Computers in Human Behavior Reports 6 (2022) 100180

Contents lists available at ScienceDirect

Computers in Human Behavior Reports

journal homepage: www.sciencedirect.com/journal/computers-in-human-behavior-reports

Internet addiction, cognitive, and dispositional factors among US adults

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ARTICLE INFO

Keywords:
Internet addiction
Cognition
Aging
Disposition
Lifespan

ABSTRACT

While a growing body of literature has examined internet addiction in the context of psychological factors, most of this work has focused on younger populations outside of the United States. A sample of 898 US adults ranging from 18 to 76 years of age were recruited through Amazon's Mechanical Turk platform to complete the Internet Addiction Test and key measures of affect, disposition, and cognitive function. A series of multiple regressions were conducted to examine Internet Addiction level as a predictor of outcome variables. ANCOVAs with Fisher's LSD post-hoc analyses were conducted using level of internet addiction as the grouping variable to examine differences between groups. Results found that Internet Addiction was a significant predictor of depression, impulsiveness, self-control, need for cognition, theories of cognitive abilities, creativity achievement, cognitive failures, smartphone use behaviors, mental rotation test, and cognitive reflection test. Further, even mild levels of internet addiction were associated with less optimal outcomes. Additionally, a significant relation between age and internet addiction also emerged such that older adults were less likely to have higher levels of internet addiction than younger adults.

However, age did not appear to modulate the association between internet addiction status and key psychological variables. To further elucidate the mechanisms and impact of internet addiction throughout the life course, future studies should collect online and in-person data, from individuals across a variety of backgrounds, throughout the lifespan.

1. Introduction

Young's (1998) internet addiction scale conceptualizes internet addiction as encompassing multiple domains, such as excessive internet use, lack of control over internet use, and preoccupation with the internet (Young, 1998). While extant research on the prevalence of internet use has highlighted pathological use of the internet during adolescence and early adulthood (Kandell, 1998), less is known about adults' problematic internet use behaviors and practices. Further, much of the research being done with Internet addiction has been conducted in countries outside the US, particularly in Asia and Europe. This work has revealed significant insights about the physiological and psychological correlates of problematic internet use but also has raised questions about the generalizability of these results to adults in middle age or late life in other national and cultural contexts.

A recent Pew report suggests that 90% of adults in the United States use the internet and at least 73% of adults in the United States use high-speed home-based broadband internet (Pew Research Center, 2021). The growth in access to high-speed internet and connected mobile services is particularly salient for older adult populations, who may utilize these technologies for social interaction and to assist with instrumental activities of daily living. While many older adults previously reported less usage and access to the internet relative to younger adults and children (Pew, 2021), this demographic has demonstrated rapid growth in internet usage (Yoon, Jang, Kim, Speasmaker, & Nam, 2021). Given the potential for differential clinical implications across age groups, it is worthwhile to explore the prevalence and related affective, dispositional, and cognitive aspects of internet addiction in a lifespan sample within the US.

1.1. Internet addiction and affective characteristics

Much of the research on internet addiction has focused on links to affective health outcomes. Affect-linked outcomes examined in previous research include depression and anxiety, both of which have also been associated with socio-emotional function. As previously mentioned,

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https://doi.org/10.1016/j.chbr.2022.100180
Received 28 July 2021; Received in revised form 22 February 2022; Accepted 23 February 2022
Available online 26 February 2022

most of the extant research examining associations between affect and internet addiction or problematic smartphone use has centered on adolescents and young adults. For example, in a cross-sectional study of Lebanese adolescents, higher levels of internet addiction were associated with higher levels of depression, impulsivity, and more social fear (Obeid et al., 2019). A comparable study conducted in Italy found that young adults with moderate levels of internet addiction were more likely to report higher attentional impulsivity and more depressive symptoms (Marzilli, Cerniglia, Ballarotto, & Cimino, 2020). One study involving medical students in Mexico, most of whom were young adults (average age = 21.5 years), found that internet addiction scores were positively correlated with impulsivity, aggression-hostility, severe depression, and social dysfunction (Capetillo-Ventura & Juárez-Treviño, 2015), however, few studies exist that examine these variables within other North American populations. Thus, the current study examines how different levels of internet addiction are associated with self-reported depression.

1.2. Internet addiction and dispositional factors

Substantial research has also examined internet addiction in the context of dispositional factors such as self-control, impulsivity, and motivational orientation. These factors may be related to, but are generally considered distinct from, affective characteristics such as anxiety and depression, and may influence and be influenced by one's usage of smartphones and the internet. Self-control, generally encompassing emotional control, habit breaking, and performance regulation (Tangney, Baumeister, & Boone, 2004), as well as impulsivity, generally typified by cognitive instability, lack of perseverance and lack of cognitive complexity (Patton, Stanford, & Barratt, 1995), have both been closely linked to self-reported problematic internet usage.

