (Study 3)                        | 803         | .40                      |                         | .39                     |                      | IAT                      |                              |
| Peters and Malesky (2008)                                  | 196         | .40                      |                         |                         |                      | GCQ                      |                              |
| Rosenthal (2009)   | 125         |                          | .21                     | .31                     |                      |                          | GPIUS                        |
| Scherer (1997)   | 380         | .26                      |                         |                         | DSM-IV-SD-A          |                          |                              |
| Schoenfeld (2011)  | 224         | .50                      |                         |                         |                      | IAT                      |                              |
| Schoenfeld (2011)  | 224         | .50                      |                         |                         |                      |                          | GPIUS                        |
| Seay and Kraut (2007)                                      | 2790        | .34                      | .32                     | .44                     |                      | GCQ                      |                              |
| Spada, Langston, Nikcevic, and Moneta (2008)               | 97          |                          |                         | .56                     |                      | IAT                      |                              |

Table 1 Continued

| Author(s) <sup>a</sup>                         | Sample Size | PIU- Time Online <i>r</i> | PIU- Loneliness <i>r</i> | PIU- Depression <i>r</i> | Substance Dependence | Impulse Control Disorder | Relational Resource Deficits |
|--|-------------|---------------------------|--------------------------|--------------------------|----------------------|--------------------------|------------------------------|
| Stieger and Burger (2010) (Study 1)            | 259         | .31                       |                          |                          |                      | IAT                      |                              |
| Stieger and Burger (2010) (Study 1)            | 259         | .34                       |                          |                          |                      |                          | OCS                          |
| Stieger and Burger (2010) (Study 2)            | 138         | .45                       |                          |                          |                      | IAT                      |                              |
| Tahiroglu, Celik, Uzel, Ozcan, and Avci (2008) | 3975        | .75                       |                          |                          |                      |                          | OCS                          |
| te Wildt et al. (2010)                         | 50          | .99 <sup>b</sup>          |                          | .99 <sup>b</sup>         | GIAS                 |                          |                              |
| Thatcher and Goolam (2005a)                    | 1795        | .35                       |                          |                          |                      | PIUQ2                    |                              |
| Thatcher and Goolam (2005b)                    | 279         | .22                       |                          |                          |                      | PIUQ2                    |                              |
| Thatcher, Wretschko, and Fisher (2008)         | 1399        | .28                       |                          |                          |                      | PIUQ2                    |                              |
| Tong, Vitak, and LaRose (2010)                 | 180         |                           | .06                      |                          |                      |                          | GPIUS                        |
| Tonioni et al. (2012)                          | 21          | .22                       |                          | -.39                     |                      | IADQ                     |                              |
| Torres (2010)                                  | 404         | .22                       |                          |                          |                      | IADQ                     |                              |
| Tutgun, Deniz, and Moon (2011)                 | 595         | .34                       | .23                      |                          |                      |                          | GPIUS2                       |
| Uneri and Tanidir (2011)                       | 114         | .26                       |                          | .20                      |                      |                          | TIAS                         |
| Ward (2000)                                    | 114         | .69                       |                          | .03                      |                      | IUQ                      |                              |
| Weitzman (2000)                                | 446         | .59                       |                          |                          | DSM-IV-SD-A          |                          |                              |
| Widyanto, Griffiths, and Brunsten (2011)       | 225         | .21                       |                          |                          |                      | IAT                      |                              |
| Widyanto and McMurrin (2004)                   | 86          | .23                       |                          |                          |                      | IAT                      |                              |

Table 1 Continued

| Author(s) <sup>a</sup>                 | Sample Size | PIU-Time Online <i>r</i> | PIU-Loneliness <i>r</i> | PIU-Depression <i>r</i> | Substance Dependence | Impulse Control Disorder | Relational Resource Deficits |
|--|-------------|--------------------------|-------------------------|-------------------------|----------------------|--------------------------|------------------------------|
| Yang, Choe, Baity, Lee, and Cho (2005) | 328         | .65                      |                         | .40                     |                      | IAT                      |                              |
| Yang and Tung (2007)                   | 1708        | .34                      |                         | .40                     |                      | IADQ                     |                              |
| Yen et al. (2008)                      | 3662        |                          |                         | .37                     | CIAS                 |                          |                              |
| Yen, Ko, Yen, Wu, and Yang (2007)      | 1890        |                          |                         | .57                     | CIAS                 |                          |                              |
| Yuen and Lavin (2004)                  | 283         | .30                      |                         |                         | DSM-IV-SD-A          |                          |                              |
| Zhong and Yao (2011)                   | 499         |                          | .48                     | .50                     |                      | IAT                      |                              |

