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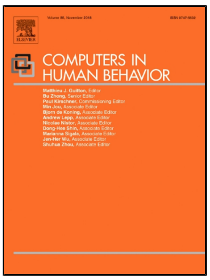


Digital Nativity and Information Technology Addiction: Age Cohort Versus Individual Difference Approaches

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# Digital Nativity and Information Technology Addiction: Age Cohort Versus Individual Difference Approaches

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# Digital Nativity and Information Technology Addiction: Age Cohort Versus Individual Difference Approaches

Abstract

A "digital native" is a member of the younger generation who grew up in the cyber age. Although earlier studies have focused on digital natives' competence in information technology (IT) usage, their vulnerability to IT addiction has received scant attention. The overarching aim of this study was to investigate the hypothesized associations between digital nativity and four common types of IT addiction (i.e., Internet addiction, Internet gaming disorder, smartphone addiction, and Facebook addiction). Specifically, our study adopted a multidimensional approach to compare the associations between specific attributes of digital natives and each types of IT addiction. We further examined whether the attributes of digital natives could explain additional variance in IT addiction beyond that accounted for by age. In 2017, a cross-sectional online survey was conducted through MTurk among 1,001 U.S. residents (56% women; $mean_{age}$ = 35.0, $range_{age}$ = 18-83). The results revealed robust positive associations between digital nativity and four types of IT addiction, albeit with differential associations between various attributes of digital natives and diverse addiction types. Moreover, attributes of digital natives exhibited explanatory power beyond that provided by age. These findings highlight the value of adopting the multidimensional, individual difference approach in the study of digital nativity.

*Keywords*: digital nativity, Internet addiction, Internet gaming disorder, smartphone addiction, Facebook addiction

## 1. Introduction

Advances in modern technology have profoundly shaped today's world, and proficiency in usage of information technology (IT) is now widely considered a pivotal skill. The term "digital nativity" was coined to describe generational differences in such proficiency (Prensky, 2001). In this conceptualization, individuals are categorized into two generations. The first is digital natives, which refer to members of the younger generation who grew up in the cyber age. These individuals are "native speakers" of the digital language, and thus able to easily adapt to IT. The second is digital immigrants, which refer to members of the generation born before the advancement of IT. They are "non-native speakers" of the digital language, and thus tend to encounter greater difficulties in adapting to the new, changing technological environment.

Growing up in the cyber age, digital natives have had earlier and greater exposure to various IT activities such as Internet surfing, online gaming, and online social networking than digital immigrants. Although some studies have provided support for the hypothesized positive associations between digital nativity and proficiency in IT usage (e.g., Hoffmann, Lutz, & Meckel, 2014; Salajan, Schönwetter, & Cleghorn, 2010), digital natives' constant exposure to IT has also aroused considerable concern over the addictive usage of such technology (e.g., Hahn, Reuter, Spinath, & Montag, 2017; Leung, 2004). However, several conceptual and methodological issues regarding the associations between digital nativity and IT addiction have remained to be addressed.

The study reported herein was conducted to address three unresolved yet important issues. First, although scholars have examined the prevalence of a single type of IT addiction

(i.e., Internet addiction) in the younger generation (e.g., Hahn et al., 2017), there have been no attempts to investigate whether digital natives are equally susceptible to other common types of such addiction (i.e., Internet gaming disorder, smartphone addiction, and Facebook addiction). Our study extended the literature by including a broader spectrum of IT addiction to compare the differential magnitude of their associations with digital nativity.

Second, as shown in studies comparing levels of IT addiction among individuals from distinct age cohorts, only some members of the younger generation experience IT addiction but not others (e.g., Cao & Su, 2007; Rehbein, Kliem, Baier, Mößle, & Petry, 2015). Also, the specific attributes of digital natives that may potentially contribute to the development of IT addiction remain unknown. Our study addressed these unresolved issues by investigating how digital natives' attributes, including both psychological characteristics and behavioral tendencies, are related to IT addiction.

Finally, digital natives embody several distinct characteristics of IT usage (Teo, 2013), suggesting the importance of conceptualizing and operationalizing digital nativity as a complex, multidimensional construct. However, previous studies adopting Prensky's (2001) conceptualization have focused on a single dimension of age cohort in the study of digital nativity. Our study seeks to expand the scope of research by conducting a more nuanced analysis of the multiple aspects of digital nativity and their specific associations with IT addiction.

### 1.1 Digital nativity and various types of IT addiction

IT provides a seemingly unlimited source of information, connectivity, and entertainment; but its excessive use can have such detrimental effects as addiction (e.g., Dong & Potenza, 2014; Kuss, Griffiths, Karila, & Billieux, 2014). As digital natives represent a

generation to be "born digital," researchers have been interested in investigating whether younger individuals are more susceptible to IT addiction than their older counterparts.

Cross-generational comparisons have generally supported an inverse association between IT addiction and age, documenting such addiction to be more prevalent among children, adolescents, and young adults than older adults (e.g., Festl, Scharkow, & Quandt, 2013; Zhitomirsky-Geffet & Blau, 2016). The association has also been tested under the digital nativity framework, with the findings providing further evidence that Internet addiction is more common among digital natives than digital immigrants (Hahn et al., 2017).

Some scholars have further proposed that individuals who grew up in the cyber age have particular attributes that increase their vulnerability to IT addiction (e.g., Leung, 2004). There is some indirect evidence indicating that those who grew up using the Internet have a tendency to be less restrained in online self-expression, an attribute that has positive associations with Internet addiction (Leung, 2004). However, there is a lack of research examining other individual characteristics that may enhance digital natives' susceptibility to IT addiction.

The present study was carried out to fill these knowledge gaps with a direct, comprehensive test of the hypothesized positive associations between several attributes of digital natives and an array of IT addiction. Previous studies have revealed younger (vs. older) individuals to be more susceptible to several common types of such addiction (Sigerson, Li, Cheung, & Cheng, 2017), including Internet addiction (Bakken, Wenzel, Götestam, Johansson, & Øren, 2009), smartphone addiction (Zhitomirsky-Geffet & Blau, 2016), Facebook addiction (Balcı & Gölcü, 2013), and Internet gaming disorder (Festl et al., 2013). To conduct a more comprehensive test, our study thus examined some specific

attributes of digital natives that pertain to these four common types of IT addiction, thereby allowing cross-type comparisons.

**1.2 Digital nativity: Age cohort versus individual difference**

The proposal of the digital nativity construct has sparked considerable research interests. However, consensus has yet to be reached among researchers on how to empirically identify digital natives. Following Prensky's (2001) initial conceptualization, earlier studies generally operationalize digital nativity in terms of age, with participants born after 1980 categorized as digital natives, and those born before that year categorized as digital immigrants (e.g., Haluza, Naszay, Stockinger, & Jungwirth, 2017; Margaryan, Littlejohn, & Vojt, 2011). Mixed findings were yielded from studies adopting this approach. Although some studies supported that digital natives tend to report higher levels of IT usage and acceptance than do digital immigrants (e.g., Hoffmann, Lutz, & Meckel, 2014; Salajan, Schönwetter, & Cleghorn, 2010), other studies documented that a considerable number of younger users tend to be less competent in utilizing IT than what scholars had initially proposed (e.g., Calvani, Fini, Ranieri, & Picci, 2012; Guo, Dobson & Petrina, 2008). In view of such inconsistent findings, some scholars cast doubt on age as the sole factor explaining the distinctions between digital natives and digital immigrants (Bennett, Maton, & Kervin, 2008), contending that the age cohort approach does not consider the influence of individuals' unique experience with and breadth of IT usage (Helsper & Eynon, 2010; Kennedy, Judd, Dalgarno, & Waycott, 2010).

