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Examining common information technology addictions and their relationships with non-technology-related addictions

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ABSTRACT

A number of novel problematic behaviors have emerged in the information technology era, and corresponding addictions have been proposed for some of these behaviors. Scholars have speculated that a common factor may underlie these information technology addictions, but this theoretical notion has yet to be tested empirically. The present study tested this notion and also investigated the relationships of information technology addictions with other behavioral addictions as well as substance addictions. We conducted an online survey in 1001 US adults (56% female; mean age = 35.0 years, range = 18–83). Two conceptual models were formulated and tested. Moreover, correlations of the information technology addictions with both problematic gambling and alcohol use disorder were examined. The confirmatory factor analysis showed that there was a common factor underlying various types of information technology addiction. In addition, problematic gambling was more strongly correlated with information technology addiction than alcohol use disorder was. Our findings are interpreted in light of a spectrum approach, which conceptualizes information technology addiction as a cluster of disorders comprising not only shared risk factors and symptoms but also distinct characteristics. The findings further reveal that information technology addiction is more similar to other behavioral addictions than substance-related addictions. Implications for researchers and practitioners are discussed.

1. Introduction

Information technology has become an integral part of modern humans' lives. People use it to facilitate the functioning of nearly all life domains. With the help of information technology, users now can acquire information, connect with people, satisfy their leisure and entertainment wants and needs, and achieve much more with speed and precision that were unforeseeable one to two decades ago. Despite the extensive benefits of information technology, excessive use of it can be detrimental. There is an increasing concern that people can suffer from pathological technology use with symptoms that resemble that of an addiction (see Sim, Gentile, Bricolo, Serpelloni, & Gulamoydeen, 2012 for a review). Much research has focused on studying how different types of information technology addiction can be accessed as well as their causes and consequences. Yet, some important research questions remain unknown. For instance, are different types of information technology addiction a cluster of closely related disorders or simply separate constructs? Also, how are these more recently proposed addictions related to the more "traditional" types of addiction such as problematic gambling? The present study was conducted to address these unexplored timely issues.

The overarching aim of this study is twofold. First, our study is the first to provide a systematic test of the relationships among four common kinds of information technology addiction: Internet addiction, Internet gaming disorder, smartphone addiction, and Facebook addiction. The results help researchers and clinicians determine whether there can be a latent factor underlying these disorders and advance the conceptualization of information technology addiction prior to its possible inclusion in the Diagnostic and Statistical Manual of Mental Disorders (DSM). Second, this study also examines how information technology addiction is related to other behavioral addictions (i.e., problematic gambling) and substance addictions (i.e., alcohol use disorder). The effect of having multiple addiction problems can be synergistic and greatly impair psychosocial functioning (Zimmerman & Mattia, 1999); hence, it is essential to find out if and how different types of addiction tend to covary. The findings yielded from this study can

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potentially inform treatment and prevention strategies.

1.1. Four common kinds of information technology addiction

A review of the literature identified four kinds of information technology addiction that have been most frequently studied, namely Internet addiction, Internet gaming disorder, smartphone addiction, and Facebook addiction. These kinds of information technology addiction share some common symptoms, but they each also have some unique characteristics.

Internet addiction is one of the earliest examined kind of information technology addiction. Young (1998) proposed a set of eight symptoms for this disorder. Examples of the symptoms are preoccupation with the Internet and tolerance. A recent meta-analysis indicates that the global prevalence of this disorder is approximately six percent (Cheng & Li, 2014). In the United States, the prevalence rates range from 0.3 to 25 percent (Weinstein & Lejoyeux, 2010). This kind of information technology addiction is frequently found to be associated with psychosocial problems such as depression, loneliness, and social anxiety (Burnay, Billieux, Blairy, & Larøi, 2015; Weinstein et al., 2015; Özdemir, Kuzucu, & Ak, 2014). There is longitudinal evidence revealing that excessive Internet use can lead to impairment in academic performance, work, and social relations (e.g., Cheng, Sun, & Mak, 2015; Tokunaga, 2014).

Internet gaming disorder, originally proposed as a subtype of Internet disorder (Young, 2009), is the first and only kind of information technology addiction mentioned in the DSM-V (American Psychiatric Association, 2013). It is a disorder characterized by symptoms such as withdrawal and tolerance. People having this disorder may spend a substantial amount of time playing video games online or offline. According to the review by Kuss and Griffiths (2012), the estimates of prevalence of Internet gaming disorder range from 30 to 50 percent based on gender, age, and types of games played. Similar to Internet addiction, Internet gaming disorder is associated with depression, loneliness, and social anxiety (e.g., Sarda, Bègue, Bry, & Gentile, 2016; Sigerson, Li, Cheung, Luk, & Cheng, 2017). Internet gaming disorder, however, is conceptually distinct from Internet addiction in that only the former is associated with aggression—possibly due to exposure to violent video games (Lemmens, Valkenburg, & Peter, 2011).