Note: Effect sizes are correlation coefficients that have been corrected for measurement error and, if applicable, dichotomization of the PIU variable. ADD = Addiction Survey (Rozin & Stoess, 1993); CIAS = Chen Internet addiction scale (Chen & Chou, 1999); DSM-IV-PG-A = Diagnostic and Statistical Manual of Mental Disorders—Pathological Gambling—Adapted (American Psychiatric Association, 1994); DSM-IV-SD-A = Diagnostic and Statistical Manual of Mental Disorders—Substance Dependence—Adapted (American Psychiatric Association, 2000); IDS = Internet Dependency Scale (Scherer, 1997); GCQ = General Computing Questionnaire (Charlton, 2002); GIAS = German Internet Addiction Scale by Hahn and Jerusalem (as cited in te Wildt et al., 2010); GPIUS = Generalized Problematic Internet Use Scale (Caplan, 2002); GPIUS2 = Generalized Problematic Internet Use Scale 2 (Caplan, 2010); IADQ = Internet Addiction Diagnostic Questionnaire (Young, 1996); IAS = Internet Addiction Scale (Nichols & Nicki, 2000); IAT = Internet Addiction Test (Young, 1998); IRABI = Internet-Related Addictive Behavior Inventory (Brenner, 1997); IUQ = Internet Use Questionnaire (Ward, 2000); IUS = Internet Usage Survey (Brenner, 1997); K-Scale (National Information Society of Korea, 2002); OCS = Online Cognition Scale (Davis et al., 2002); PIUQ-1 = Problematic Internet Use Questionnaire-1 (Demetrovics et al., 2008); PIUQ-2 = Problematic Internet Use Questionnaire-2 (Thatcher & Goolam, 2005a); PIUS = Problematic Internet Usage Scale (Ceyhan et al., 2007); PUS = Pathological Use Scale (Morahan-Martin & Schumacher, 2000); SOGS-A = South Oaks Gambling Screen—Adapted (as cited in Ofosu, 1999); TIAS = Turkish Internet Addiction Scale by Gunuc (as cited in Uneri & Tanidir, 2011); VAS = Virtual Addiction Survey (Greenfield, 1999).

<sup>a</sup>The complete details of the references given in Table 1 are provided in Appendix S1, Supporting Information.

<sup>b</sup>Indicates that the corrected correlation coefficient exceeded 1.00 and was accordingly fixed at .99.

abuse of specific Internet functions,” such as online games, adult websites, and auction websites. Time spent online was operationally defined in the sample of reports as the actual or perceived minutes or hours per week, day, or session that individuals used the Internet. Reports that operationalized time spent using the Internet as an online experience (e.g., number of years since first going online) were excluded. In a majority of the reports, loneliness was operationally defined using a version of the UCLA Loneliness Scale, but some studies used DiTommaso and Spinner’s (1993) Social and Emotional Loneliness Scale. Finally, depression was operationally defined among reports in the sample using inventories and checklists, such as the Center for Epidemiologic Studies Depression Scale and Beck’s Depression Inventory.

To address RQ2, the reports were categorized into one of three groups (i.e., substance dependence, impulse control disorder, relational resource deficits) based on the tradition from which the PIU measure was designed. The original source of the PIU measure used in each report was identified. In instances when the authors adapted a measure for their study, the original instrument on which the adaptation was based was used to categorize the report. Reports that were categorized into the **substance dependence group** operationally defined PIU using Chen’s Internet Addiction Scale (Chen & Chou, 1999), Clinical Symptom of Internet Dependency (CSID; Scherer, 1997), Internet-Related Addictive Behavior Inventory (IRABI; Brenner, 1997), Internet Addiction Scale (Nichols & Nicki, 2004), ISS-20 (Hahn & Jerusalem, 2001 as cited in te Wildt et al., 2010), K-Scale (Koh, 2007), and adaptations of the Diagnostic and Statistical Manual of Mental Disorders (DSM) measure for substance dependence (e.g., Yuen & Lavin, 2004). Reports in the **impulse control disorder group** most often operationalized PIU using the Internet Addiction Diagnostic Questionnaire (IADQ; Young, 1996) and the Internet Addiction Test (Young, 1998). Other cases in this group measured PIU using the Pathological Use Scale (Morahan-Martin & Schumacher, 2000), Addiction-Engagement Questionnaire (Charlton, 2002), Problematic Internet Use Questionnaire-1 (Thatcher & Goolam, 2005a, 2005b), Problematic Internet Use Questionnaire-2 (Demetrovics, Szeredi, & Rózsa, 2008), Virtual Addiction Scale (Greenfield, 1999), and adaptations of the DSM’s pathological gambling scale. Reports in the **relational resource deficits group** operationally defined PIU using the Generalized Problematic Internet Use Scale (GPIUS; Caplan, 2002), Online Cognition Scale (OCS; Davis et al., 2002), and Problematic Internet Usage Scale (Ceyhan, Ceyhan, & Gurcan, 2007). One additional report (Uneri & Tanidir, 2011) used the Internet Dependency Scale (Gunuc, 2009 as cited in Uneri & Tanidir, 2011).

### Effect size extraction

Each research report that met the inclusion criteria was reviewed for effect estimates of the relationship between PIU and time spent online, loneliness, and depression. In rare instances, the  $r$  value was unreported and had to be estimated through means and standard deviations or a transformation of the reported  $t$  or  $F$  statistic (when there

was one degree of freedom in the numerator of the  $F$  test; see Lipsey & Wilson, 2001, p. 193).

### Correction for study artifacts

Effect sizes were corrected for measurement error and, if applicable, the artificial dichotomization of a continuous PIU variable. Measurement error and dichotomization attenuate effect estimates (Hunter & Schmidt, 2004). Corrections for attenuation originating from study artifacts are particularly important in moderator tests because bias introduced by the artifacts could produce spurious results. In the substance dependence and impulse control disorder groups, PIU is routinely dichotomized. Conversely, PIU is left as a continuous variable in the relational resource deficits group, thereby avoiding attenuation. Correcting for dichotomization helps to ensure that the results are not unduly influenced by this study artifact.