Even within the same generation, individuals differ vastly in their experience, preferences, and behavioral tendencies pertaining to IT usage. Hence, although digital natives may express a stronger preference for IT usage than digital immigrants, the extent of access

to such technology and digital skills is not homogeneous within the younger generation. These within-generation differences are influenced by such demographic factors as gender and education (e.g., Jackson et al., 2008; Koivusilta, Lintonen, & Rimpelä, 2007). In a similar vein, digital immigrants also display considerable diversity regarding their IT skills and experience (e.g., N. G. Choi & DiNitto, 2013; Gell, Rosenberg, Demiris, LaCroix, & Patel, 2013), with some members of that generation holding more favorable views of IT usage than others (Mitzner et al., 2010).

To address these uncertain issues, Teo (2013) put forward an alternative approach that focuses on individual differences in digital nativity. Instead of relying solely on age as the defining factor, this individual difference approach advances current knowledge by highlighting the influential role of individual attributes—including psychological characteristics and behavioral tendencies—in delineating the distinctions between digital natives and digital immigrants. In this perspective, digital nativity is no longer conceptualized as common or shared characteristics within an entire generation of IT users, but as a set of characteristics with varying levels among these users (Teo, 2013; Chen, Teo, & Zhou, 2016). To assess individual differences in a range of specific attributes characterizing a digital native, Teo (2013) developed a self-report instrument, namely the Digital Natives Assessment Scale (DNAS). Studies have adopted this measure and revealed that self-report levels of digital nativity are positively associated with various indicators of IT usage, such as preference for online social interactions (Grieve, 2017) and online information search competencies (Çoklar, Yaman, & Yurdakul, 2017).

The foregoing literature review indicates that researchers have used either the age cohort approach or the individual difference approach to study digital nativity. Our study is

the first to use both approaches for a direct, comprehensive test of the hypothesized positive associations between digital nativity and IT addiction. The adoption of both approaches allows us to disentangle the explanatory utility of each and to evaluate which approach accounts for a larger portion of variance in the hypothesized associations. As some scholars have posited that age may not fully capture the broad spectrum of between-generation distinctions (Bennett et al., 2008; Helsper & Eynon, 2010), we predict that the attributes of digital natives may exhibit stronger associations with IT addiction than do age.

**1.3 Digital nativity as a multifaceted construct**

Another difference between the age cohort and the individual difference approaches is that the former views digital nativity as a global, unidimensional construct while the latter views it as a complex, multifaceted construct. Defining digital nativity solely with age, the age cohort approach adopts a unidimensional perspective to understand the differences between digital natives and digital immigrants based on cross-generational comparisons. However, such comparisons do not allow researchers to further identify which specific attributes of digital natives contribute to the development of IT addictions.

Adopting a multidimensional approach, Teo (2013) conceptualized digital nativity as comprising four distinct factors, each of which is related to the experience of being a digital native that differ from those of being a digital immigrant: “grow up with technology,” “comfortable with multitasking,” “reliant on graphics for communication,” and “thrive on gratifications and rewards.”

Being born in the cyber age, digital natives are more likely than digital immigrants to consider IT use an intrinsic way of life. Hence, the first factor, “grow up with technology,” refers to individual differences in the experience and habit of using IT. Moreover, as the

operating systems of current technology platforms such as personal computers allow users to adopt an array of applications concurrently, multitasking is a common behavioral tendency among digital natives. The second factor, "comfortable with multitasking," reflects individual variations in the capacity to engage in two or more tasks simultaneously. In addition to multitasking, digital natives have developed various visual rather than text-based communication strategies through the use of graphics (i.e., images, emoticons). Hence, the third factor, "reliant on graphics for communication," evaluates individual differences in the tendency to intuitively use images and emoticons during online conversations rather than text alone. Finally, the efficiency of various IT platforms has led to the widespread perception among digital natives that their demands can be satisfied instantly. The fourth factor, "thrive on instant gratifications and rewards," thus refers to individual differences in the expectancy of an immediate payoff following their use of IT platforms.

This four-factor model of digital nativity lays the foundation for a multidimensional approach toward the examination of diverse attributes and their specific associations with IT addiction. Of the four factors included in the DNAS, certain attributes may have stronger associations with such addiction than others. To afford a more comprehensive perspective on the hypothesized associations, it is important to distinguish among that array of attributes.

First, we hypothesize that "thrive on instant gratifications and rewards" is positively associated with IT addiction. Technology platforms such as the Internet foster the instant satisfaction of users' needs, including their need for information, social connectivity, and entertainment. The ease of use and efficiency of need gratification on these platforms render them irresistible and addictive to many individuals (Young & De Abreu, 2010), and may even enhance their willingness to sacrifice long-term rewards or tolerate sizeable losses to

gain short-term rewards through using IT devices (Volkow, Baler, & Goldstein, 2011). Supporting our proposition is evidence indicating that individuals with IT addiction tend to experience greater difficulties than others in inhibiting immediate reward-seeking behavior (Balconi, Venturella, & Finocchiaro, 2017).

Second, we also hypothesize that "reliant on graphics for communication" is positively associated with IT addiction. Although past studies have not directly examined the association between this factor and IT addiction, studies have revealed positive associations between the usage of graphics and impulsivity (Roffo, Giorgetta, Ferrario, & Cristani, 2014), a personality trait that has been consistently identified as a risk factor for IT addiction (e.g., Cao, Su, Liu, & Gao, 2007; Y. Kim et al., 2016). More specifically, the use of emoticons to express unpleasant emotions is positively associated with trait impulsivity (Roffo et al., 2014), and studies have shown emoticon usage to be more common in social media posts expressing impulsive emotions than in regular social media posts (Rodríguez-Hidalgo, Tan, & Verlegh, 2017).

Contrary to our predictions for the two aforementioned factors, we hypothesize that "comfortable with multitasking" bears no association with IT addiction. Although prior studies have revealed technology multitasking to be related to such undesirable consequences as declining academic performance (Rosen, Carrier, & Cheever, 2013) and mental health problems (Becker et al., 2013), none has identified a direct association between multitasking tendencies and IT addiction (Błachnio & Przepiorka, 2016; Chang, Liu, Chen, & Hsieh, 2017). Moreover, the capability of successful performance of multiple tasks simultaneously requires good control over one's cognitive resources (Grawitch & Barber, 2013), and high levels of self-control have been shown to enable regulation of impulsive and excessive usage of IT devices (E. J. Kim, Namkoong, Ku, & Kim, 2008).

Finally, we hypothesize that "grow up with technology" also has no association with IT addiction. Although growing up with IT allows individuals to gain more experience with it, past experience per se may not constitute a risk factor for IT addiction. For instance, research has shown that prior experience with Internet use is unrelated to Internet addiction in North American, Chinese, and Spanish samples (González & Orgaz, 2014; Zhang, Amos, & McDowell, 2008).

**1.4 Study aims and hypotheses**

The present study expands the literature on both digital nativity and IT addiction by addressing several unresolved but significant knowledge gaps. First, this study provides a comprehensive test of the hypothesized positive associations between digital nativity and the four most common types of such addiction, namely, Internet addiction, Internet gaming disorder, smartphone addiction, and Facebook addiction (Sigerson et al., 2017). Although these types of IT addiction share similar risk factors, they are conceptually distinct (see review by Sigerson et al., 2017). Hence, our first hypothesis puts forward that the global construct of digital nativity is positively associated with all four types of IT addiction.

Second, this study is the first attempt to compare the age cohort and the individual difference approaches to the study of digital nativity. Specifically, our second hypothesis states that the attributes of digital natives may account for a greater portion of variance in the association between digital nativity and IT addiction beyond that explained by age. Such additional variance may further enrich our understanding of the association.