For example, researchers have considered the links between self-control and internet addiction within adolescents in some detail. Among Chinese adolescents, higher rates of internet addiction were associated with lower capacity for self-control (Li, Dang, Zhang, Zhang, & Guo, 2014), while work with South Korean college students found that higher self-reported self-control was related to lower levels of internet addiction (Kim, Hong, Lee, & Hyun, 2017). Further work with young adult internet gamers in Korea also found an inverse relation between self-control and online gaming addiction, wherein more self-control corresponded with lower levels of video game addiction (Kim et al., 2007). Researchers have also noted a relative paucity of literature examining relations between internet addiction and impulsivity. However, one study (Cau, Su, Liu, & Gau, 2007) found that Chinese adolescents who met the criteria for internet addiction (Beard & Wolf, 2001) scored higher than those who did not on the 30-item Barratt Impulsiveness Scale. Contemporary work has also found that internet addiction was associated with increased levels of trait impulsivity measured by the Barratt Impulsiveness Scale 11 (Lee et al., 2012), and more recent studies have found that internet addiction and low attention and motor impulsivity were predictors of risky cyber security behaviors, such as password-sharing and improperly storing personal information (Hadlington, 2017).

Motivation-related variables such as need for cognition and mindset orientation have also been examined in the context of problematic internet usage. Need for cognition has regularly been utilized as a predictor of quality and quantity of internet use; one experimental study involving young adults in Israel found that individuals with lower need for cognition preferred more interactive sites with embedded hyperlinks versus flat sites with continuous streams of information (Amichai-Hamburger, Kaynar, & Fine, 2007). Furthermore, another study drawing on a random selection of adult internet users in China found an inverse relation between need for cognition and problematic internet use (Shi, Chen, & Tian, 2011). While there is limited work directly examining mindset or theories of intelligence (Dweck, 1999) and internet use, the framework of growth versus fixed mindsets has been applied to social media use. For example, Song, Lee, and Kim (2018) considered how growth and fixed mindsets might differentially relate to Instagram use and found that individuals with a growth mindset were more likely to use Instagram for more varied activities and report multiple motives for Instagram use.

Finally, while problematic internet use is often associated with less adaptive dispositional and thinking outcomes, at least one line of work suggests that greater internet use might actually be *positively associated* with creativity and creative achievement. For example, social media use is associated with novel code communication and creative language use (Jimaima & Simungala, 2019). Further, the integration of technology and web-based teaching in the classroom requires creative thinking on the part of teachers, and these modes of teaching have been associated with positive learning outcomes and students' creativity in Taiwan (Lin & Wu, 2016). The affective and dispositional correlates of internet addiction may be somewhat nuanced, rather than a single manifold associated with maladaptive behaviors. The current study explores how different levels of internet addiction are related to dispositional variables, including self-control, impulsivity, cognitive mindset, and creativity.

1.3. Internet addiction and cognition

While there is a growing body of evidence supporting the deleterious effects of internet addiction on mental health and disposition, there is little research on the cognitive correlates of problematic internet use. This is somewhat surprising, given that work in related sub-fields has found that behaviors such as excessive smartphone and social media usage have themselves been linked with reduced performance on cognitive measures, including executive functions such as working memory, inhibitory control, and attention. Thus, there are ongoing concerns about how increased internet usage may affect adolescent cognitive development (Johnson, 2006; , 2015Mills). Some recent work has identified insults to performance on executive function tasks, such as attention shifting and inhibitory function, in the presence of internet addiction (Zhou, Yuan, & Yao, 2012). Impaired cognitive control and cognitive inflexibility have been found in individuals with internet addiction (Brand et al., 2014, 2016; Cudo & Zabielsk-Mendyk, 2019). Recent work has also found that increased cognitive flexibility may predict lower levels of internet addiction among Chinese adolescents (Yu, Sun, & Gao, 2019). Initial work also suggests there may be impairments to working memory with increased internet addiction (Zhou, Zhou, & Zhu, 2016), such as on a digit span test.

While intervention work is more limited, one recent study found that brief abstinence from social media was related to feelings of autonomy over social media use, but only for US university students who were high, but not low, in cognitive reflection (Turel, 2020). We note, however, that the cognitive reflection test may be linked to both basic cognition as well as dispositional factors. Additionally, few studies have explored the links between cognition and internet addiction in the context of neural correlates: in one fMRI study, internet addicted individuals displayed higher activation in the superior temporal gyrus during a color-word Stroop task involving switching relative to non-addicted individuals (Dong, Lin, Zhou, & Lu, 2014).