The reported reliability coefficients for all variables were used to correct for measurement error. When the reliability coefficient was not reported, it was estimated using the Spearman-Brown formula and the number of items in the measure. The mean number of items across the cases for a particular variable was used when the number of items for a scale was not reported. The single-item reliability and average number of items for each variable used in the correction formulas are as follows: PIU ( $\alpha_{\text{single-item}} = .33$ ;  $M_{\text{items}} = 20$ ), time spent online ( $\alpha_{\text{single-item}} = .66$ ;  $M_{\text{items}} = 2$ ), loneliness ( $\alpha_{\text{single-item}} = .31$ ;  $M_{\text{items}} = 17$ ), and depression ( $\alpha_{\text{single-item}} = .30$ ;  $M_{\text{items}} = 17$ ). In most instances, time spent online was measured as a one-item observed variable. Because single-item variables are assumed to be measured without error, the scale reliability for these cases was assumed to be  $\alpha = 1.00$ . To correct for dichotomization of the PIU variable, the proportions of individuals assigned to PIU and non-PIU groups were used in the correction formula given by Hunter and Schmidt (2004).

### Computation of weighted mean effect and homogeneity tests

Fixed-effect model meta-analyses (Hedges & Vevea, 1998) were conducted to determine the mean effect size for the relationships between PIU and time spent online, loneliness, and depression. Pearson's product moment correlation coefficient,  $r$ , was the effect size used in the meta-analyses. The corrected effect sizes and weights were used in the meta-analyses to answer RQs 2 and 3. The principal goal of these meta-analyses, however, was not to determine the weighted mean effect size but rather to examine whether systematic variations in the relationships between PIU and the three variables can be traced to the way PIU was operationalized. To do this, a homogeneity statistic,  $Q$ , must first be calculated. The  $Q$  statistic indicates whether the studies included in the meta-analysis share a common effect size. Formulas for testing the homogeneity of effect sizes in meta-analysis are provided by Hedges and Olkin (1985). In order to test the moderators, the between-class goodness-of-fit statistic,  $Q_B$ , was used. As an omnibus test, a significant  $Q_B$  statistic indicates that at least two groups of the moderator variable significantly differ but does not indicate where the difference lies.

**Table 2** Dimensions of PIU Evaluated in Specific PIU Measures

| Measure                                 | Uncontrolled |                    |                          |                    |                    |                      |
|---|--------------|--------------------|--------------------------|--------------------|--------------------|----------------------|
|   | Internet Use | Preoccu-<br>pation | Tolerance/<br>Withdrawal | Mood<br>Alteration | Online<br>Efficacy | Negative<br>Outcomes |
| Substance dependence tradition          |              |                    |                          |                    |                    |                      |
| CIAS (Chen & Chou, 1999)                | Included     | Included           | Included                 | Included           | Omitted            | Included             |
| DSM-IV-SD-A (APA, 2000)                 | Included     | Included           | Included                 | Omitted            | Omitted            | Included             |
| IAS (Nichols & Nicki, 2004)             | Included     | Included           | Included                 | Included           | Omitted            | Included             |
| IRABI (Brenner, 1997)                   | Included     | Included           | Omitted                  | Omitted            | Omitted            | Included             |
| Impulse control disorder tradition      |              |                    |                          |                    |                    |                      |
| GCQ (Charlton, 2002)                    | Included     | Included           | Included                 | Included           | Omitted            | Included             |
| IADQ (Young, 1996)                      | Included     | Included           | Included                 | Included           | Omitted            | Included             |
| IAT (Young, 1998)                       | Included     | Included           | Included                 | Included           | Omitted            | Included             |
| PUS (Morahan-Martin & Schumacher, 2000) | Included     | Included           | Omitted                  | Included           | Omitted            | Included             |
| PIUQ (Thatcher & Goolam, 2005a)         | Included     | Included           | Included                 | Included           | Included           | Included             |
| Relational resource deficits tradition  |              |                    |                          |                    |                    |                      |
| GPIUS (Caplan, 2002)                    | Included     | Included           | Omitted                  | Included           | Included           | Omitted              |
| OCS (Davis et al., 2002)                | Included     | Included           | Omitted                  | Included           | Included           | Omitted              |
| PIUS (Ceyhan et al., 2007)              | Included     | Omitted            | Omitted                  | Omitted            | Included           | Included             |

## Results

The literature search and criteria used to select cases resulted in 112 reports. The total sample size across all reports was 91,640, with a mean of 790 participants per study. Approximately 70% of the reports sampled pre-college or college student populations. The studies documented in the reports were conducted in 26 different countries. Across the reports, 24 unique PIU measures were used, with 12 measures used in three or more reports. Measures developed in the impulse control disorder tradition were used in over half of the reports ( $n = 71$ , 63.4%), whereas measures from the relational resource deficits ( $n = 21$ , 18.7%) and substance dependence ( $n = 20$ , 17.9%) traditions were used in approximately one-fifth of the reports.