Smartphone addiction has received increasing attention since the popularization of smartphones around the globe. In the United States, 68 percent of adults own a smartphone, and the figure increases to 86 percent for adults under 30 years of age (Anderson, 2015). Prior to the invention of smartphones, people mostly used their mobile phones solely for communication purposes. Text-message addiction has been a major public concern. It is noteworthy that modern smartphones function like mobile mini-computers. Smartphone users can surf the Web and make use of a plethora of mobile applications downloaded from the Internet. Those with a smartphone addiction show addictive symptoms such as functional impairment and withdrawal (Lin et al., 2014). The new features of smartphones are not only addictive to adults but also to adolescents. Smartphone addiction is a relatively new research topic, and thus not many studies have investigated its prevalence rate. A study in South Korea reported a 17 percent and 27 percent prevalence rate of smartphone addiction among adolescent boys and girls, respectively (Kwon, Kim, Cho, & Yang, 2013). Similar to other kinds of information technology addiction, smartphone addiction is associated with depression, loneliness, and anxiety (Bian & Leung, 2015; Demirci, Akgönül, & Akpinar, 2015; Mok et al., 2014). In addition, smartphone addiction is associated with fear of ostracism (Igarashi, Motoyoshi, Takai, & Yoshida, 2005), and such an association is unique to this kind of information technology addiction.

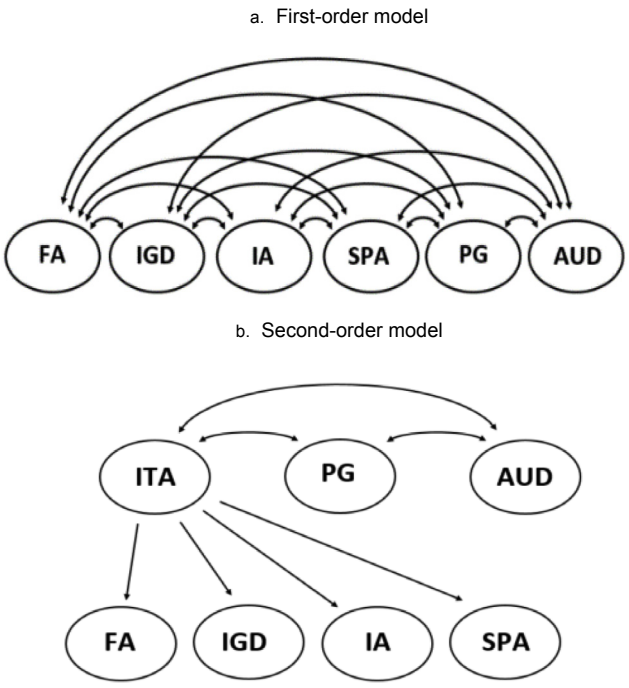

Fig. 1. Conceptual overview of the two proposed models.[1]

Facebook addiction is a phenomenon that has emerged over the past decade while the percentage of adults using social networking sites has soared from 7 to 65 percent (Perrin, 2015). There is still no consensus to date on how social networking should be defined; hence, most studies have focused on the use of and addiction to individual social networking sites since the development and validation of the Bergen Facebook Addiction Scale (BFAS). This measure assesses symptoms of Facebook addiction such as salience and withdrawal (Andreassen, Torsheim, Brunborg, & Pallesen, 2012). As of now, the prevalence of Facebook addiction is unclear. Recent studies have revealed that Facebook addiction is similar to other kinds of information technology addiction in its association with depression, loneliness, and anxiety (Ryan, Chester, Reece, & Xenos, 2014). As Facebook is unique in that it allows self-expression, and sometimes false self-expression (Gil-Or, Levi-Belz, & Turel, 2015), it may be related to specific correlates such as motives for impression management.

1.2. Two proposed conceptual models

The present study has two aims. First, we investigated the relationships among the four most frequently studied information technology addictions, namely Internet addiction, Internet gaming disorder, smartphone addiction, and Facebook addiction. Second, we examined whether these types of information technology addiction were related to non-technology-related behavioral addiction and substance addiction, respectively. To achieve the first aim, we constructed two models: the first-order model (see Fig. 1a) and second-order model (see Fig. 1b). These models were tested with a large sample to investigate if they had good statistical fit to

[1] Including the following variables: Facebook addiction (FA), Internet Gaming Disorder (IGD), Internet addiction (IA), smartphone addiction (SPA), information technology addiction (ITA), problematic gambling (PG), and alcohol use disorder (AUD).

empirical data. Second, we tested whether these information technology addictions would be related to other more "traditional" type of addictions. Problematic gambling/gambling disorder was included in the models to represent non-technology-related behavioral addictions because it is the only addictive disorder included in the DSM-V (American Psychiatric Association, 2013). Alcohol use disorder was also included in the models because it is one of the most common kind of substance addictions in the U.S. The lifetime prevalence rate of alcohol use disorder could exceed 40% for specific ethnic groups (i.e., Whites and US-born Hispanics; Grant et al., 2012).