Finally, we adopt a multidimensional approach to examine the association between specific attributes of digital natives and various types of IT addiction. We apply Teo's (2013) four-factor model of digital nativity, wherein each factor represents distinct psychological characteristics or behavioral tendencies of digital natives. Grounded in previous findings, our

third hypothesis proposes that the two factors of "thrive on instant gratifications and rewards" and "reliant on graphics for communication" may be positively associated with all four types of IT addiction, whereas no such associations may be found for "comfortable with multitasking" or "grow up with technology."

## 2. Methods

### 2.1 Research design and procedures

Adopting a cross-sectional design, we conducted a web survey among 1,030 U.S. adult residents recruited through a popular online crowdsourcing platform Amazon's Mechanical Turk (MTurk). This platform was chosen because it has been shown to yield high-quality data for academic research (Landers & Behrend, 2015).

An advertisement was initially posted on MTurk to recruit U.S. residents over 18 years old. Eligible participants who were interested in our survey were directed to complete an online questionnaire after endorsing an informed consent statement. Participants were remunerated with 1.5 U.S. dollars for 15 minutes of their participation. The remuneration and other aspects of data collection process were adhered to the established regulations concerning the use of MTurk. Prior research ethics approval had been obtained from the Human Research Ethics Committee of the authors' institution.

Two measures were adopted to further ensure data quality. First, only participants with an excellent reputation on the site (i.e., those who had successfully completed over 99% of previous tasks) were allowed to take part. Second, two attention check questions were included. Data were excluded if participants had failed to answer more than 5% of questions or had provided an incorrect answer to either of the two attention check questions. All participants were notified of these exclusion criteria before the study commenced. The

rejection rate was very low (3%), indicating that the data were of high quality.

**2.2 Sample**

After excluding 29 participants who failed to meet the eligibility criteria, the final sample totaled 1,001 participants. Just over half the participants (56%) were women, and the average age was 35 (*SD* = 10.6, range = 18-83). More detailed demographic information is given in Table 1. Although U.S. census data indicate that the average age of our sample was younger than that of the entire population, our sample was older than those of previous research using the same measure of digital nativity, which has primarily targeted adolescents and young adults (Chen et al., 2016; Grieve, 2017; Teo, 2013). The present data are part of a larger project on the psychology of IT usage.

**2.3 Measures**

The DNAS (Teo, 2013) was selected to measure self-reported levels of digital nativity. This instrument includes 21 items to which participants respond on a 7-point Likert scale ranging from "strongly disagree" to "strongly agree." Sample items include "I use computers for many things in my daily life." and "I am able to surf the internet and perform another activity comfortably." In the original factor structure of the DNAS proposed by Teo (2013), the reliability of the first factor (grow up with technology) was below the commonly accepted cutoff of .70 (Cronbach's α=.63). Further analysis indicated that the fifth item was lowering the first factor's reliability, so this item was removed and the scale's reliability was estimated again. In this revised model, reliability was acceptable for all four factors, as well as for the whole scale (Cronbach's α=.93).

As the DNAS had never been used in a U.S. sample, we needed to examine the factor structure of our four-factor model using CFA. The first four items of the scale displayed

considerable skew in our sample, with 45% to 80% of respondents selecting the "strongly agree" option. Therefore, the maximum likelihood method, which assumes a normal distribution of data, was not employed for model estimation and the diagonally weighted least squares (DWLS) was chosen instead. RMSEA was selected as the indicator of model fit because it has been shown to be more accurate when using robust techniques such as DWLS (Hutchinson & Olmos, 1998), although the CFI and Tucker-Lewis index (TLI) values are reported as well. This analysis revealed the four-factor structure proposed by Teo (2013) to exhibit a good fit in our U.S. sample (RMSEA = .049, 90% confidence interval = .045, .054; CFI = .888, TLI = .870). We noted that the CFI and TLI values were marginally below the standard cutoff of .90 for an acceptable model fit. However, the RMSEA, which is deemed more appropriate for model estimation using DWLS, indicated good model fit. We thus considered that the revised factor structure of the DNAS (without the fifth item) demonstrated a good fit to the data for our sample.

The Young Diagnostic Questionnaire (Young, 1998) was adopted to measure Internet addiction because it is the most popular existing measure of such addiction (Cheng & Li, 2014). The instrument includes eight items with dichotomous (yes/no) response options. Sample items are as follows: "Do you feel the need to use the Internet with increasing amounts of time in order to achieve satisfaction?" and "How often do you find yourself anticipating when you will go online again?" Although its reliability in this study was slightly lower than the optimal level, it was still within the acceptable range (Cronbach's $\alpha = .62$).

The short version of the Smartphone Addiction Scale (Kwon, Kim, Cho, & Yang, 2013) was employed because this scale is one of the very few measures of smartphone addiction that has been validated in different cultural regions (Akın, Altundağ, Turan, &

Akın, 2014; De Pasquale, Sciacca, & Hichy, 2017). Compared with the full version, the short version is deemed more appropriate for the present sample because only the short version has been validated with both adult and adolescent samples. The short form comprises 10 items, with respondents indicating whether those items are true of them on a 6-point rating scale. Sample items include "Missing planned work due to smartphone use." and "Feeling impatient and fretful when I am not holding my smart phone." The instrument was found to be reliable in this study (Cronbach's $\alpha = .83$).

The widely used Bergen Facebook Addiction Scale (Andreassen, Torsheim, Brunborg, & Pallesen, 2012) was used to measure Facebook addiction. Respondents were asked to report how often they engage in six typical Facebook behaviors using five response options anchored by "very rarely" and "very often." Sample items are "How often during the last year have you felt an urge to use Facebook more and more?" and "Used Facebook in order to forget about personal problems?" The measure had acceptable reliability in our study (Cronbach's $\alpha = .72$).

Finally, Internet gaming disorder was measured by the Nine-Item Short-Form Internet Gaming Disorder Scale (Pontes & Griffiths, 2015), which was selected because it was constructed based on the DSM-5's proposed criteria for such disorder (American Psychiatric Association, 2013). Sample items are "Have you continued your gaming activity despite knowing it was causing problems between you and other people?" and "Do you systematically fail when trying to control or cease your gaming activity?" The short form includes nine items on a 5-point rating scale, and was found to be highly reliable in this study (Cronbach's $\alpha = .91$).

The factor structures of four IT addiction measures were also examined using CFA.

Similar to the previous analysis, the DWLS method was selected for model estimation, RMSEA was chosen as the indicator of overall model fit, and both the CFI and TLI values were reported as well. These analyses indicated that all of the IT addiction measures had satisfactory model fit in our current sample (i.e., all RMSEA's < .061, all CFI's > 0.970, and all TLI's > 0.970).

**2.4 Data analysis plan**

Pearson product-moment correlation would be used to test our first hypothesis by revealing the inter-relationships between digital nativity and the four common types of IT addiction. Bonferroni correction would be applied to the correlation analysis to control for the potential Type I error pertaining to multiple comparisons (Curtin & Schulz, 1998).

Hierarchical regression analysis would be performed to test our second hypothesis by evaluating whether attributes of digital natives would explain additional variance in various types of IT addiction beyond that accounted for by age. We would test four pairs of regression models, each of which would include one type of IT addiction as the criterion. For each pair, the model with age as the sole independent variable would be compared with another model including both age and digital nativity as independent variables. If the latter model explained a significantly greater portion of variance than the former, then the result would be taken to indicate that the attributes of digital natives had additional explanatory utility over age in predicting a particular criterion.