### Examining the dimensions of PIU evaluated in PIU measures

RQ1 asked about whether measures included or omitted PIU dimensions in a manner consistent with the traditions in which they were devised. To address this question, the authors independently coded the items of the 12 PIU measures that were used in three or more reports in the sample. The analyses focused on those scales used in at least three reports in an effort to evaluate measures prevalent in PIU research. The reports were coded based on whether they included or omitted the six PIU dimensions (i.e., uncontrolled Internet use, preoccupation, tolerance/withdrawal,

mood alteration, interpersonal efficacy online, negative outcomes). Disagreements between the coders were resolved through discussion of the items. The results are presented in Table 2.

Important consistencies and inconsistencies between the conceptual and operational definitions within the three traditions of measuring PIU can be ascertained by examining the data presented in Table 2. Consistent with expectations, uncontrolled Internet use is represented in almost all PIU measures. Also, as expected, tolerance and withdrawal items appear in the PIU instruments modeled after the substance dependence and impulse control disorder traditions and are absent in measures developed from the resource deficit tradition. An item from the Internet Addiction Scale (Nichols & Nicki, 2004), "I find that I need to use the Internet more to get the same enjoyment as before," reflects the measurement of tolerance, whereas "The more time I spend away from the Internet, the more irritable I feel" targets withdrawal. Items addressing interpersonal efficacy online, reflected by statements such as "I am at my best when I am online" (Davis et al., 2002), were present in certain measures as expected, with only measures from the relational resource deficits tradition including these items. Measures from the substance dependence and impulse control disorder tradition, with the exception of the Problematic Internet Use Questionnaire (Thatcher & Goolam, 2005a), do not address effectiveness in online relationships. Finally, as expected, negative social and professional outcomes appear in all PIU measures designed in the substance dependence and impulse control disorder traditions but not the relational resource deficits tradition.

There were also some noteworthy inconsistencies between the ways PIU has been conceptualized and measured. Although preoccupation is discussed in relation to substance dependence (Kosten, Rounsaville, Babor, Spitzer, & Williams, 1987), it is not a criterion used to distinguish dependents from nondependents in the *DSM*. Yet, PIU measures devised in the substance dependence tradition, which are purportedly modeled after the substance dependence criteria in the *DSM*, include preoccupation. Similarly, mood alteration is not a dimension of substance dependence in the *DSM*. However, two measures developed from this tradition (Chen & Chou, 1999; Nichols & Nicki, 2004) include items addressing mood alteration.

### **Differences in the results of PIU research based on PIU measurement tradition**

RQ2 asks about differences in the associations between PIU and time spent online, loneliness, and depression across the three traditions of PIU measures. RQ3 asks about potential explanations for differences in the three traditions based on the degree to which specific dimensions of PIU are evaluated in each dimension. Fixed-effect model meta-analyses (Hedges & Vevea, 1998) were conducted to answer these questions. The relationships between PIU and the three antecedents/outcomes were each evaluated separately. Table 3 summarizes the results of the analyses conducted to test differences in the associations between PIU and the three antecedents/outcomes across the traditions of PIU measures. The results of the analyses conducted to test for differences based on the degree to which specific dimensions were present or absent in PIU

**Table 3** Weighted Mean Correlations Between PIU and Key Antecedents and Outcomes Across the Three Traditions of PIU Measures

| Relationship    | Substance Dependence Group                               | Impulse Control Disorder Group                           | Relational Resource Deficits Group                      | Overall Test of Difference |
|-----------------|--|--|---|----------------------------|
| PIU-Time Online | $r = .45_a$<br>95% CI [.43, .47]<br>$n = 11,461, k = 12$ | $r = .42_b$<br>95% CI [.41, .43]<br>$n = 49,250, k = 53$ | $r = .53_c$<br>95% CI [.51, .55]<br>$n = 8,642, k = 13$ | 84.47***                   |
| PIU-Loneliness  | $r = .37_a$<br>95% CI [.30, .43]<br>$n = 932, k = 4$     | $r = .34_a$<br>95% CI [.32, .37]<br>$n = 6,936, k = 13$  | $r = .29_b$<br>95% CI [.26, .31]<br>$n = 7,027, k = 15$ | 12.50**                    |
| PIU-Depression  | $r = .41_a$<br>95% CI [.39, .44]<br>$n = 10,906, k = 9$  | $r = .44_a$<br>95% CI [.43, .46]<br>$n = 19,623, k = 31$ | $r = .36_b$<br>95% CI [.33, .39]<br>$n = 4,018, k = 10$ | 26.38***                   |

Note:  $k$  = number of cases in the analysis. Common subscripts next to each mean effect size indicate that the effects are not significantly different from each other.

\*\* $p < .01$ . \*\*\* $p < .001$ .

measures can be found in Table 4. We note that this latter set of analyses was conducted among only those cases that adopted a PIU instrument used in at least three reports in the sample.

**PIU and time spent online.** Seventy-eight cases ( $N = 69,353$ ) were included in the meta-analysis of the relationship between PIU and time spent using the Internet. The findings from the analysis indicate that PIU is significantly associated with Internet use among the cases in the sample,  $r = .44$ , 95% confidence interval (CI) [.44, .45],  $SE = 0.005$ ,  $p < .001$ . The effect sizes of the relationship varied considerably among the cases in the sample,  $Q(77) = 3450.88$ ,  $p < .001$ . The significant homogeneity statistic (i.e.,  $Q$  test) signaled the potential presence of moderating variables.