In the first-order model, we examined the correlations among problematic gambling, alcohol use disorder, and the aforementioned common types of information technology addiction. As all addictions include symptoms such as dysfunctional preoccupation, withdrawal, and tolerance, we hypothesized that all of the correlations in the first-order model should be statistically significant and the model as a whole should have good statistical fit. This hypothesis was also derived from a recent study (Tozzi, Akre, Fleury-Schubert, & Suris, 2013), which revealed that problematic gambling was associated with both alcohol misuse and Internet addiction. More important, we expected that the correlations among the information technology addictions would be particularly strong compared with their correlations with non-technology-related addictions because they all involve continuous engagement in technology-related rewarding behaviors despite undesirable outcomes resulting from excessive engagement.

In the second-order model, we added a second-order variable to group the four kinds of information technology addiction and scrutinized its relationships with problematic gambling and alcohol use disorder. We included the second-order variable because the expected strong correlations among different kinds of information technology addiction would suggest the presence of an underlying disorder linking them (Brown, 2015, p. 323) and such a model can test the validity of its existence. This notion is derived from Billieux (2012)'s Spectrum Model of Cyber Addictions. According to this model, technology-related addictions have general or shared risk factors that make them a cluster of inter-related disorders, which should be classified under an umbrella term of cyber addictions. Nonetheless, each kind of technology addiction should be distinct from others in that they are distinguished by specific risk factors associated with them. In this light, we expected the second-order model to have good statistical fit and the second-order variable to correlate significantly with problematic gambling and alcohol use disorder.

If the first-order model fit the data reasonably well, we could then further test the second-order model with a general construct of information technology addiction. If the second-order model also fit the data reasonably well, this result would support the theoretical notion regarding the existence of a general construct of information technology addiction. On the other hand, if the first-order model had good statistical fit, but the second-order model did not, we would conclude that each type of information technology addiction should be treated as a separate disorder instead of a member of a cluster of closely-related disorders that shared high levels of commonality.

2. Methods

2.1. Data collection and quality

US residents were recruited from Amazon's Mechanical Turk (MTurk), and were required to have high reputations on MTurk (i.e., successfully completed over 99% of their previous jobs). Participants' compensation ($1.50 for 15 min) and all other aspects of data collection adhered to well-established rules regarding academic use of MTurk (*Guidelines for Academic Requesters,* 2014). Numerous studies have validated the use of MTurk for academic research (e.g., Buhrmester, Kwang, & Gosling, 2011; Hauser & Schwarz, 2015), and have suggested that participants may be more comfortable disclosing clinical information online (Shapiro, Chandler, & Mueller, 2013).

Following previous recommendations (Harms & DeSimone, 2015; Meade & Craig, 2012), two attention check questions were inserted into the survey. Responses were rejected if either question was answered incorrectly or more than 5% of questions were left unanswered, and participants were notified of these inclusion criteria before the survey began. As the rejection rate was only 2.9% and the measures all had good reliability (all Cronbach α's were above 0.76), we concluded that the data were of a good quality.

2.2. Participants

After omitting 29 cases that failed to meet our a priori inclusion criteria mentioned above, the final sample consisted of 1001 US participants. Demographic information for these participants (Table 1) shows that they were broadly representative of the US population (U.S. Census Bureau, 2011), though they were younger. Given that previous studies have found information technology addictions to be more common among young people, this sample was especially appropriate for our study (e.g., Anderson, 2001; Sharma, Sahu, Kasar, & Sharma, 2014).

2.3. Measures

Young's Diagnostic Questionnaire (Young, 1998), the most popular scale of Internet addiction by far (Cheng & Li, 2014), was included in this study. The validated questionnaire consists of eight items, such as "Do you feel the need to use the Internet with increasing amounts of time in order to achieve satisfaction?" It displayed good reliability in our sample ($\alpha = 0.76$).

The Smartphone Addiction Scale-Short Version (Kwon, Kim et al., 2013) is a 10-item validated short form of an assessment tool for smartphone addiction (Kwon, Lee et al., 2013). Respondents indicate whether a series of statements (e.g., "Missing planned work due to smartphone use") are true of them. This scale has been used successfully with African American university students as well as French and Spanish samples of wide age ranges (Lee, 2015; Lopez-Fernandez, 2017). The present results revealed that its items were internally consistent ($\alpha = 0.89$).

The Bergen Facebook Addiction Scale (Andreassen et al., 2012) is the most widely used validated measure evaluating Facebook

Table 1
Demographic information for the sample.

Demographic Variable	Mean/%
Age	Mean = 35.0
	SD = 10.6
	Range = 18-83
Gender	%
Male	43.8
Female	56.2
Education Level	
High school	30.6
Some tertiary education	21.4
Bachelor's degree (completed)	39.4
Postgraduate degree	8.6
Relationship Status	
Never married	54.5
Married	37.2
Separated/Divorced/Widowed	8.3

addiction (e.g., Satici & Uysal, 2015). It was included in this study and showed good reliability ($\alpha = 0.89$). The scale includes six items, such as "How often during the last year have you spent a lot of time thinking about Facebook or planned use of Facebook?"

The Nine-Item Short-Form Internet Gaming Disorder Scale (Pontes & Griffiths, 2015) was used to assess Internet gaming disorder, with good internal consistency in this study ($\alpha = 0.90$). This validated scale was chosen because it was adapted from the DSM-V's proposed criteria for Internet gaming disorder. All nine items of the scale referred to both online and offline gaming. A sample item is "Have you experienced loss of interests in previous hobbies and entertainment as a result of, and with the exceptions of, Internet games?"