Finally, work examining internet use and self-reported cognitive failures found that both pathological internet use and problematic mobile phone use were associated with more cognitive failures, such that individuals with higher rates of both internet use and mobile phone use reported more cognitive failures (Hadlington, 2015). Later work (Hong, Liu, Ding, Sheng, & Shen, 2020) also found that mobile phone addiction was associated with more reported cognitive failures. Given that individual studies have generally examined internet addiction in the context of only one or two cognitive variables, the present research examines multiple cognitive factors associated with different levels of internet addiction in a single sample.

1.4. Internet addiction and links to other problematic behaviors

Given links between affect, disposition, and cognition and internet use, it is unsurprising that internet addiction-adjacent research, such as problematic smartphone use and video gaming addiction, has also focused on problematic behaviors associated with these activities. For example, in one study of Korean adults, issues with self-control, anxiety, depression, and impulsiveness (Rho et al., 2019) were associated with problematic phone usage. Reviews in this space largely reinforce the potential negative affective influence of problematic smartphone use, although, again, most of this work was conducted with children or younger adults. A systematic review of 14 studies across six countries found that problematic smartphone use was a risk factor for poor sleep quality, as well as anxiety and depression; however, only two of these studies included participants over the age of 27 (Yang, Fu, Liao, & Li, 2020).

Targeted studies of internet gaming addiction, which has been linked to internet addiction more generally, have found similar associations with poor mental health and other affective characteristics. Liu et al. (2018) found a positive association between internet gaming addiction and depression among Chinese college students. A few of these studies have examined usage in the context of age or other demographic characteristics. An examination of adults' (over the age of 18) microtransactions within the online game "Fortnite" found that adults who spent more money within the game were older, had different payment methods, and had close friends who also played the game (King, Russell, Delfabbro, & Polisena, 2020). Adults who had close friends who played and spent money in "Fortnite" were more likely to spend money themselves, and adults who spent more money within the game spent more time playing and were more likely to be impulsive. The study also found nuanced associations between play time and self-worth: players who spent more time playing felt as though the choice to engage in less play time would have negative repercussions on their self-worth. Thus, there may be important implications for affective and dispositional factors, as well as specific behaviors, associated with problematic online game play. Recent work (Griffiths & Pontes, 2014) has sought to clarify important differences between general internet addiction and specific internet gaming addiction, as the two have been found to be, in some circumstances, unrelated (Montag et al., 2015). Thus, it is still important to consider how mobile phone game engagement may be related to important affective, dispositional, and cognitive outcomes, as well as internet addiction specifically.

1.5. Internet usage and age

Finally, while some work has examined internet usage among older adults, much of it has focused on access, experience, and training to use the technology. For example, opportunities for engagement (Mitzner et al., 2019), knowledge of use (Hunsaker & Hargittai, 2018) and socioeconomic status (Hargittai, Piper, & Morris, 2019) may be antecedents of older adults' technology adoption and use. Much of this work has focused on potential benefits of social media as an extension of older adults' social support networks (Sum, Mathews, Pourghasem, & Hughes, 2008; Heo, Chun, Lee, Lee, & Kim, 2015), and positive associations between internet use and cognitive functioning were found among adults in Europe (Kamin & Lang, 2020). Research from another sample of European older adults found a small gender effect, such that older men who may benefit from increased cognitive reserve related to frequent internet use (Ihle, Bavelier, Maurer, Oris, & Kliegel, 2020).

1.6. Current study

In aggregate, the extant work discussed here makes clear that there is an increasingly substantial body of literature focusing on affective, dispositional, and cognitive correlates of internet addiction. However, there is still a relative paucity of literature examining internet addiction throughout adulthood, specifically in older adulthood, and significant questions remain about how internet addiction may be linked to other problematic technology behaviors more generally. The present study focused on examining multiple affective, dispositional, and cognitive factors, as well as technology behaviors, in the context of internet addiction, drawing on an online sample from throughout adulthood, so that these factors could be examined in concert across the life course.

2. Methods

2.1. Participants

Participants were recruited through Amazon's Mechanical Turk (MTurk) in 2018 to participate in an online survey. Participants were compensated at a rate of $7.50 per hour of participation and average time to complete was ~30 min, albeit with some variance across participants, (M = 31.33, SD = 40.28) for an average compensation of approximately $4 per participant. Participants were recruited by age band with a goal of recruiting 150 participants in each age band. There were 918 participants who completed the survey through MTurk; however, 20 participants were removed for failing attention checks. Thus, the final sample included 898 participants (56.7% female). Participants ranged in age from 18 to 76 years (M = 39.81, SD = 13.72). Of the final sample, 88 participants were between 18 and 24 years of age, 168 were between 25 and 29 years, 153 were between 30 and 34 years, 177 were between 35 and 44, 139 were between 45 and 54 years, and 173 were 55 years or older. Participants were fairly well educated; 38.6% had some college or an associate's degree and 51% had at least a bachelor's degree. Of all participants, 44.3% had an annual income between $35,000 and $74,999.