To address RQ2a, the type of PIU measure (i.e., the tradition from which the measure was devised) was tested as a moderator. As reported in Table 3, PIU measurement accounted for a significant proportion of the variance in the effect sizes representing the relationships between PIU and time spent online. This result provides evidence of differences among the three traditions of PIU measures. Post hoc pair-wise comparison tests showed that the average effect size for the association between PIU and time spent online was significantly larger among cases that used a PIU measure from the relational resource deficits tradition than cases that measured PIU from the substance dependence,  $\bar{r}_{diff} = .07$ , 95% CI [.04, .11],  $Z_{Diff} = 4.18$ ,  $p < .001$ , and impulse control disorder,  $\bar{r}_{diff} = .10$ , 95% CI [.08, .13],  $Z_{Diff} = 7.07$ ,  $p < .001$ , traditions. The post hoc comparisons indicated that studies using substance dependence and impulse control disorder measures significantly differed,  $\bar{r}_{diff} = .03$ , 95% CI [.004, .06],  $Z_{Diff} = 2.28$ ,  $p = .02$ .

To address RQ3a, the presence of specific dimensions in PIU measures was examined as separate moderators of the relationship between PIU and time spent online.

**Table 4** Differences in the Weighted Mean Correlations as a Function of the Presence of Specific Dimensions Included in PIU Measures

|                        | Tolerance/<br>Withdrawal                    | Mood<br>Alteration                          | Interpersonal<br>Efficacy Online            | Negative<br>Outcomes                        |
|------------------------|---|---|---|---|
| <b>PIU-Time Online</b> |   |   |   |   |
| Included               | $r = .42$<br>95% CI [.42, .43],<br>$k = 53$ | $r = .45$<br>95% CI [.44, .46],<br>$k = 65$ | $r = .46$<br>95% CI [.44, .47],<br>$k = 14$ | $r = .42$<br>95% CI [.41, .43],<br>$k = 65$ |
| Omitted                | $r = .52$<br>95% CI [.51, .54],<br>$k = 17$ | $r = .34$<br>95% CI [.31, .38],<br>$k = 9$  | $r = .44$<br>95% CI [.44, .47],<br>$k = 60$ | $r = .60$<br>95% CI [.58, .62],<br>$k = 9$  |
| $Q_B$                  | 86.79***                                    | 34.96***                                    | 3.16  | 220.58***                                   |
| <b>PIU-Loneliness</b>  |   |   |   |   |
| Included               | $r = .34$<br>95% CI [.31, .36],<br>$k = 12$ | $r = .31$<br>95% CI [.29, .32],<br>$k = 28$ | $r = .28$<br>95% CI [.25, .30],<br>$k = 14$ | $r = .35$<br>95% CI [.33, .37],<br>$k = 20$ |
| Omitted                | $r = .30$<br>95% CI [.28, .32],<br>$k = 20$ | $r = .35$<br>95% CI [.32, .39],<br>$k = 4$  | $r = .35$<br>95% CI [.33, .37],<br>$k = 18$ | $r = .23$<br>95% CI [.20, .27],<br>$k = 12$ |
| $Q_B$                  | 4.87*                                       | 4.81*                                       | 17.43***                                    | 35.51***                                    |
| <b>PIU-Depression</b>  |   |   |   |   |
| Included               | $r = .44$<br>95% CI [.42, .45],<br>$k = 34$ | $r = .44$<br>95% CI [.43, .45],<br>$k = 42$ | $r = .36$<br>95% CI [.32, .38],<br>$k = 8$  | $r = .43$<br>95% CI [.42, .44],<br>$k = 37$ |
| Omitted                | $r = .36$<br>95% CI [.33, .39],<br>$k = 10$ | $r = .29$<br>95% CI [.25, .34],<br>$k = 2$  | $r = .44$<br>95% CI [.42, .45],<br>$k = 36$ | $r = .40$<br>95% CI [.35, .44],<br>$k = 7$  |
| $Q_B$                  | 21.04***                                    | 43.29***                                    | 20.59***                                    | 1.47  |

Note:  $k$  = number of cases in the group.

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

Each of the dimensions was examined separately to determine if the association between PIU and time spent online was stronger in cases where a given dimension was or was not evaluated. As reported in Table 4, the association was stronger among cases that included items assessing mood alteration but weaker among cases where tolerance/withdrawal and negative outcomes were measured. There was no difference based on whether interpersonal efficacy online was evaluated. Because preoccupation and uncontrolled use were included in almost all PIU measures, neither could be tested as a moderator in this project.

**PIU and loneliness**

Thirty-two cases ( $N = 14,895$ ) were included in the meta-analysis of the relationship between PIU and loneliness. A moderate association was found across the cases in the sample,  $r = .32$ , 95% CI [.30, .33],  $SE = 0.005$ ,  $p < .001$ . The test for homogeneity

of effect sizes was significant,  $Q(31) = 230.74, p < .001$ , indicating that the cases in the sample did not share a common effect. The type of PIU measure was examined as a potential moderator to test RQ2b. As reported in Table 3, differences in the effect sizes among the three groups of measures exist.

Post hoc pair-wise comparisons showed that the mean effect size for the association between PIU and loneliness was significantly smaller in cases that used relational resource deficits measures than cases that used substance dependence,  $\bar{r}_{diff} = .08$ , 95% CI [.003, .16],  $Z_{Diff} = 2.04, p = .04$ , and impulse control disorder,  $\bar{r}_{diff} = .06$ , 95% CI [.02, .09],  $Z_{Diff} = 2.82, p = .004$ , PIU measures. The average effect size of the relationship between PIU and loneliness among cases that used instruments from the substance dependence tradition did not significantly differ from the impulse control disorder group,  $\bar{r}_{diff} = .03$ , 95% CI [−.05, .11],  $Z_{Diff} = 0.67, p = .50$ .