The Problematic Gambling Severity Index (Ferris & Wynne, 2001) measured problematic gambling with nine items, such as "How often do you bet more than you could really afford to lose?" It was influenced by the DSM-IV's definition of pathological gambling, and developed for use with the general population. It displayed good reliability in our sample ($\alpha = 0.92$).

The Alcohol Use Disorders Identification Test (Saunders, Aasland, Babor, De la Fuente, & Grant, 1993) was developed by the World Health Organization to assess alcohol use disorder. It included 10 items, such as "How often during the last year have you been unable to remember what happened the night before because you had been drinking?" Its items were internally consistent in this study ($\alpha = 0.88$).

3. Results

3.1. Data analysis

As some items are binary, it is not appropriate to treat the data as continuous. Diagonally Weighted Least Squares (DWLS) was chosen as the model estimator because it can handle items with both binary and continuous responses. Multiple studies have shown that this method performed well in simulations with sample sizes over 700, regardless of data non-normality, model size, or other influencing factors (e.g., DiStefano & Morgan, 2014; Yang-Wallentin, Jöreskog, & Luo, 2010). Listwise deletion was used for missing data, with a minimum of 814 cases used in model constructions.

3.2. Fit indices

As the analysis involved model testing and comparison, selecting the proper fit indices was essential. It is widely known that the χ^2 is overly sensitive to sample size in Confirmatory Factor Analysis models, and the CFI has been shown to be unsuitable with DWLS (Sugawara & MacCallum, 1993). Rather, the RMSEA has been recommended for categorical data by a number of studies (e.g., Nye & Drasgow, 2010; Sugawara & MacCallum, 1993), including data with both categorical and continuous outcomes (Yu, 2002). In addition, it has been found to be robust to effects of non-normal data (Hutchinson & Olmos, 1998) as well as sample size, factor loadings and model complexity (Bodine, 2015). Therefore, we relied primarily on the RMSEA in assessing global fit of models, though the CFI and χ^2 were also reported. The Satorra-Bentler robust χ^2 (Satorra & Bentler, 1988) and robust standard errors were reported in the analysis. Given that there are no agreed-upon cutoff criteria for the RMSEA with this type of data, we also consider parsimony and theoretical meaning when assessing models, following recommendations by Browne and Cudeck (1992). The Satorra-Bentler robust χ^2 (Satorra & Bentler, 1988) and robust standard errors were used in the analysis. All analyses were conducted in Lavaan version 5.19 (Rosseel, 2012), semTools version 4.9 (semTools Contributors, 2015), and R version 3.2.2 (R Core Team, 2015).

3.3. Model testing

To evaluate our predictions, two models were fit to the data. We first tested the first-order model, which included the four common types of information technology addiction, problematic gambling, and alcohol use disorder, Results revealed an excellent data fit, RMSEA = 0.026 (90% CI = 0.024, 0.028), CFI = 0.950, χ^2(df = 1259,

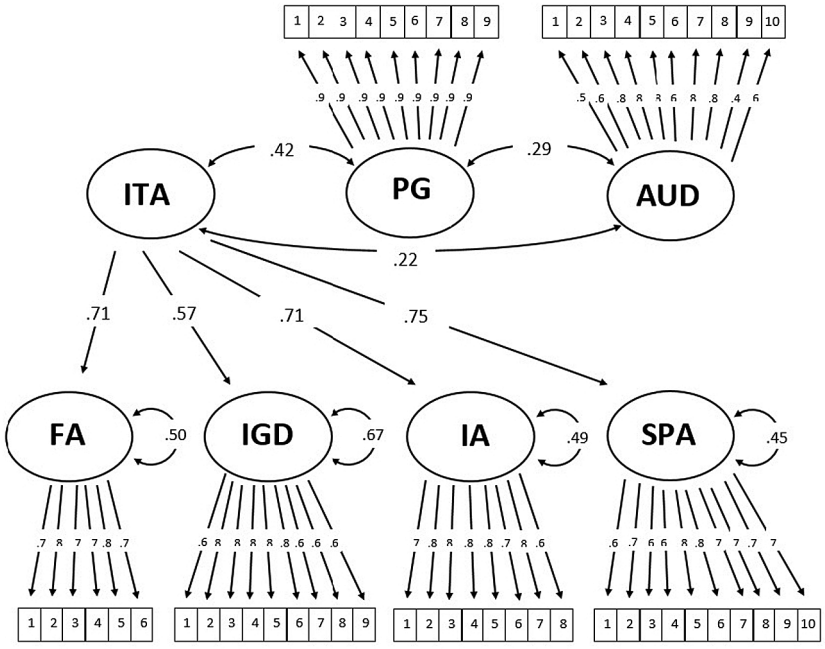

Fig. 2. Second-order model with standardized parameter estimates, including the following latent variables: Facebook addiction (FA), Internet Gaming Disorder (IGD), Internet addiction (IA), smartphone addiction (SPA), information technology addiction (ITA), problematic gambling (PG), and alcohol use disorder (AUD).