We would test the third hypothesis by scrutinizing the associations between each DNAS factor and IT addiction. This test would consist of four sets of hierarchical regression analysis, with each type of addiction included as the criterion. In each model, age would be entered in the first step, and then all four DNAS factors would be entered simultaneously to

examine the unique variance accounted for by the four factors of digital nativity beyond that explained by age.

Before the hypothesis testing, the assumptions of multiple regression were checked. The results were similar for both clusters of hierarchical regression analysis in revealing no violations of the following assumptions. First, no multicollinearity issues were detected as indicated by the variance inflation factor (VIF) and tolerance statistics. Second, the regression residual was not significantly deviated from normal distribution. Last, the assumption of independent errors was also not violated based on the results of Durbin-Watson tests.

## 3. Results

### 3.1. Detection of potential age-related measurement biases

As this study was the first to administer the DNAS in a heterogeneous sample with a diverse age range, it was necessary to test its psychometric equivalence across age groups using multi-group confirmatory factor analysis (CFA). This analysis evaluated whether the DNAS had the same scaling and psychometric properties for different age groups and whether it was subject to age-related measurement bias. Following previous practice (e.g., Steinmetz, Schmidt, Tina-Booh, Wieczorek, & Schwartz, 2009), we categorized participants into three roughly equally sized age groups. The model fit (assessed by the confirmatory fit index [CFI] and root mean square error of approximation [RMSEA]) did not worsen by more than .008 in any step of multi-group CFA, indicating that the psychometric properties of the DNAS did not vary across age groups according to widely adopted standards (Cheung & Rensvold, 2002). We thus concluded that the analyses reported below were not threatened by the age-related measurement bias of the DNAS, which was deemed adequate for use in

samples with a wide age range.

### 3.2 Relationship between digital nativity and common types of IT addiction

Table 2 reports the zero-order correlation coefficients among the study variables. As the table shows, digital nativity was significantly and positively related to all four types of IT addiction, with *r*'s ranging from .211 to .353. These findings were in line with our first hypothesis in revealing positive associations between levels of digital nativity and various types of IT addiction.

### 3.3 Comparison of the age cohort and the individual difference approaches

The results of multiple regression analysis are summarized in Table 3, which shows that the DNAS factors (i.e., Model 2) accounted for a significant portion of the variance in all four types of IT addiction beyond age (i.e., Model 1). It is important to note that in the regression model with Internet addiction as the criterion, the effect of age was no longer significant after digital nativity had been entered, indicating that digital nativity can also explain the variance accounted for by age. These findings supported our second hypothesis in showing that the individual difference approach has greater utility in explaining the association between digital nativity and IT addiction than the age cohort approach.

### 3.4 Dimensions of digital nativity and IT addiction

Table 4 summarizes the findings of four hierarchical regression analyses, demonstrating that all four DNAS factors had significant associations with Internet addiction, although "comfortable with multitasking" displayed an inverse association, whereas the other three displayed positive associations. However, only "thrive on instant gratifications and rewards" and "reliant on graphics for communication" had significant associations with Internet gaming disorder, smartphone addiction, and Facebook addiction. In summary, these

results were consistent with our hypotheses concerning the "thrive on instant gratifications and rewards" and "reliant on graphics for communication" factors, but provided only partial support for those pertaining to the "comfortable with multitasking" and "grow up with technology" factors.

## 4. Discussion

### 4.1 Summary of hypothesis testing

In the present study, we recruited a U.S. community adult sample to examine the association between digital nativity and IT addiction, and the results generally support our hypotheses. First, there are robust positive associations between digital nativity and four common types of IT addiction. Second, we directly compared the age cohort versus the individual difference approaches to the conceptualization of digital nativity, and found the individual difference approach to improve the explanatory power of all four types of IT addiction relative to the more conventional age cohort approach. Finally, a multidimensional approach was adopted to examine individual factors of digital nativity and their separate associations with four common types of IT addiction. The analyses yielded a complex pattern of results, with robust positive associations found of "thrive on instant gratifications and rewards" and "reliant on graphics for communication" with all four types of IT addiction. However, only Internet addiction was associated with "grow up with technology" (positively) and "comfortable with multitasking" (inversely).

### 4.2 Age cohort versus individual difference: Differences in explanatory power

One of the major contributions of this study is its comparison of the age cohort and the individual difference approaches in operationalizing digital nativity as well as its demonstration of the latter's explanatory utility in such measurement. The individual

difference approach directly assesses diverse attributes of digital natives including both psychological characteristics and behavioral tendencies, thereby providing a more comprehensive examination of digital nativity than does the age cohort approach. Although using age as the sole factor to differentiate between digital natives and digital immigrants is a relatively more objective and straightforward approach, it tends to overlook the diversity within each group (Helsper & Eynon, 2010). Specifically, the age cohort approach does not account for the individual differences in the extent of IT usage within the two groups, instead regarding digital nativity as a common characteristic within the entire generation of digital natives and digital immigrants (Selwyn, 2009; Chen, Teo, & Zhou, 2016). Hence, considering age alone may not be able to fully capture the association between IT usage-related characteristics and IT addiction.

Our results further demonstrate that the individual difference approach can improve the explanatory power of addiction across multiple IT platforms. As the present study examined addictive usage of both recently emerged (i.e., smartphone and Facebook) and more common (i.e., Internet) IT platforms, it is important to evaluate whether this increase in explanatory utility is restricted by the nature of digital medium. For instance, studies have revealed that even within the generation of digital natives, younger members tend to report significantly greater usage of recently emerged platforms such as social network sites than older ones, but there are less age differences in general Internet usage (e.g., Joiner et al., 2013; S. K. Wang, Hsu, Campbell, Coster, & Longhurst, 2014). In the present study, although age per se is a significant indicator of three types of IT addiction (i.e., Internet Addiction, Internet gaming disorder, and smartphone addiction), the attributes of digital natives account for a significantly larger portion of variance in the associations with each

type of IT addiction. Thus, the individual difference approach enriches the picture by indicating how users from the same age cohort may have distinct experiences with these novel IT platforms, thus substantiating the role of this approach in affording a more extensive assessment of digital nativity and its association with addiction to an array of IT platforms.

### 4.3 Digital nativity and IT addiction

This study fills another knowledge gap by revealing a positive association between digital nativity (measured as a global construct) and all four common types of such addiction. Such robust findings indicate that the harmful aspects of digital nativity may apply to a variety of platforms rather than a specific one. To further examine the relationship between specific attributes of digital natives and IT addiction, we adopted a multidimensional approach based on Teo's (2013) four-factor digital nativity model. That approach yielded more refined details concerning each factor's distinct role in explaining such addiction.

Our findings thus indicate that the magnitude of the association with IT addiction may differ for different attributes possessed by digital natives. For example, the characteristics of thriving on instant gratifications and relying on graphics for communication are positively associated with all four types of such addiction considered, as predicted; but mixed findings are obtained for being comfortable with multitasking and having grown up with technology, as discussed in the following sections.

#### 4.3.1 Comfort with multitasking

As noted, empirical inconsistencies are observed regarding the association between the "comfortable with multitasking" factor and the four types of IT addiction. As hypothesized, the factor has no significant associations with Internet gaming disorder,

smartphone addiction, or Facebook addiction. Interestingly, this factor is inversely associated with Internet addiction, albeit weakly.

This weak inverse association is potentially attributable to the nature of multitasking. Performing multiple tasks simultaneously using IT devices requires good control of one's cognitive resources (Chang et al., 2017), and impaired cognitive control has been consistently identified as a risk factor for Internet addiction (e.g., Brand, Young, & Laier, 2014; Y. Kim et al., 2016). These findings indicate that individuals with strong multitasking skills are more likely than those without them to exercise higher levels of self-control, which serves as a buffer against the development of Internet addiction. Further empirical investigation is needed to directly test the actual mastery of multitasking skills among individuals with different levels of IT addiction, preferably in a controlled, laboratory setting.