2.2. Procedure

Amazon's MTurk portal is a widely used online crowdsourcing platform often used for recruiting participants for academic research, including older adults (Ogletree & Katz, 2020). A built-in feature of the Human Intelligence Task (HIT) studies allows recruitment of participants from specific age groups. For this study, participants were recruited from the following age bands, with expected recruitment of approximately 150 participants per age band: 18–24, 25–29, 30–34, 35–44, 45–54, and 55 and older. Participants were able to read a brief summary of the study and reward amount before agreeing to participate. Participants who agreed to participate reviewed an informed consent statement before continuing to complete survey items and computer tasks. Throughout the online survey, attention checks were included, such as instructing the participant to select a specific response for a question, as a way to identify participants who were not paying attention or following instructions or to remove automated "bots" programmed to complete tasks for participant rewards. This study was reviewed and approved by the Institutional Review Board at the affiliated university. For this study, attention checks were embedded within the Barratt Impulsivity Scale and the Internet Addiction Test.

2.3. Measures

2.3.1. Internet addiction

The Internet Addiction Test (IAT; Young, 1998) consists of twenty items scored on a 6-point Likert Scale (0 = does not apply, 5 = always) to assess attitudes and behaviors about online activity (e.g., "How often do you feel preoccupied with the Internet when offline, or fantasize about being online?"). Cronbach's α was 0.94. Frangos and colleagues (2012) computed a Cronbach's alpha score across 11 studies of 0.889. Scores were summed across all 21 items; composite scores ranged from 0 to 95 (M = 27.92, SD = 14.77). Following guidelines by Young (2018), groups were designated as non-addicted users (IAT score 0–30), mild level of addiction (31–49), moderate level of addiction (50–70), and severe

dependence upon the internet (80–100). The number of users within each category is discussed in the first paragraph of *Results*, below.

2.3.2. Affective variables

Depression. The Center for Epidemiologic Studies Depression Scale (CESD; Radloff, 1977) contains ten items rated on a 4-point Likert scale (1 = Rarely or none of the time (Less than 1 day), 4 = All of the time (5–7 days) to report on incidence of depressive symptoms within the past week (e.g., "I had trouble keeping my mind on what I was doing."). Cronbach's α was 0.89. Cosco, Prina, Stubbs, and Wu (2017) observed a Cronbach's alpha score of 0.90. Scores were summed such that higher scores indicate more depressive symptoms. Scores ranged from 0 to 30 ($M = 7.24$, $SD = 6.28$).

2.3.3. Dispositional variables

Impulsiveness. The Barratt Impulsivity Scale (BIS; Patton, Stanford, Barratt, 1995) contains fifteen items rated on a 4-point Likert scale (1 = Rarely/Never, 4 = Always/Almost Always) to assess the behavioral construct of impulsiveness (e.g., "I do things without thinking."). Cronbach's alpha was low (α = 0.45) compared to prior studies with higher Cronbach's alpha (α = 0.80; Reise et al., 2014). Scores were summed such that higher scores reflect greater impulsiveness. Scores ranged from 21 to 49 ($M = 32.97$, $SD = 4.14$).

Self control. The Self Control Scale (SCS; Tangney et al., 2004) contains 10 items rated on a 5-point Likert scale (1 = Not at all like me, 5 = Very much like me) to assess individual self control capacity (e.g., "I refuse things that are bad for me, even if they are fun"). Cronbach's α was 0.87. Tangney et al. (2004) found Cronbach's alphas ranging from 83 to 0.89. Scores were averaged across items, such that higher scores indicate less. self control. Scores ranged from 1 to 5 ($M = 3.67$, $SD = 0.76$).

Need for cognition. Need for Cognition (NFC; Cacioppo, Petty, & Kao, 1984) was assessed with eighteen items scored on a 9-point Likert scale (1 = very strong agreement, 9 = very strong disagreement) to assess an individual's preference for cognitively challenging activities (e.g., "I like to have the responsibility of handling a situation that requires a lot of thinking."). Cronbach's α was 0.96. Cacioppo et al. (1984) found Cronbach's alpha of .90. Scores were summed and higher scores indicate greater need for cognition. Scores ranged from −72 to 72 ($M = 15.70$, $SD = 31.05$).