Table 2
Correlations among latent variables in the first-order model.

	1	2	3	4	5	6
1. Facebook Addiction	–					
2. Internet Gaming Disorder	0.355	–				
3. Internet Addiction	0.431	0.522	–			
4. Smartphone Addiction	0.618	0.389	0.508	–		
5. Problematic Gambling	0.301	0.317	0.244	0.256	–	
6. Alcohol Use Disorder	0.166	0.115	0.141	0.170	0.289	–

Note: All correlations were significant at $p < 0.001$.

n = 814) = 1959.261.

In the second-order model (see Fig. 2), a second-order variable was added to explain the strong correlations among the information technology addictions (see Table 2). This model similarly had an excellent data fit, RMSEA = 0.027 (90% CI = 0.025, 0.030), CFI = 0.945, χ^2(df = 1267, n = 814) = 2038.005. In addition, the standardized factor loadings of the second-order variable were all above 0.57. As we judged the model to be theoretically more meaningful and because it was more parsimonious than the first-order model, we considered the second-order model a better overall explanation of the data. In addition, in this model, Information Technology Addiction had significant, positive correlations with both Problematic Gambling ($r = 0.42$) and Alcohol Use Disorder ($r = 0.22$).

3.4. Checks for potential artificially inflated correlations

We acknowledged the possibility that participants might encounter difficulties categorizing technology-related activities. For instance, some participants who are addicted to online games might answer yes to scale items assessing Internet gaming disorder as well as those assessing Internet addiction because they have problems distinguishing between these two types of information technology addiction. Correlations among the four kinds of information technology addiction would be inflated if this problem was present.

To test this possibility, we conducted an exploratory factor analysis (EFA) with the individual items from the four scales assessing the information technology addictions. If the correlations were being artificially inflated, then the EFA results should show strong cross-loading of items between scales. For example, items from the Internet Gaming Disorder Scale would also load strongly on the Internet Addiction factor.

Parallel analysis of the items suggested the presence of six factors. An EFA was then run on the items, using an oblique rotation and Weighted Least Squares as an estimator, as some items were categorical. The first four factors corresponded clearly to each of the four kinds of information technology addiction, and accounted for between 9.5% and 14.3% of the total variance. The final two factors accounted for 3.6% and 3.2% of the variance respectively, and no more than two items loaded primarily on each of these factors. We determined that these last two factors did not represent meaningful patterns in the data, and both of these factors were not retained for further consideration. Among the four information technology addiction factors, there was no strong cross-loading of items. Due to the lack of cross-loading among the information technology addictions, we concluded that we could model information technology addictions as distinct variables. This result implied that perceived overlap or “double-dipping” was not a valid concern and the correlations found were not artificially inflated.

4. Discussion

The major objective of this study is to examine how different kinds of information technology addiction are related to one another and how they are related to other addictions including other behavioral addictions (i.e., problematic gambling) and substance addictions (i.e., alcohol use disorder). As proposed, all kinds of addiction studied are significantly correlated. Most important, the correlations among the four common kinds of information technology addiction are stronger than their correlations with problematic gambling and alcohol use disorder. The strong correlations among the information technology addictions suggest that there could be a second-order variable grouping them. The present results provide some support for this notion by demonstrating that the second-order model has an excellent statistical fit. Just as addictions to different types of substance can be categorized under substance use disorder, addictions to different types of information technology can also be categorized under a second-order variable—information technology addiction.

The present new results may be interpreted in light of a spectrum approach, which states that a spectrum of mental disorder comprises related yet distinct disorders. A well-known example is the autism spectrum disorder (Lord & Bishop, 2010). This approach puts forward that the disorders within a spectrum have some shared risk factors and symptoms (Billieux, 2012; Lord & Bishop, 2010). As reviewed previously, the four kinds of information technology addiction have three shared risk factors, including anxiety, depression, and loneliness (see Introduction). They also have three common symptoms (Sim et al., 2012). First, withdrawal refers to the experience of agitation or restlessness when not using the mobile device (e.g., game console, smartphone). Second, tolerance refers to the need to increase the duration and intensity of information technology use in order to feel satisfied. Third, impaired functioning refers to disturbance to activities caused by information technology use in one or more major life domains, such as poor work performance and social isolation.

Despite having these shared risk factors and symptoms, the four common kinds of information technology addiction examined are not identical and they each have specific correlates not shared by others. For instance, perception of phantom phone signals is a condition uniquely identified in individuals having smartphone addiction. Specifically, heightened awareness of the importance of smartphones may foster vigilance to phone signals, resulting in hypersensitivity to stimuli that resemble ringtones or message notification sounds (Tanis, Beukeboom, Hartmann, & Vermeulen, 2015). Moreover, the experience of Facebook jealousy is exclusive to addiction to Facebook, an online platform wherein users share their personal information and activities to a public audience. Viewing Facebook posts showing the successes or envious lifestyles of others tends to elicit upward social comparison that arouses inferiority feelings among users, and viewing partners’ Facebook profiles often provokes jealousy and misunderstanding (e.g., a winking emoji sent by an opposite-sex friend being interpreted as flirtatious) in romantic relations (Fox & Warber, 2014). It is noteworthy that our study shows that each kind of information technology addiction has around 50% of variance unexplained by the second-order variable (i.e., information technology addiction).