Comparisons of the effect sizes between cases that evaluated or omitted a specific dimension of PIU were made to address RQ3b. As illustrated in Table 4, the association between PIU and loneliness was stronger among cases where items were included to evaluate tolerance/withdrawal and negative outcomes. This association was weaker among cases that assessed mood alteration and interpersonal efficacy online.

### PIU and depression

Fifty cases ( $N = 34,547$ ) were examined to determine the average effect between PIU and depression. The relationship between PIU and depression was statistically significant,  $r = .42$ , 95% CI [.41, .43],  $SE = 0.007, p < .001$ . The homogeneity test indicated significant variance in the effect sizes across the cases included in the meta-analysis,  $Q(49) = 1582.69, p < .001$ . RQ2c explored whether there were differences in the association between PIU and depression based on the tradition in which a study's PIU measure was devised. Table 3 offers evidence that measurement was a significant moderator of the association between PIU and depression.

Post hoc comparisons examined differences in the pairs of mean effect sizes among the three groups of measures. The mean effect size for the association between PIU and depression was significantly lower in cases that used measures of PIU from the relational resource deficits tradition than cases that used PIU measures from the substance dependence,  $\bar{r}_{diff} = .06$ , 95% CI [.01, .10],  $Z_{Diff} = 2.52, p = .01$ , and impulse control disorder,  $\bar{r}_{diff} = .09$ , 95% CI [.05, .13],  $Z_{Diff} = 4.38, p < .001$ , traditions. The average effect size for studies that measured PIU with instruments from the substance dependence tradition did not significantly differ from cases in the impulse control disorder group,  $\bar{r}_{diff} = .03$ , 95% CI [−.01, .06],  $Z_{Diff} = 1.59, p = .11$ .

RQ3c asked whether the mean effect size between PIU and depression differed when specific dimensions of PIU were represented in PIU measurement. As shown in Table 4, the association between PIU and depression was stronger among cases that included items addressing tolerance/withdrawal and mood alteration but weaker among cases that evaluated interpersonal efficacy online. The weighted mean correlation between PIU and depression did not differ significantly in cases that did and did not measure negative outcomes.

## Discussion

Research on PIU has experienced dramatic growth in the past decade, but this growth has come at a cost. The different ways of thinking about and studying this phenomenon have created considerable confusion about PIU. The goal of this project was to attempt to bring order to this body of research by examining the different ways PIU has been conceptualized and measured. A meta-analytic review was conducted to evaluate the different conceptual and operational definitions of PIU used in prior research and investigate the implications of these definitions. In the following paragraphs, we consider the findings from the review and offer some suggestions for proceeding with research.

The first objective of this project was to examine the degree to which PIU measures are faithful to the three traditions of conceptualizing this phenomenon. PIU measures were generally consistent with the perspectives in which they were designed, with some notable inconsistencies. All three traditions uniformly acknowledge that PIU involves a loss of control over Internet use, and this dimension was reflected in PIU measures. The inclusion of tolerance/withdrawal and negative outcomes only in PIU measures from the substance dependence and impulse control disorder groups was consistent with the conceptual definitions of these perspectives. The relational resource deficits tradition uniquely discusses the dimension of interpersonal efficacy online as a component of PIU, and this dimension was represented only in PIU measures developed in this tradition.

The three traditions of measures uniformly evaluated preoccupation with previous and/or future Internet use, which is not part of the conceptual definitions of substance dependence and thus inconsistent with this perspective. Mood alteration also appeared in two PIU measures from the substance dependence perspective despite it not being discussed as a component of dependence. To summarize, the measures developed from the impulse control and relational deficits traditions appear to have construct validity. However, the construct validity of measures developed in the substance dependence tradition might be questioned. Preoccupation and mood alteration are not components of the conceptual definition of PIU as a form of substance dependence but are included in at least half of the measures in the substance dependence tradition evaluated in this project.

A second objective of this project was to examine the implications of the differences in how PIU is measured across the three traditions. By emphasizing and omitting certain dimensions of PIU, measures developed from one tradition might be more or less sensitive to some variables than measures from other traditions. In practical terms, these differences might lead to inconsistent and even incompatible findings across a body of research and thus undermine the collective efforts to understand this phenomenon.

The results showed some differences in the relationships between PIU and key antecedents and outcomes based on the tradition from which PIU was measured. The effect sizes from research reports that measured PIU using instruments emphasizing

relational resource deficits were consistently different from reports using measures designed in the substance dependence and impulse control disorder frameworks. Few differences, however, existed in the results between studies using measures developed from the substance dependence and impulse control disorder traditions. This lack of differences may be an artifact of the construct validity issues with the substance dependence tradition discussed in the preceding paragraph. Had the measures developed from the substance dependence tradition been more consistent with the way PIU is conceptualized, there may have been differences between the substance dependence and impulse control disorder perspectives. This pattern of results is further addressed in considering our third objective.