Theories of Cognitive Ability. Theories of Cognitive Ability (TOCA; adapted from Dweck, 1999) is a measure that includes eight items scored on a 6-point Likert scale (1 = disagree a lot, 6 = agree a lot) to assess ideas about intelligence as a fixed or flexible trait (e.g., "No matter how much intelligence you have, you can always change it a good deal."). Cronbach's α was 0.72. Cook, Castillo, Gas, and Artino (2017) found internal reliability scores of $\alpha \geq 0.77$. Scores were summed such that higher scores indicate more cognitive flexibility. Scores ranged from −24 to 24 ($M = 2.92$; $SD = 7.90$).

Creativity achievement score. The Creativity Achievement Score (CA; Carson, Peterson, & Higgens, 2005) includes nine items assessing engagement in creative activities scored on an 8-point Likert scale (1 = no training or recognized talent, 8 = my work has been critiqued in national publications) in nine different areas (e.g., visual arts, music, dance, etc.). Cronbach's α was 0.79. Total scores were summed, with higher scores indicating greater engagement in creative activities. Scores ranged from 0 to 44 ($M = 4.36$, $SD = 6.22$).

2.3.4. Cognitive variables

Cognitive failures. Cognitive failures were measured by twenty-five items (CFQ; Broadbent, Cooper, FitzGerald, & Parkes, 1982) rated on a 5-point Likert scale (1 = very often, 5 = never) to assess frequency of mistakes related to cognitive failures, such as forgetfulness, distractibility, and interrupted processes, in the past six months (e.g., "Do you find you forget why you went from one part of the house to the other?"). Cronbach's α was 0.93. Wallace, Kass, and Stanny (2002) found a Cronbach's alpha score of 0.92. Scores were summed across all 25 items with higher scores reflecting greater incidence of cognitive failures. Composite scores ranged from 0 to 100 ($M = 34$, $SD = 15.22$).

Mental rotation test. The Mental Rotation Test (MRT; Peters et al., 1995 based on; Vandenberg & Kuse, 1978) consists of twenty-four items that asked participants to imagine what a stimulus would look like if rotated in 3D space. Correct scores were coded as 1. Cronbach's α was 0.89. Scores were summed, such that higher scores indicate more accuracy in mental rotation. Scores ranged from 0 to 24 ($M = 8.74$, $SD = 5.93$).

Cognitive reflection test. The Cognitive Reflection Test (CRT; Frederick, 2005) includes three questions used to assess an individual's ability to suppress an immediate response in favor of a slower, correct response. For this study, we categorized the CRT as a cognitive variable; however, we recognize that there are overlaps between cognitive thinking as well as dispositional orientations (Toplak, West, & Stanovich, 2011). The CRT asks the participant to overcome an impulsive response in favor of a more reflective answer (e.g., "A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?"). Correct responses were assigned a score of 1 and incorrect responses were assigned a score of 0. Cronbach's α was 0.79. Bialek and Pennycook (2018) found internal consistency scores ranging from 0.53 to 0.72 across participants familiar and unfamiliar with the measure. Composite scores were summed across all three questions and ranged from 0 to 3 ($M = 1.74$, $SD = 1.23$).

2.3.5. Smartphone use measures

Phone behaviors. Participants self-reported yes/no scores for the playing games on their smartphones or tablet in the following contexts: while driving, while in traffic, during class/work, during meals, in the restroom, and before bed. Composite scores were creating total scores across all 7 behaviors. Higher scores indicate more engagement with these behaviors. Scores ranged from 0 to 7 ($M = 1.60$, $SD = 1.30$).

In game cash spending. Participants self-reported the total amount they spent on in-game paid features or accessories within the past year. Higher scores indicate more yearly cash payment for games. Scores ranged from 0 to 2000 dollars per year ($M = 29.08$, $SD = 132.60$). There were 10 outliers, as defined as datapoints existing more than 3 standard deviations above the mean, in the In Game Cash Spending variable and a variable eliminating these outliers was created. For In Game Cash Spending without outliers, scores ranged from 0 to 400 dollars per year ($M = 17.06$, $SD = 48.79$).

3. Results

3.1. Analysis

Following the Internet Addiction Test Manual (2018), IAT scores were grouped by level of addiction. Users with scores of 0–30 were assigned to the non-addicted users group, users with scores of 31–49 were assigned to the mild addiction group, users with scores of 50–79 were assigned to the moderate addiction group, and users with scores of 80–100 were assigned to the severe addiction group. However, due to

low frequency of severe dependence users ($N = 5$) that would prohibit meaningful analysis and interpretation, users in the moderate and severe addiction groups were combined, for a total of 3 groups. In total, there were 569 non-addicted users, 258 with a mild addiction and 70 with a moderate-to-severe addiction (referred to as moderate addiction). For descriptive statistics by level of internet addiction, see Table 1. Descriptive statistics by participant age band are included in Table 2.