An alternative explanation for the high correlations found among the four common kinds of information technology addiction is that participants might have had problems distinguishing among various types of technology-related activity, and as a result, the correlations obtained may be artificially inflated due to a “double-dipping effect”. This alternative explanation is ruled out as the EFA analysis conducted shows that there is no strong cross-loading of scale items among different kinds of information technology addiction. Another alternative explanation is that the information technology addictions might be strongly correlated because they might all be grouped under Internet addiction rather than

information technology addiction. If this alternative explanation holds, Internet addiction should take the place of the second-order variable; and the relationship between Internet addiction and the second-order variable should be much stronger than those between the second-order variable and other kinds of information technology addiction. Yet, these patterns are not observed, and such a lack of empirical support indicates that this alternative explanation is also invalid.

In addition, the present findings reveal the second-order variable in the second-order model (i.e., information technology addiction) is more closely related to problematic gambling than it is to alcohol use disorder (0.42 vs. 0.22). Although researchers are still uncertain whether behavioral and substance addictions are manifestations of one syndrome or two separate types of addiction (Yau & Potenza, 2015), in both cases, we would expect more commonalities between two behavioral addictions than those between a behavioral and a substance addiction. This pattern is revealed in our findings. Although related, information technology addiction, problematic gambling, and alcohol use disorder should be understood as distinct constructs. Previous work has proposed that information technology addiction such as Internet addiction is characterized by pathological engagement in technology-related activities that are interactive and can give one a sense of fluid identity (Chou, Condron, & Belland, 2005; Leung, 2004). However, these characteristics are not shared by problematic gambling and alcohol use disorder.

4.1. Limitations

There are caveats to the present study. First, not all kinds of information technology addiction, behavioral addictions, and substance addictions have been studied. Nonetheless, the addictions selected in this study are well-studied and representative of the category they fall under. Second, we have only included self-report measures in this study. As self-report is still the most feasible method for assessing information technology addiction, we have endeavored to minimize the problems inherited in this method by reassuring participants about data anonymity and confidentiality, and respondents are generally comfortable with self-disclosure in an online environment (Shapiro et al., 2013). Nevertheless, participants' self-report of attitudes towards and use of information technology may still be clouded by socio-demographic factors such as occupation. For instance, constant checking of Facebook messages is essential for online shop owners who rely on Facebook for marketing their products but problematic for others having a different job, such as air traffic controllers. Future studies can extend our work by covering more types of addiction and assessing them with multiple forms of measures in heterogeneous samples.

4.2. Implications

In spite of these caveats, the present findings have some major theoretical and research implications. Specifically, the new findings imply that the common practice of studying information technology addictions independently, one at a time, may not be optimal. As this study reveals evidence that there are high correlations among various kinds of information technology addiction and they might be subsumed under a higher order construct, we recommend that future research should study these disorders together and explore the commonalities and differences among them which in turn may guide the conceptualization of information technology addiction in general. Furthermore, the present findings may guide practices in clinical settings. As we found significant correlations among information technology addictions, problematic gambling, and alcohol use disorder, we recommend that individuals who are diagnosed with any of these addictions should also be screened for the other types of addiction to ensure more comprehensive diagnosis and efficient treatment.

Contributors

All authors contributed to the conceptualization and design of the study. Authors LS and AYLL implemented the data collection process. Authors LS and MWLC conducted the data analysis. Authors LS and AYLL conducted literature searches and wrote the first draft of the study. All authors contributed to subsequent revisions and have approved the final manuscript.

Conflicts of interest

All authors declare that they have no conflicts of interest.

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References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders* (5th ed.). Washington, DC: American Psychiatric Association.

Anderson, K. J. (2001). Internet use among college students: An exploratory study. *Journal of American College Health, 50*, 21–26.

Anderson, M. (2015). *Technology device ownership: 2015*. Retrieved from http://www.pewinternet.org/2015/10/29/technology-device-ownership-2015.

Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports, 110*, 501–517.

Bian, M., & Leung, L. (2015). Linking loneliness, shyness, smartphone addiction symptoms, and patterns of smartphone use to social capital. *Social Science Computer Review, 33*, 61–79.

Billieux, J. (2012). Problematic use of the mobile phone: A literature review and a pathways model. *Current Psychiatry Reviews, 8*, 299–307.

Bodine, A. J. (2015). *A Monte Carlo investigation of fit statistic behavior in measurement models assessed using limited-and full-information estimation*. Doctoral dissertation. The Ohio State University. Retrieved from http://search.proquest.com/docview/1734474501?accountid=14548 (Order No. 3732290).

Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. New York, NY: Guilford Publications.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods and Research, 21*, 230–258.

Buhrmester, M., Kwang, T., & Gosling, S. D. (2011). Amazon's Mechanical Turk a new source of inexpensive, yet high-quality, data? *Perspectives on Psychological Science, 6*, 3–5.

Burnay, J., Billieux, J., Blairy, S., & Larøi, F. (2015). Which psychological factors influence internet addiction? evidence through an integrative model. *Computers in Human Behavior, 43*, 28–34.