The third objective of this project involved examining the influence of the specific dimensions of PIU included within the measures to understand general patterns of similarities and differences in the associations between PIU and key antecedents/outcomes across the three traditions. Considering specific dimensions of measures offers insights into the differences in the results between reports using relational resource deficits measures and reports using measures from the substance dependence and impulse control disorder traditions. The association between PIU and time spent online, for example, was stronger among cases using relational resource deficits measures than measures developed from the other two traditions.

The relational resource deficits measures are distinguished from substance dependence and impulse control disorder measures on the basis of the exclusion of items addressing negative outcomes and tolerance/withdrawal. The analyses conducted to answer the third research question showed that the association between PIU and time spent online was larger in reports when tolerance/withdrawal and negative outcomes were excluded than when they were included. The inclusion of tolerance/withdrawal items, in particular, may attenuate the association between PIU and time spent online. Tolerance suggests increasing levels of time spent online to reach levels of pleasure previously experienced, which, by definition, implies a stronger relationship between PIU and time online, whereas withdrawal reflects the aversive feelings experienced when individuals abstain from Internet use, which implies a weaker association between PIU and time spent online. A possible outcome of including both types of items in the same measure is a smaller association between PIU and time spent online among instruments developed in the substance dependence and impulse control disorder traditions.

A similar trend was observed in the meta-analyses examining correlations between PIU and both loneliness and depression. In this case, measures from the relational resource deficits tradition produced weaker correlations than measures from the other two traditions. The analyses of specific PIU dimensions offer insights into why these differences exist. Reports using measures that included tolerance/withdrawal items produced larger correlations between PIU and both depression and loneliness than reports using measures that omitted these items.

Withdrawal items such as “I feel restless, moody, depressed, or irritable when attempting to cut down or stop using the Internet” (Young, 1996) measure aversive moods, which would strongly covary with loneliness and depression. Some of these items even include the term “depression.” It seems obvious that by including items that explicitly mention depression in a measure of PIU, these measures must be, at least to some degree, correlated with depression. The results of the analyses used to study the third objective demonstrated that the presence of tolerance/withdrawal items produced larger effects between PIU and loneliness and depression. The absence of tolerance/withdrawal items in measures from the relational resource deficits tradition may therefore be responsible for the smaller effects in these relationships.

The negative outcomes measured as part of the PIU construct may also account for the stronger effects between PIU and loneliness in the substance dependence and impulse control disorder classes of measures. Indicators of negative social outcomes, such as “I see my friends less often because of the time that I spend on the Internet,” in these measures may reflect or induce thoughts about declining relationships or interpersonal failures. Including items that make relational failures salient increases the likelihood that the measure will be strongly associated with loneliness, which the results of RQ3 revealed.

Another possibility is that dimensions reflected in PIU measures from the relational resource deficits tradition may be responsible for smaller associations between PIU and depression. Interpersonal efficacy online items such as “I seek others online when I feel isolated” represent lingering social detachment and would be endorsed by people with high levels of depression. Other online efficacy items such as “I am at my best when I’m online” reflect the outcome of mood regulation and would indicate higher PIU among individuals with low depression. In other words, the potential for and aftereffects of mood regulation are confounded only in the class of PIU measures designed from the relational resource deficits tradition. The third analysis supports this point by demonstrating that including the interpersonal efficacy online dimension in PIU measures reduces the relationship between PIU and depression.

Finally, the results of the moderator tests for the second research question indicate that studies conducted from the substance dependence and impulse control disorder traditions generally produced similar effect sizes. The consistencies among the results of reports using measures designed in these two traditions can be attributed to the similarity in dimensions represented within the two classes of measures. As illustrated in Table 2, the set of measures from the substance dependence and impulse control disorder traditions did not differ much in their dimensions. Although these two perspectives share similar conceptual foundations in their pathology model approach to PIU (LaRose, Lin, & Eastin, 2003; Tokunaga, 2015; Tokunaga & Rains, 2010), differences between these perspective would have been expected if the measures developed in the substance dependence tradition were more closely aligned to the conceptual definitions of substance dependence. The inclusion of mood alteration and preoccupation dimensions in measures modeled after the *DSM*'s substance

dependence criteria likely contributed to the similar effects between the substance dependence and impulse control disorder traditions.

### **Implications of findings for theory and research on PIU**

There are several implications of this project for theorists and practitioners. The three traditions of conceptualizing and operationalizing PIU identified in this project provide valuable information about the state of research on this phenomenon. The consistencies across the various measures created within the traditions signal core elements of PIU agreed on by researchers. A loss of control over Internet activities, marked by unsuccessful attempts to cut down or moderate use, and preoccupation appear in almost every PIU measure. This common thread implies that maladaptive cognitive and behavioral elements play a central role in the experience of PIU. The other components emphasized in PIU measures, however, introduce several challenges to research. The results of this meta-analysis offer evidence that the lack of continuity in measurement among the three traditions can undermine the cumulative function of research by producing inconsistent results; that is, the findings from a given investigation may vary based on the type of measure used to evaluate PIU.

The results of this project also suggest some ways to advance PIU research. Programmatic research on PIU relies on well-validated and consistent measures (Davis et al., 2002). Consistency in measurement makes it possible to compare and synthesize results across studies. Advancing this body of research — as a whole — likely requires greater attention to and consistency in the way PIU is conceptually and operationally defined. The goal to rally around a few well-validated measures for researchers within these three traditions may be achievable given that the measures are more similar than different. Moreover, it should be noted that despite some discrepancies in the results, all of the mean effect sizes were generally of the same magnitude (i.e., mostly medium-sized effects) and in the same direction. Some measures from the relational resource deficits tradition are simply more or less sensitive to particular variables based on the degree to which components of PIU are emphasized.