A correlation matrix among variables of interest can be found in Table 3. Multiple regression analyses were conducted in IBM SPSS 26 with Internet Addiction, scored into by group- Normal user (1), Mild Addiction (2), and Moderate Addiction (3), as a predictor variable. Demographic variables (age, sex, education, and income) were also included as covariates. Standardized βs are reported. ANCOVAs were conducted with Fisher's LSD post-hoc analyses to examine differences between groups of internet addiction. Estimated marginal means and standard errors, controlling for demographic variables, are reported. We note that group sizes were unequal, and for all variables except cognitive failures, there were unequal group variances among internet addiction categories. A table showing means and standard deviations of study variables across levels of internet addiction can be found in Table 4; however, many variables have non-normal distribution. For visualization of data spread by level of internet addiction, see Fig. 1.

3.2. Affective variables

Internet Addiction was a significant predictor of Depression scores, adjusted $R^2 = 0.25$, $F(5, 891) = 59.311$, $p < .001$, $\beta = 0.43$, $p < .001$. Income, $\beta = -0.18$, $p < .001$, was a significant predictor, and age, $\beta = -0.05$, $p = .09$, was marginally significant as a predictor. There was a positive relation between Internet Addiction and Depression. Individuals with moderate addiction ($EM = 14.09$, $SE = 0.67$) had higher depression scores than those with mild addiction ($EM = 9.46$, $SE = 0.34$, $p < .001$) and higher scores than non-addicted users ($EM = 5.39$, $SE = 0.23$, $p < .001$). Individuals with a mild addiction also had higher depression scores than non-addicted users ($p < .001$).

3.3. Dispositional variables

Internet Addiction was a significant predictor of Impulsiveness scores, adjusted $R^2 = 0.08$, $F(5, 891) = 15.91$, $p < .001$, $\beta = 0.21$, $p < .001$. Age, $\beta = -0.10$, $p < .01$, and income, $\beta = 0.15$, $p < .001$, were also significant predictors. There was a positive relation between Internet Addiction and Impulsiveness. Individuals with a moderate addiction ($EM = 35.79$, $SE = 0.49$) had higher impulsiveness scores than those with mild addiction ($EM = 33.41$, $SE = 0.25$, $p < .001$) and higher scores than non-addicted users ($EM = 32.43$, $SE = 0.17$, $p < .001$) Individuals with mild addiction also had higher impulsiveness scores than non-addicted users ($p = .001$).

Internet Addiction was a significant predictor of Self-Control scores, adjusted $R^2 = 0.23$, $F(5, 891) = 54.49$, $p < .001$, $\beta = -0.42$, $p < .001$. Age, $\beta = 0.12$, $p < .001$, and income, $\beta = 0.06$, $p < .05$, were significant predictors. Education, $\beta = 0.05$, $p = .09$, was marginally significant as a predictor. There was a negative relation between internet addiction and self-control. Adults with moderate addiction ($EM = 2.92$, $SE = 0.08$) had lower self-control scores than those with mild addictions ($EM = 3.37$, $SE = 0.04$, $p < .001$) and lower scores than non-addicted users ($EM = 3.89$, $SE = 0.03$, $p < .001$). Individuals with mild addiction also had lower self-control scores than non-addicted users ($p < .001$).

Internet Addiction was a significant predictor of Cognitive Failure scores, adjusted $R^2 = 0.23$, $F(5, 892) = 53.46$, $p < .001$, $\beta = 0.44$, $p < .001$. Sex, $\beta = 0.13$, $p < .001$, and income, $\beta = -0.08$, $p < .05$, were also significant predictors. There was a positive relation between Internet Addiction and Cognitive Failures. Adults with moderate addiction ($EM = 48.92$, $SE = 1.63$) had higher cognitive failure scores than those with mild addiction ($EM = 40.74$, $SE = 0.84$, $p < .001$) and higher scores than non-addicted users ($EM = 29.12$, $SE = 0.57$, $p < .001$). Users with mild addiction also had higher cognitive failure scores than non-addicted users ($p < .001$).

Internet Addiction was a significant predictor of Need for Cognition scores, adjusted $R^2 = 0.06$, $F(5, 892) = 12.79$, $p < .001$, $\beta = -0.17$, $p < .001$. Sex, $\beta = -0.08$, $p < .05$, and education, $\beta = -0.15$, $p < .001$, were also significant predictors. There was a negative relation between Internet Addiction and Need for Cognition. Users with moderate addiction ($EM = 7.07$, $SE = 3.67$) had lower need for cognition scores than non-addicted users ($EM = 20.03$, $SE = 1.27$, $p \leq .001$). Adults with mild addiction ($EM = 8.46$, $SE = 1.89$) also had lower need for cognition scores than non-addicted users ($p < .001$). However, individuals with moderate addiction did not have significantly different need for cognition scores than those with mild addiction ($p = .73$).