Cheng, C., & Li, A. Y. L. (2014). Internet addiction prevalence and quality of (real) life: A meta-analysis of 31 nations across seven world regions. *Cyberpsychology, Behavior, and Social Networking, 17*, 755–760.

Cheng, C., Sun, P., & Mak, K. (2015). Internet addiction and psychosocial maladjustment: Avoidant coping and coping inflexibility as psychological mechanisms. *Cyberpsychology, Behavior, and Social Networking, 18*, 539–546.

Chou, C., Condron, L., & Belland, J. C. (2005). A review of the research on Internet addiction. *Educational Psychology Review, 17*, 363–388.

Demirci, K., Akgönül, M., & Akpinar, A. (2015). Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. *Journal of Behavioral Addictions, 4*, 85–92.

DiStefano, C., & Morgan, G. B. (2014). A comparison of diagonal weighted least squares robust estimation techniques for ordinal data. *Structural Equation Modeling, 21*, 425–438.

Ferris, J., & Wynne, H. (2001). *The Canadian problem gambling index*. Ottawa, ON: Canadian Centre on Substance Abuse.

Fox, J., & Warber, K. M. (2014). Social networking sites in romantic relationships: Attachment, uncertainty, and partner surveillance on Facebook. *Cyberpsychology, Behavior, and Social Networking, 17*, 3–7.
Gil-Or, O., Levi-Belz, Y., & Turel, O. (2015). The "Facebook-self": Characteristics and psychological predictors of false self-presentation on Facebook. *Frontiers in Psychology, 6*, 1–10.
Grant, J. D., Vergés, A., Jackson, K. M., Trull, T. J., Sher, K. J., & Bucholz, K. K. (2012). Age and ethnic differences in the onset, persistence and recurrence of alcohol use disorder. *Addiction, 107*, 756–765.
Harms, P. D., & DeSimone, J. A. (2015). Caution! MTurk workers ahead—fines doubled. *Industrial and Organizational Psychology, 8*, 183–190.
Hauser, D. J., & Schwarz, N. (2015). *Behavior Research Methods, 48*, 400–407.
Hutchinson, S. R., & Olmos, A. (1998). Behavior of descriptive fit indexes in confirmatory factor analysis using ordered categorical data. *Structural Equation Modeling, 5*, 344–364.
Igarashi, T., Motoyoshi, T., Takai, J., & Yoshida, T. (2005, April). The text messaging addiction scale: Factor structure, reliability, and validity. In *Paper presented at sixth biennial conference of the Asian association of social psychology, Wellington, New Zealand*.
Kuss, D. J., & Griffiths, M. D. (2012). Internet gaming addiction: A systematic review of empirical research. *International Journal of Mental Health and Addiction, 10*, 278–296.
Kwon, M., Kim, D. J., Cho, H., & Yang, S. (2013). The smartphone addiction scale: Development and validation of a short version for adolescents. *PloS One, 8*, e83558.
Kwon, M., Lee, J.-Y., Won, W.-Y., Park, J.-W., Min, J.-A., Hahn, C., et al. (2013). Development and validation of a smartphone addiction scale (SAS). *PloS One, 8*, e56936.
Lee, E. B. (2015). Too much information heavy smartphone and Facebook utilization by African American young adults. *Journal of Black Studies, 46*, 44–61.
Lemmens, J. S., Valkenburg, P. M., & Peter, J. (2011). The effects of pathological gaming on aggressive behavior. *Journal of Youth and Adolescence, 40*, 38–47.
Leung, L. (2004). Net-generation attributes and seductive properties of the internet as predictors of online activities and internet addiction. *CyberPsychology and Behavior, 7*, 333–348.
Lin, Y. H., Chang, L. R., Lee, Y. H., Tseng, H. W., Kuo, T. B., & Chen, S. H. (2014). Development and validation of the smartphone addiction inventory (SPAI). *PLoS One, 9*, e98312.
Lopez-Fernandez, O. (2017). Short version of the smartphone addiction scale adapted to Spanish and French: Towards a cross-cultural research in problematic mobile phone use. *Addictive Behaviors, 64*, 275–280.
Lord, C., & Bishop, S. L. (2010). Social policy report: Autism spectrum disorders. Diagnosis, prevalence, and services for children and families. *Society for Research in Child Development, 24*, 1–27.
Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods, 17*, 437–455.
Mok, J. Y., Choi, S. W., Kim, D. J., Choi, J. S., Lee, J., Ahn, H., et al. (2014). Latent class analysis on Internet and smartphone addiction in college students. *Neuropsychiatric Disease and Treatment, 10*, 817–828.
Nye, C. D., & Drasgow, F. (2010). Assessing goodness of fit: Simple rules of thumb simply do not work. *Organizational Research Methods, 14*, 548–570.
Özdemir, Y., Kuzucu, Y., & Ak, Ş. (2014). Depression, loneliness and internet addiction: How important is low self-control? *Computers in Human Behavior, 34*, 284–290.
Perrin, A. (2015). *Social media usage: 2005-2015*. Retrieved from http://www.pewinternet.org/2015/10/08/social-networking-usage-2005-2015/.