**4.3.2 Growing up with technology and Internet addiction**

Mixed findings are also yielded regarding the association between the "grow up with technology" factor and IT addiction. Contrary to our hypothesis, that factor is positively associated with Internet addiction. One plausible explanation for this finding is the difference between past experience using IT and the age of first exposure to it. Although no research to date has identified a direct association between experience of Internet use and Internet addiction, several studies have identified the age of first Internet exposure as a risk factor for such addiction (Ni, Yan, Chen, & Liu, 2009; L. Wang et al., 2013). Digital natives who frequently interact with IT in early stages of their lives are more likely to embrace the Internet as an indispensable part of everyday life than those who do so less frequently (Teo, 2013). Although older and younger individuals may report using the Internet for a similar period of time, the former age group may be less likely to consider Internet use an intrinsic

way of life. For instance, even within the generation of digital natives, individuals born after the rapid advancement of Internet-related technology report more favorable attitudes toward the Internet and greater Internet usage than those born before such advancement (Joiner et al., 2013). Digital natives with early exposure to the Internet may also encounter more problems limiting their Internet use, as such use has securely integrated into their lives (S. K. Wang et al., 2014). Hence, individuals who have grown up in the cyber age may be more vulnerable to Internet addiction than those born earlier.

However, the current study does not reveal a similarly positive association between this factor of digital nativity and Internet gaming disorder, Facebook addiction, or smartphone addiction. These empirical discrepancies are theoretically attributable to the differences among IT platforms. Further, although these three types of addiction bear some similarity to Internet addiction, there are specific risk factors associated with each type of addiction (e.g., S. W. Choi et al., 2015; Pontes & Griffiths, 2014). For example, although smartphone addiction tends to be relatively more prevalent among female adolescents, Internet addiction tends to be more common among male adolescents (S. W. Choi et al., 2015). Thus, experiences related to general Internet usage may not be strong indicators of Internet gaming disorder, smartphone addiction, or Facebook addiction. In addition, most of the DNAS items developed to assess the "grow up with technology" factor specifically tap respondents' experiences of using the Internet via a personal computer, with other IT platforms receiving far less emphasis. Such narrow item content may explain in part why that factor, as assessed by the DNAS, does not exhibit a direct association with Internet gaming disorder, smartphone addiction, or Facebook addiction.

**4.4 Research and practical implications**

The present study has several important research implications. For example, it identifies distinct patterns among different types of IT addiction. Although some factors of digital nativity are found to be associated with all four types of addiction considered, certain factors are largely unrelated to smartphone, Internet gaming, or Facebook addiction. These complex findings highlight the importance of differentiating between specific and generalized forms of IT addiction. Some scholars have posited that specific types of IT addiction, such as Internet gaming disorder, are conceptually distinct from the more generalized construct of Internet addiction (Montag et al., 2015; Pontes & Griffiths, 2014). For example, there is evidence suggesting that Internet addiction is associated with the amount of time spent on both general Internet usage and Internet gaming, whereas Internet gaming disorder is associated only with the amount of time spent on Internet gaming (e.g., Király et al., 2014; Sigerson, Li, Cheung, Luk, & Cheng, 2017). Our results support these findings by revealing diverse risk factors for different types of addiction. For instance, we found experience with general Internet usage via a personal computer to be a risk factor for Internet addiction, but not for Internet gaming disorder, smartphone addiction, or Facebook addiction. Researchers should be aware of such differences when investigating different types of addiction and should include as many types as possible to ensure comprehensive examination of IT addiction.

Furthermore, the instrument we adopted to assess digital nativity, namely the DNAS, primarily measures a respondent's experience using the Internet via a personal computer. For example, the "grow up with technology" factor is evaluated by such items as "I use computers for many things in my daily life" and "I use the computer for leisure every day." However, these items may not reflect experience with more recent platforms such as

smartphones and tablet computers, which are frequently used by young people to access the Internet (Lenhart et al., 2015). Previous studies employing this digital nativity assessment tool have also focused on general Internet usage rather than the use of specific platforms such as smartphones (Çoklar et al., 2017). Future research should expand the scope of digital nativity assessment by including specific IT usage via other popular platforms, including smartphones and video game consoles.

Our findings also have practical implications for the development of preventive measures for IT addiction. Over the past decade, issues related to such addiction have gradually been recognized as a public health concern. Two broad types of preventive strategy have been proposed, namely, universal prevention targeting the general population and selective prevention focusing on high-risk groups. The latter type has been widely implemented, targeting such age groups as adolescents and young adults, and the effectiveness of specific prevention strategies has been empirically evaluated (e.g., Mun & Lee, 2015; Turel, Mouttapa, & Donato, 2015). For instance, after watching educational videos on Internet addiction, young adults reported more favorable attitudes toward reducing Internet use (Turel, Mouttapa, & Donato, 2015). However, universal prevention strategies have received scant attention.

The present study highlights the value of implementing both universal and specific prevention programs, showing that the inclusion of the digital nativity construct can better explain IT addiction than a consideration of age per se. Although determining high-risk groups based on age offers a cost-effective approach for public program implementation, it risks neglecting atypical cases such as high-risk individuals from age groups deemed to be low risk in general. For instance, lonely older adults with a strong urge for the instant

gratification of their heightened social needs, as well as those who consider IT to be a highly integral part of their lives, may be susceptible to IT addiction. Hence, universal prevention programs providing public education should also reach out to atypical but vulnerable cases whose demographic characteristics deviate from those of high-risk groups. Future research should also implement and evaluate the effectiveness of universal prevention strategies for mitigating IT addiction.

In the education setting, the present findings also provide insights into identifying potentially high-risk IT users among digital native students. Although Teo (2013) proposed that the attributes of digital natives can be utilized by teachers to obtain a basic understanding of student's relationship with technology, our findings reveal that these attributes can also serve as potential indicators of several common types of IT addiction. Hence, educational professionals, such as school psychologists and teachers, may employ the DNAS as an alternative measure to identify at-risk individuals among digital native students. Moreover, our findings highlight that distinct attributes of digital natives are associated with different types of IT addiction. When formulating preventive measures of IT addiction, educational professionals may focus on specific attributes that are associated with a particular type of IT addiction. For instance, the present findings indicate that the habit and experience of general Internet usage is associated with greater vulnerability to Internet addiction, but not other types of IT addiction. However, as the DNAS primarily assesses individual's Internet usage via a personal computer, platform-specific attributes associated with other types of IT platforms (e.g., social network sites, Internet gaming) remain to be explored. Researchers should further investigate the attributes that are associated with platforms other than personal computer for a more precise identification of specific profiles of digital natives who are at

risk for various types of IT addiction.

**4.5 Limitations and future research directions**

Like many studies, the present study is limited by its sample characteristics. Although we sought to enhance the generalizability of the study's findings by recruiting a large, demographically heterogeneous sample in a country in which the DNAS had never been administered (i.e., the United States), it should be noted that the sample is recruited from a single cultural region. Hence, although the study constitutes the first to demonstrate that the DNAS is not susceptible to age-related measurement bias, it remains unknown whether the instrument possesses the same psychometric properties across culturally diverse samples. A fruitful direction for future research is to expand the scope of this study by including participants from multiple cultural regions to allow the investigation of such unresolved issues as cross-cultural measurement invariance and cross-cultural differences in digital nativity.