Internet Addiction was a significant predictor of Theory of Cognitive Ability scores, adjusted $R^2 = 0.04$, $F(5, 892) = 9.23$, $p < .001$, $\beta = -0.17$, $p < .001$. Age, $\beta = -0.11$, $p < .01$, and sex, $\beta = -0.09$, $p < .01$, were also

Table 1
Descriptive Information for Demographic Variables.

	Non-Addicted Users		Mild Level of Addiction		Moderate Level of Addiction		All	
Age	*n*	%	*n*	%	*n*	%	*n*	%
18-24	34	6	34	13.2	20	28.6	88	9.8
25-29	83	14.6	67	26.0	18	25.7	168	18.7
30-34	96	16.8	41	15.9	16	22.9	153	17.0
35-44	128	22.5	42	16.3	7	10	177	19.7
45-54	94	16.5	38	14.7	7	10	139	15.5
55 or older	135	23.7	36	14.0	2	2.9	173	19.3
Sex								
Male	247	43.3	114	44.2	28	40.0	389	43.3
Female	323	56.7	144	55.8	42	60.0	509	56.7
Education								
Some high school	3	0.5	0	0.0	0	0.0	3	.3
High school	58	10.2	22	8.5	10	14.1	90	10
Some college	136	23.9	70	27.1	23	32.9	229	25.5
Associates degree	69	12.1	40	15.5	9	12.9	118	13.1
Bachelor's degree	233	40.9	94	36.4	25	35.7	352	39.2
Graduate Degree	71	12.5	32	12.4	3	4.3	106	11.8
Income								
Less than $25,000	109	19.1	54	20.9	20	28.6	183	20.4
$25,000–34,999	75	13.2	45	17.4	6	8.6	126	14.0
$35,000–49,999	103	18.1	58	22.5	20	28.6	181	20.2
$50,000–74,999	144	25.3	55	21.3	17	24.3	216	24.1
$75,000–99,999	62	10.9	25	9.7	3	4.3	90	10
$100,000 or more	77	13.5	21	8.1	4	5.7	102	11.4

Table 2
Descriptive Information for Study Variables by Age Bands.

	18–24		25–29		30–34		35–44		45–54		55+	
	n	%	*n*	%	*n*	%	*n*	%	*n*	%	*N*	%
	88	9.8	168	18.7	153	17.0	177	19.7	139	15.5	173	19.3
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
IAT	36.55	17.90	31.89	15.66	28.46	16.41	25.46	12.80	26.65	12.78	22.75	10.66
CESD	10.00[1]	3.38	8.38	6.66	7.48	6.61	5.85	5.68	7.29	6.30	5.92	5.46
BIS	34.38	4.39	33.54[2]	4.40	32.79	4.15	33.12	3.86	32.35	3.89	32.28	4.02
SCS	3.43	.76	3.51	.80	3.62	.79	3.66	.76	3.66	.71	3.99[7]	.63
NFC	11.56	28.86	16.47	29.14	18.39	32.65	16.41	31.90	14.47	30.51	14.92	32.16
TOCA	2.77	7.36	3.32	7.94	4.16	8.22	2.95	7.79	2.28	7.97	2.01	7.62
CA	7.52	8.78	6.17	7.34	5.24	6.56	4.93	4.40	4.52	4.81	4.71	5.48
CFQ	39.31	17.74	36.27	15.12	31.80	16.44	33.37	15.67	34.18	13.73	31.53	12.42
MRT	7.51	6.18	8.99	6.47	9.37	5.89	9.76	6.16	9.57	6.17	6.86	4.12
CRT	1.55	1.28	1.58	1.23	1.95	1.18	1.95	1.20	1.78	1.23	1.56	1.24
Phone beh.[a]	2.22	1.47	1.91	1.50	1.82	1.23	1.59	1.13	1.41	1.17	.98	.99
In Game $[b]	26.25[1]	60.36	14.56[3]	38.22	25.59[4]	62.87	19.32[5]	50.92	14.11[6]	47.59	7.48	31.53

Note.
[a] Phone use behaviors.
[b] In-Game Cash Spending.
[1] $n = 87$.
[2] $n = 167$.
[3] $n = 165$.
[4] $n = 150$.
[5] $n = 175$.
[6] $n = 138$.
[7] $n = 172$.