Pontes, H. M., & Griffiths, M. D. (2015). Measuring DSM-5 internet gaming disorder: Development and validation of a short psychometric scale. *Computers in Human Behavior, 45*, 137–143.
R Core Team. (2015). *R: A language and environment for statistical computing. R foundation for statistical computing, Vienna, Austria*. Retrieved from https://www.R-project.org/.
Rosseel, Y. (2012). lavaan: An R package for structural equation modeling. *Journal of Statistical Software, 48*, 1–36.
Ryan, T., Chester, A., Reece, J., & Xenos, S. (2014). The uses and abuses of Facebook: A review of Facebook addiction. *Journal of Behavioral Addictions, 3*, 133–148.
Sarda, E., Bègue, L., Bry, C., & Gentile, D. (2016). Internet gaming disorder and well-being: A scale validation. *Cyberpsychology, Behavior and Social Networking, 19*, 674–679.
Satici, S. A., & Uysal, R. (2015). Well-being and problematic Facebook use. *Computers in Human Behavior, 49*, 185–190.
Satorra, A., & Bentler, P. M. (1988). Scaling corrections for chi-square statistics in covariance structure analysis. In *ASA 1988 proceedings of the business and economic statistics section (308–313)*. Alexandria, VA: American Statistical Association.
Saunders, J. B., Aasland, O. G., Babor, T. F., De la Fuente, J. R., & Grant, M. (1993). Development of the alcohol use disorders identification test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption-II. *Addiction, 88*, 791–804.
Shapiro, D. N., Chandler, J., & Mueller, P. A. (2013). Using Mechanical Turk to study clinical populations. *Clinical Psychological Science, 1*, 213–220.
Sharma, A., Sahu, R., Kasar, P. K., & Sharma, R. (2014). Internet addiction among professional courses students: A study from central India. *International Journal of Medical Science and Public Health, 3*, 1069–1073.
Sigerson, Leif, Li, Angel Y.-L., Cheung, Mike W.-L., Luk, Jeremy W., & Cheng, Cecilia (November 2017). Psychometric properties of the Chinese Internet Gaming Disorder Scale. *Addictive Behaviors, 74*, 20–26. http://dx.doi.org/10.1016/j.addbeh.2017.05.031. ISSN 0306-4603.
Sim, T., Gentile, D. A., Bricolo, F., Serpelloni, G., & Gulamoydeen, F. (2012). A conceptual review of research on the pathological use of computers, video games, and the internet. *International Journal of Mental Health and Addiction, 10*, 748–769.
Sugawara, H. M., & MacCallum, R. C. (1993). Effect of estimation method on incremental fit indexes for covariance structure models. *Applied Psychological Measurement, 17*, 365–377.
Tanis, M., Beukeboom, C. J., Hartmann, T., & Vermeulen, I. E. (2015). Phantom phone signals: An investigation into the prevalence and predictors of imagined cell phone signals. *Computers in Human Behavior, 51*, 356–362.
Tokunaga, R. S. (2014). A unique problem or the manifestation of a preexisting disorder? the mediating role of problematic internet use in the relationships between psychosocial problems and functional impairment. *Communication Research, 41*, 531–560.
Tozzi, L., Akre, C., Fleury-Schubert, A., & Suris, J. C. (2013). Gambling among youths in Switzerland and its association with other addictive behaviours: A population-based study. *Swiss Medical Weekly, 143*, w13768.
U.S. Census Bureau. (2011). *Age and sex composition:2010*. Retrieved from http://www.census.gov/prod/cen2010/briefs/c2010br-03.pdf.
Weinstein, A., Dorani, D., Elhadif, R., Bukovza, Y., Yarmulnik, A., & Dannon, P. (2015). Internet addiction is associated with social anxiety in young adults. *Annals of Clinical Psychiatry, 27*, 4–9.
Weinstein, A., & Lejoyeux, M. (2010). Internet addiction or excessive internet use. *The American Journal of Drug and Alcohol Abuse, 36*, 277–283.
Yang-Wallentin, F., Jöreskog, K. G., & Luo, H. (2010). Confirmatory factor analysis of ordinal variables with misspecified Models. *Structural Equation Modeling, 17*, 392–423.
Yau, Y. H., & Potenza, M. N. (2015). Gambling disorder and other behavioral addictions: Recognition and treatment. *Harvard Review of Psychiatry, 23*, 134–146.
Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *CyberPsychology and Behavior, 1*, 237–244.
Young, K. (2009). Internet addiction: Diagnosis and treatment considerations. *Journal of Contemporary Psychotherapy, 39*, 241–246.
Yu, C. Y. (2002). *Evaluating cutoff criteria of model fit indices for latent variable models with binary and continuous outcomes*. Doctoral dissertation. University of California Los Angeles. Retrieved from http://search.proquest.com/docview/276287121?accountid=14548 (Order No. 3066425).
Zimmerman, M., & Mattia, J. I. (1999). Psychiatric diagnosis in clinical practice: Is comorbidity being missed? *Comprehensive Psychiatry, 40*, 182–191.