It is also worth noting that we need to make one modification to the factor structure of the DNAS to yield a good model fit, namely, removal of the fifth item for the "grow up with technology" factor to improve the reliability of that factor. Teo (2013) posited that such modifications should be expected when the DNAS is adopted in new samples with dissimilar demographic characteristics, as the original scale was developed from a sample of secondary school students aged 12 to 16. It is thus unsurprising that the original factor structure is not applicable to the demographically heterogeneous community sample with a wide age range recruited for the present study. However, the revised DNAS factor structure yielded in this study should be further validated in samples with different demographic characteristics or even in different cultural regions to ensure its generalizability.

### 4.6 Conclusions

The present work reports the first empirical evidence of positive associations between digital nativity and four common types of IT addiction. Our refined analysis further reveals differences in the magnitude of the associations between four specific attributes of digital natives and such addiction. In addition, we provide additional insights into the assessment of digital nativity. Specifically, in comparing the age cohort and the individual difference approaches to such assessment, the findings indicate the latter to improve the explanatory utility of the four types of IT addiction. Our results further demonstrate the potential of the DNAS as a valuable tool for exploring more refined definitions of digital nativity and advancing scholarly understanding of the complex associations between attributes of digital nativity and various types of IT addiction.

**References**

Akın, A., Altundağ, Y., Turan, M. E., & Akın, U. (2014). The validity and reliability of the Turkish version of the smart phone addiction scale-short form for adolescent. *Procedia-Social and Behavioral Sciences, 152*, 74–77. doi:10.1016/j.sbspro.2014.09.157

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

Andreassen, C. S., Torsheim, T., Brunborg, G. S., & Pallesen, S. (2012). Development of a Facebook addiction scale. *Psychological Reports, 110*, 501–517. doi:10.2466/02.09.18.PR0.110.2.501-517

Bakken, I. J., Wenzel, H. G., Götestam, K. G., Johansson, A., & Øren, A. (2009). Internet addiction among Norwegian adults: A stratified probability sample study. *Scandinavian Journal of Psychology, 50*, 121–127. doi:10.1111/j.1467-9450.2008.00685.x

Balcı, Ş., & Gölcü, A. (2013). Facebook addiction among university students in Turkey: "Selcuk University example." *Selçuk Üniversitesi Türkiyat Araştırmaları Dergisi, 1*, 255–278.

Balconi, M., Venturella, I., & Finocchiaro, R. (2017). Evidences from rewarding system, FRN and P300 effect in Internet-addiction in young people. *Brain Sciences, 7*, 81. doi:10.3390/brainsci7070081

Bennett, S., Maton, K., & Kervin, L. (2008). The 'digital natives' debate: A critical review of the evidence. *British Journal of Educational Technology, 39*, 775–786. doi:10.1111/j.1467-8535.2007.00793.x

Błachnio, A., & Przepiorka, A. (2016). Dysfunction of self-regulation and self-control in Facebook addiction. *Psychiatric Quarterly, 87*, 493–500. doi:10.1007/s11126-015-9403-1

Brand, M., Young, K. S., & Laier, C. (2014). Prefrontal control and Internet addiction: A theoretical model and review of neuropsychological and neuroimaging findings. *Frontiers in Human Neuroscience, 8*, 375. doi:10.3389/fnhum.2014.00375

Calvani, A., Fini, A., Ranieri, M., & Picci, P. (2012). Are young generations in secondary school digitally competent? A study on Italian teenagers. *Computers and Education, 58*, 797–807. doi:10.1016/j.compedu.2011.10.004

Cao, F., & Su, L. (2007). Internet addiction among Chinese adolescents: Prevalence and psychological features. *Child: Care, Health and Development, 33*, 275–281. doi:10.1111/j.1365-2214.2006.00715.x

Cao, F., Su, L., Liu, T., & Gao, X. (2007). The relationship between impulsivity and Internet addiction in a sample of Chinese adolescents. *European Psychiatry, 22*, 466–471. doi:10.1016/j.eurpsy.2007.05.004

Chang, Y. H., Liu, D. C., Chen, Y. Q., & Hsieh, S. (2017). The relationship between online game experience and multitasking ability in a virtual environment. *Applied Cognitive Psychology, 31*, 653–661. doi:10.1002/acp.3368

Chen, P.-H., Teo, T., & Zhou, M. (2016). Relationships between digital nativity, value orientation, and motivational interference among college students. *Learning and Individual Differences, 50*, 49–55. doi:10.1016/j.lindif.2016.06.017

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. doi:10.1089/cyber.2014.0317

Cheung, G. W., & Rensvold, R. B. (2002). Evaluating goodness-of-fit indexes for testing measurement invariance. *Structural Equation Modeling, 9*, 233–255. doi:10.1207/S15328007SEM0902_5

Choi, N. G., & DiNitto, D. M. (2013). The digital divide among low-income homebound older adults: Internet use patterns, eHealth literacy, and attitudes toward computer/Internet use. *Journal of Medical Internet Research, 15*. doi:10.2196/jmir.2645

Choi, S. W., Kim, D. J., Choi, J. S., Ahn, H., Choi, E. J., Song, W. Y., . . . Youn, H. (2015). Comparison of risk and protective factors associated with smartphone addiction and Internet addiction. *Journal of Behavioral Addictions, 4*, 308–314. doi:10.1556/2006.4.2015.043

Çoklar, A. N., Yaman, N. D., & Yurdakul, I. K. (2017). Information literacy and digital nativity as determinants of online information search strategies. *Computers in Human Behavior, 70*, 1–9. doi:10.1016/j.chb.2016.12.050

Curtin, F., & Schulz, P. (1998). Multiple correlations and Bonferroni's correction. *Biological Psychiatry, 44*, 775–777. doi:10.1016/S0006-3223(98)00043-2

De Pasquale, C., Sciacca, F., & Hichy, Z. (2017). Italian validation of Smartphone Addiction Scale Short Version for Adolescents and Young Adults (SAS-SV). *Psychology, 8*, 1513. doi:10.4236/psych.2017.810100

Dong, G., & Potenza, M. N. (2014). A cognitive-behavioral model of Internet gaming disorder: Theoretical underpinnings and clinical implications. *Journal of Psychiatric Research, 58*, 7–11. doi:10.1016/j.jpsychires.2014.07.005

Festl, R., Scharkow, M., & Quandt, T. (2013). Problematic computer game use among

adolescents, younger and older adults. *Addiction, 108*, 592–599. doi:10.1111/add.12016

Gell, N. M., Rosenberg, D. E., Demiris, G., LaCroix, A. Z., & Patel, K. V. (2013). Patterns of technology use among older adults with and without disabilities. *The Gerontologist, 55*, 412–421. doi:10.1093/geront/gnt166

González, E., & Orgaz, B. (2014). Problematic online experiences among Spanish college students: Associations with Internet use characteristics and clinical symptoms. *Computers in Human Behavior, 31*, 151–158. doi:10.1016/j.chb.2013.10.038

Grawitch, M. J., & Barber, L. K. (2013). In search of the relationship between polychronicity and multitasking performance: The importance of trait self-control. *Journal of Individual Differences, 34*, 222. doi:10.1027/1614-0001/a000118

Grieve, R. (2017). Unpacking the characteristics of Snapchat users: A preliminary investigation and an agenda for future research. *Computers in Human Behavior, 74*, 130–138. doi:10.1016/j.chb.2017.04.032

Guo, R. X., Dobson, T., & Petrina, S. (2008). Digital natives, digital immigrants: An analysis of age and ICT competency in teacher education. *Journal of Educational Computing Research, 38*, 235–254.