For future researchers, the results of this project underscore the need to give greater attention to the decisions made in choosing measures of PIU. The first step for researchers would be to recognize the tradition they are operating from in conceptualizing PIU and understand the implications of this tradition relative to other traditions. The second step would be to select a measure aligned with the core assumptions they are making about PIU. Third, it is critical that scholars formally articulate these assumptions. Explicitly discussing the tradition PIU is being studied and measured from would be particularly valuable. Such efforts will help advance research on PIU by allowing readers to better evaluate the study results and determine when it is and is not appropriate to compare findings across studies.

### **Reflections on the state of PIU research**

Reviewing over 100 reports included in this meta-analytic investigation revealed several noteworthy observations about the state of PIU research. The first observation

is that these empirical projects were conducted in 26 different countries. The idea that PIU has been studied in virtually every continent indicates widespread concern about—or at least interest in—this phenomenon. The potential deleterious consequences of Internet use appear to be a pervasive topic that transcends countries and cultures.

Given such widespread interest in PIU, the second trend noticed is perhaps even more concerning; that is, a large proportion of PIU studies fail to sample individuals who experience meaningful levels of PIU. Although most PIU research relies on convenience samples, there is no reason to believe that PIU is pervasive enough to be studied with convenience sampling techniques. For example, of the 38 research reports in which participants were dichotomized as having “clinical” or “nonclinical” levels of PIU, 25% or less of the sample experienced “clinical” levels of PIU in 22 of the reports. Similar trends appear in those studies that reported a mean PIU score for their sample. The mean for the measure of PIU was typically near the lower limit of the scale, indicating the total absence of PIU, and the standard deviation was generally quite small. Such results indicate that the vast majority of participants in these samples did not experience PIU. These trends suggest that much of the literature on PIU has been conducted among individuals who do not experience meaningful levels of PIU. Only a few studies (e.g., Lee et al., 2012; te Wildt et al., 2010; Tonioni et al., 2012) actually examined PIU using populations of self-identified PIU sufferers or those seeking clinical help for PIU symptoms. As such, questions might be raised about whether existing research on PIU is applicable to people who experience meaningful levels of PIU. Moving forward, it is critical that scholars make a concerted effort to sample individuals who actually experience PIU. Convenience sampling techniques, particularly those that target college students, do not appear to be a viable option for studying this phenomenon.

Approximately 70% of the studies in the sample of this meta-analytic review were conducted with junior high school, high school, or university students. The tendency to study PIU among young adults raises questions about how this phenomenon may be more common among particular age groups. Given that Internet use is fairly widespread, it would seem reasonable to expect that PIU is applicable across the age spectrum. Yet, there may be specific factors that make this phenomenon more common among young adults. Future research attempting to better understand what age groups are most likely to experience PIU would allow researchers to focus their efforts and more effectively study this phenomenon.

Finally, the large majority of studies in this meta-analytic review focused on “the Internet” when measuring PIU although some studies (e.g., Seay & Kraut, 2007) consider specific Internet contexts, such as online gaming and gambling. More recently, scholars have acknowledged the problem of presenting the Internet as an undifferentiated medium in PIU measures and have taken a more nuanced medium-centric approach (LaRose, Kim, & Peng, 2011). Future meta-analytic reviews should endeavor to compare the effects of PIU across different online media, media functions, or even media affordances when such studies become more readily available.

## Conclusion

The body of research on PIU has grown considerably in the past two decades since Young's (1996) initial essay on the topic. Over 450 empirical research projects have been undertaken, in countries all across the world, to better understand the implications of PIU. Yet, the rapid growth of this research has led to some fragmentation. Research on PIU is marked by three distinct traditions of thinking about and studying this phenomenon. This project reflects one attempt to organize and bring coherence to this body of research by exploring the different ways PIU has been conceptualized and studied. This review identifies core aspects of PIU on which researchers have some level of agreement, but it also reveals other areas of disagreement that contribute to differences in measurement and, in turn, findings using these measures. The results of this project suggest that researchers studying this phenomenon must pay greater attention to how PIU is conceptualized and measured in their projects. Rallying around a few validated measures representing agreed-on conceptualizations of PIU would also be valuable. Such efforts will help to foster a body of research that, in aggregate, yields a robust understanding of PIU.

## Notes

- 1 We are not claiming that these three perspective represent the only approaches to conceptualizing PIU; rather, we believe that these are the three most widely adopted perspectives in the existing body of PIU research.
- 2 The 10 studies excluded from the meta-analysis used measures that included items from PIU measures devised in different traditions, making it impossible to place them into just one class. Meerkerk et al.'s (2009) compulsive Internet use scale, which was used to measure PIU in a majority of these cases, included five of the six dimensions of PIU (i.e., tolerance/withdrawal, mood alteration, preoccupation, uncontrolled Internet use, negative outcomes) but also stressed other components, such as intrapersonal conflict and deception about Internet involvement.

## Supporting Information

Additional supporting information may be found in the online version of this article:

**Appendix S1.** References of cases used in the meta-analysis.

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