Hahn, E., Reuter, M., Spinath, F. M., & Montag, C. (2017). Internet addiction and its facets: The role of genetics and the relation to self-directedness. *Addictive Behaviors, 65*, 137–146. doi:10.1016/j.addbeh.2016.10.018

Haluza, D., Naszay, M., Stockinger, A., & Jungwirth, D. (2017). Digital natives versus digital immigrants: Influence of online health information seeking on the doctor-patient relationship. *Health Communication, 32*, 1342–1349. doi:10.1080/10410236.2016.1220044

Helsper, E. J., & Eynon, R. (2010). Digital natives: Where is the evidence? *British Educational Research Journal, 36*, 503–520. doi:10.1080/01411920902989227

Hoffmann, C. P., Lutz, C., & Meckel, M. (2014). Digital natives or digital immigrants? The impact of user characteristics on online trust. *Journal of Management Information Systems, 31*, 138–171. doi:10.1080/07421222.2014.995538

Hutchinson, S. R., & Olmos, A. (1998). Behavior of descriptive fit indexes in confirmatory factor analysis using ordered categorical data. *Structural Equation Modeling: A Multidisciplinary Journal, 5*, 344–364. doi:10.1080/10705519809540111

Jackson, L. A., Zhao, Y., Kolenic III, A., Fitzgerald, H. E., Harold, R., & Von Eye, A. (2008). Race, gender, and information technology use: The new digital divide. *Cyberpsychology and Behavior, 11*, 437–442. doi:10.1089/cpb.2007.0157

Joiner, R., Gavin, J., Brosnan, M., Cromby, J., Gregory, H., Guiller, J., . . . Moon, A. (2013). Comparing first and second generation digital natives' Internet use, Internet anxiety, and Internet identification. *Cyberpsychology, Behavior, and Social Networking, 16*, 549–552. doi:10.1089/cyber.2012.0526

Kennedy, G., Judd, T., Dalgarno, B., & Waycott, J. (2010). Beyond natives and immigrants: Exploring types of net generation students. *Journal of Computer Assisted Learning, 26*, 332–343. doi:10.1111/j.1365-2729.2010.00371.x

Kim, E. J., Namkoong, K., Ku, T., & Kim, S. J. (2008). The relationship between online game addiction and aggression, self-control and narcissistic personality traits. *European Psychiatry, 23*, 212–218. doi:10.1016/j.eurpsy.2007.10.010

Kim, Y., Jeong, J. E., Cho, H., Jung, D. J., Kwak, M., Rho, M. J., . . . Choi, I. Y. (2016). Personality factors predicting smartphone addiction predisposition: Behavioral inhibition and activation systems, impulsivity, and self-control. *PloS ONE, 11*, e0159788. doi:10.1371/journal.pone.0159788

Király, O., Griffiths, M. D., Urbán, R., Farkas, J., Kökönyei, G., Elekes, Z., . . . Demetrovics, Z. (2014). Problematic internet use and problematic online gaming are not the same: Findings from a large nationally representative adolescent sample. *Cyberpsychology, Behavior, and Social Networking, 17*, 749–754. doi:10.1089/cyber.2014.0475

Koivusilta, L. K., Lintonen, T. P., & Rimpelä, A. H. (2007). Orientations in adolescent use of information and communication technology: A digital divide by sociodemographic background, educational career, and health. *Scandinavian Journal of Social Medicine, 35*, 95–103. doi:10.1080/14034940600868721

Kuss, J. D., Griffiths, G. M., Karila, L., & Billieux, J. (2014). Internet addiction: A systematic review of epidemiological research for the last decade. *Current Pharmaceutical Design, 20*, 4026–4052.

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. doi:10.1371/journal.pone.0083558

Landers, R. N., & Behrend, T. S. (2015). An inconvenient truth: Arbitrary distinctions between organizational, Mechanical Turk, and other convenience samples. *Industrial and Organizational Psychology, 8*, 142–164. doi:10.1017/iop.2015.13

Lenhart, A., Duggan, M., Perrin, A., Stepler, R., Rainie, H., & Parker, K. (2015). *Teens, social media & technology overview 2015*. Washington, DC: Pew Research Center Internet & American Life Project.

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. doi:10.1089/1094931041291303

Margaryan, A., Littlejohn, A., & Vojt, G. (2011). Are digital natives a myth or reality? University students' use of digital technologies. *Computers and Education, 56*, 429–440. doi:10.1016/j.compedu.2010.09.004

Mitzner, T. L., Boron, J. B., Fausset, C. B., Adams, A. E., Charness, N., Czaja, S. J., . . . Sharit, J. (2010). Older adults talk technology: Technology usage and attitudes. *Computers in Human Behavior, 26*, 1710–1721. doi:10.1016/j.chb.2010.06.020

Montag, C., Bey, K., Sha, P., Li, M., Chen, Y. F., Liu, W. Y., . . . Keiper, J. (2015). Is it meaningful to distinguish between generalized and specific Internet addiction? Evidence from a cross-cultural study from Germany, Sweden, Taiwan and China. *Asia-Pacific Psychiatry, 7*, 20–26. doi:10.1111/appy.12122

Mun, S. Y., & Lee, B. S. (2015). Effects of an integrated Internet addiction prevention program on elementary students' self-regulation and Internet addiction. *Journal of Korean Academy of Nursing, 45*, 251–261.

Ni, X., Yan, H., Chen, S., & Liu, Z. (2009). Factors influencing internet addiction in a sample of freshmen university students in China. *Cyberpsychology and Behavior, 12*, 327–330. doi:10.1089/cpb.2008.0321

Pontes, H. M., & Griffiths, M. D. (2014). Internet addiction disorder and Internet gaming disorder are not the same. *Journal of Addiction Research and Therapy, 5*. doi:10.4172/2155-6105.1000e124

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. doi:10.1016/j.chb.2014.12.006

Prensky, M. (2001). Digital natives, digital immigrants part 1. *On the Horizon, 9*, 1–6. doi:10.1108/10748120110424816

Rehbein, F., Kliem, S., Baier, D., Mößle, T., & Petry, N. M. (2015). Prevalence of Internet gaming disorder in German adolescents: Diagnostic contribution of the nine DSM-5 criteria in a state-wide representative sample. *Addiction, 110*, 842–851. doi:10.1111/add.12849

Rodríguez-Hidalgo, C., Tan, E. S., & Verlegh, P. W. (2017). Expressing emotions in blogs: The role of textual paralinguistic cues in online venting and social sharing posts. *Computers in Human Behavior, 73*, 638–649. doi:10.1016/j.chb.2017.04.007

Roffo, G., Giorgetta, C., Ferrario, R., & Cristani, M. (2014). *Just the way you chat: Linking personality, style and recognizability in chats*. Paper presented at the International

Workshop on Human Behavior Understanding, Switzerland.

Rosen, L. D., Carrier, L. M., & Cheever, N. A. (2013). Facebook and texting made me do it: Media-induced task-switching while studying. *Computers in Human Behavior, 29*, 948–958. doi:10.1016/j.chb.2012.12.001

Salajan, F. D., Schönwetter, D. J., & Cleghorn, B. M. (2010). Student and faculty inter-generational digital divide: Fact or fiction? *Computers and Education, 55*, 1393–1403. doi:10.1016/j.compedu.2010.06.017

Selwyn, N. (2009). The digital native – Myth and reality. *Aslib Proceedings: New Information Perspectives, 61*, 364–379. doi:10.1108/00012530910973776

Sigerson, L., Li, A. Y. L., Cheung, M. W. L., & Cheng, C. (2017). Examining common information technology addictions and their relationships with non-technology-related addictions. *Computers in Human Behavior, 75*, 520–526. doi:10.1016/j.chb.2017.05.041

Sigerson, L., Li, A. Y. L., Cheung, M. W. L., Luk, J. W., & Cheng, C. (2017). Psychometric properties of the Chinese Internet Gaming Disorder Scale. *Addictive Behaviors, 74*, 20–26. doi:10.1016/j.addbeh.2017.05.031

Steinmetz, H., Schmidt, P., Tina-Booh, A., Wieczorek, S., & Schwartz, S. H. (2009). Testing measurement invariance using multigroup CFA: Differences between educational groups in human values measurement. *Quality and Quantity, 43*, 599. doi:10.1007/s11135-007-9143-x

Teo, T. (2013). An initial development and validation of a Digital Natives Assessment Scale (DNAS). *Computers and Education, 67*, 51–57. doi:10.1016/j.compedu.2013.02.012

Turel, O., Mouttapa, M., & Donato, E. (2015). Preventing problematic Internet use through video-based interventions: A theoretical model and empirical test. *Behaviour and Information Technology, 34*, 349–362. doi:10.1080/0144929X.2014.936041

Volkow, N. D., Baler, R. D., & Goldstein, R. Z. (2011). Addiction: Pulling at the neural threads of social behaviors. *Neuron, 69*, 599–602. doi:10.1016/j.neuron.2011.01.027

Wang, L., Luo, J., Bai, Y., Kong, J., Luo, J., Gao, W., & Sun, X. (2013). Internet addiction of adolescents in China: Prevalence, predictors, and association with well-being. *Addiction Research and Theory, 21*, 62–69. doi:10.3109/16066359.2012.690053

Wang, S. K., Hsu, H. Y., Campbell, T., Coster, D. C., & Longhurst, M. (2014). An investigation of middle school science teachers and students use of technology inside and outside of classrooms: Considering whether digital natives are more technology savvy than their teachers. *Educational Technology Research and Development, 62*, 637–662. doi:10.3109/16066359.2012.690053

Young, K. S. (1998). Internet addiction: The emergence of a new clinical disorder. *Cyberpsychology and Behavior, 1*, 237–244. doi:10.1089/cpb.1998.1.237

Young, K. S., & De Abreu, C. N. (2010). *Internet addiction: A handbook and guide to evaluation and treatment*. New York, NY: Wiley.

Zhang, L., Amos, C., & McDowell, W. C. (2008). A comparative study of Internet addiction between the United States and China. *Cyberpsychology and Behavior, 11*, 727–729. doi:10.1089/cpb.2008.0026

Zhitomirsky-Geffet, M., & Blau, M. (2016). Cross-generational analysis of predictive factors of addictive behavior in smartphone usage. *Computers in Human Behavior, 64*, 682–693. doi:10.1016/j.chb.2016.07.061

Table 1

*Demographic information for the sample*

| Demographic Variable | Percentage |
|---|---|
| Age | |
| < 20 | 0.8% |
| 20 – 29 | 35.9% |
| 30 – 39 | 37.1% |
| 40 – 49 | 14.5% |
| 50 – 59 | 8.2% |
| 60 – 69 | 3.3% |
| > 69 | 0.3% |
| 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% |

Table 2

*Zero-order correlation coefficients among study variables*

| Variable | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | -- | | | | | | | | | |
| 2. Digital nativity (total) | -.366* | -- | | | | | | | | |
| 3. Grow up with technology | -.113* | .547* | -- | | | | | | | |
| 4. Comfortable with multitasking | -.387* | .712* | .412* | -- | | | | | | |
| 5. Reliant on graphics for communication | -.222* | .674* | .113* | .161* | -- | | | | | |
| 6. Thrive on instant gratifications and rewards | -.129* | .594* | .208* | .165* | .255* | -- | | | | |
| 7. Internet addiction | -.104 | .211* | .218* | .036 | .148* | .200* | -- | | | |
| 8. Internet gaming disorder | -.186* | .241* | .106 | .090 | .226* | .176* | .477* | -- | | |
| 9. Smartphone addiction | -.180* | .353* | .146* | .151 | .297* | .293* | .428* | .345* | -- | |
| 10. Facebook addiction | .003 | .233* | .114* | .040 | .257* | .189* | .386* | .291* | .525* | -- |

*Note***.** *Correlation coefficients that are significant after applying Bonferroni adjustment, $p < .0011$ (.05/45).

Table 3

*Hierarchical regression analysis comparing the age cohort and the individual difference approaches*

| | Age | Digital nativity | | | | |
|---|---|---|---|---|---|---|
| Criterion model | $\beta$ ($p$) | $\beta$ ($p$) | $R^2$ | Change in $R^2$ | $F$ | $p$ |
| Criterion: Internet addiction | | | | | | |
| Model 1 | -.104 (.001) | - | .011 | - | - | - |
| Model 2 | -.031 (.359) | .200 (<.001) | .045 | .034 | 36.209 | < .001 |
| Criterion: Internet gaming disorder | | | | | | |
| Model 1 | -.186 (<.001) | - | .035 | - | - | - |
| Model 2 | -.112 (.001) | .199 (<.001) | .069 | .034 | 35.334 | < .001 |
| Criterion: Smartphone addiction | | | | | | |
| Model 1 | -.180 (<.001) | - | .032 | - | - | - |
| Model 2 | -.048 (.037) | .331 (<.001) | .127 | .095 | 107.778 | < .001 |
| Criterion: Facebook addiction | | | | | | |
| Model 1 | -.003 (.920) | - | <.001 | - | - | - |
| Model 2 | -.103 (.002) | .271 (<.001) | .054 | .054 | 66.157 | < .001 |

*Note.* Model 1 includes age as the only independent variable for testing the age cohort approach; Model 2 includes both age and digital nativity as independent variables for testing the individual difference approach.

Table 4

*Multiple regression analysis of age and digital nativity factors on four common types of IT addiction*

| | Type of IT addiction | | | |
|---|---|---|---|---|
| Independent variable | Internet addiction | Internet gaming disorder | Smartphone addiction | Facebook addiction |
| Step 1 | | | | |
| Age | -.104*** | -.186*** | -.180*** | -.003 |
| Adjusted $R^2$ | .011 | .035 | .032 | <.001 |
| *F* | 12.302*** | 34.811*** | 37.391*** | 0.053 |
| Step 2 | | | | |
| Age | -.097** | -.140*** | -.090** | .075* |
| Grow up with technology | .209*** | .006 | -.052 | -.060 |
| Comfortable with multitasking | -.108*** | -.013 | .065 | .037 |
| Reliant on graphics for communication | .114** | .165*** | .217*** | .230*** |
| Thrive on instant gratifications and rewards | .147*** | .117*** | .230*** | .160*** |
| Adjusted $R^2$ | .096 | .082 | .156 | .096 |
| $R^2$ Change | .085*** | .047*** | .124*** | .096*** |
| *F* | 20.831*** | 16.901*** | 37.120*** | 20.280*** |

*Note***.** IT = information technology. Standardized regression coefficients are reported for age and each digital nativity factor. *$p < .05$; **$p < .01$; ***$p < .001$.

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**Contributors**
Authors HW and LS conducted literature review and wrote the first draft of the manuscript. Author LS implemented the data collection. Authors HW and LS performed data analysis. Author CC conceptualized the study, coordinated and supervised the project, assisted in data interpretation, as well as provided advice and editorial support for manuscript drafting and revision. All authors contributed to subsequent revisions and have approved the final manuscript.

**Highlights**

- Digital nativity is positively associated with four common types of IT addiction.
- Age is not the most fitting indicator of digital nativity.
- Individual attributes of digital natives improve explanatory power of IT addiction.