Table 3
Correlation among Variables of Interest.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
1. Age	–															
2. Sex	.12**	–														
3. Education	.04	-.02	–													
4. Income	.05	-.02	.32**	–												
5. Int. Addiction[a]	-.26**	.02	-.05	-.08*	–											
6. Depression	-.17**	.03	-.08*	-.23**	.52**	–										
7. Impulsiveness	-.14**	.01	.04	.13**	.22**	.11**	–									
8. Self Control	.23**	.02	.10**	.13**	-.52**	-.56**	-.19**	–								
9. NFC	-.01	-.09**	.17**	.10**	-.18**	-.24**	-.06·	.29**	–							
10. TOCA	-.07*	-.10**	.06·	.08*	-.17**	-.28**	-.02	.32**	.73**	–						
11. CA	-.11**	-.08*	.10**	-.01	.24**	.21**	.09**	-.11**	.11**	.07*	–					
12. CFQ	-.12**	.14**	-.05	-.13**	.51**	.54**	.19**	-.56**	-.26**	-.25**	.22**	–				
13. MRT	-.09**	-.18**	.13**	.03	-.12*	-.03	-.11**	.03	.17**	.13**	-.04	-.08*	–			
14. CRT	-.03	-.18**	.15**	.02	-.14**	-.08*	-.09**	.04	.13**	.04	-.01	-.13**	.35**	–		
15. Phone Beh.[b]	-.30**	.01	-.01	.02	.24**	-.6·	.08*	-.20**	.04	.03	.06·	.12**	.06·	-.04	–	
16. In Game $[c]	−0.10**	-.08*	-.03	.00	.12**	-.07**	.04	-.08*	.01	.01	.06·	.00	-.02	.03	.22**	–

Note. $^{**}p < .01$, $^{*}p < .05$, $^{\cdot}p < .10$.
[a] Internet addiction.
[b] Phone use behaviors.
[c] In-Game Cash Spending.

significant predictors. There was a negative association between Internet Addiction and Theory of Cognitive Ability. Users with moderate addiction ($EM = 1.10$, $SE = 0.94$) had lower theory of cognitive ability scores than non-addicted users ($EM = 4.03$, $SE = 0.33$, $p < .01$) and users with mild addiction ($EM = 0.96$, $SE = 0.48$) had lower scores than non-addicted users ($p \leq .001$) but those with moderate and mild addictions were not significantly different than each other ($p = .89$).

Internet Addiction was a significant predictor of Creative Achievement scores, adjusted $R^2 = 0.07$, $F(5, 892) = 15.44$, $p < .001$, $\beta = 0.22$, $p < .001$. Sex, $\beta = -0.08$, $p < .05$, and education, $\beta = 0.12$, $p < .001$, were also significant predictors. There was a positive association between Internet Addiction and Creative Achievement. Adults with moderate addiction ($EM = 10.26$, $SE = 0.73$) had higher scores than those with mild addiction ($EM = 5.91$, $SE = 0.37$, $p < .001$) and non-addicted users ($EM = 4.52$, $SE = 0.25$, $p < .001$). Users with mild addiction also had higher creativity achievement scores than non-addicted users ($p < .01$).

3.4. Cognitive variables

Internet Addiction was a significant predictor of Mental Rotation Test scores, adjusted $R^2 = 0.07$, $F(5, 892) = 15.37$, $p < .001$, $\beta = -0.17$, $p < .001$. Age, $\beta = -0.12$, $p < .001$, sex, $\beta = -0.16$, $p < .001$, and education, $\beta = 0.13$, $p < .001$, were also significant predictors. There was a negative relation between Internet Addiction and Mental Rotation. Individuals with moderate addiction ($EM = 6.20$, $SE = 0.70$) had lower mental rotation test scores than those with mild addiction ($EM = 7.89$, $SE = 0.36$, $p < .001$) and lower scores than non-addicted users ($EM = 9.44$, $SE = 0.24$, $p < .001$). Users with mild addiction also had lower scores than non-addicted users ($p < .05$).

Internet Addiction was a significant predictor of Cognitive Reflection

Table 4
Descriptive Information for Study Variables by Level of Internet Addiction.

	Normal User		Mild Addiction		Moderate Addiction	
	n	%	*N*	%	*n*	%
	570	9.8	258	18.7	60	17.0
	M	SD	M	SD	M	SD
CESD	5.24[1]	5.18	9.66	6.20	14.59	6.29
BIS	32.41	3.82	33.42	4.28	35.90[4]	4.75
SCS	3.91[1]	.68	3.35	.67	2.84	.64
NFC	20.00	30.22	8.73	31.58	6.31	29.38
TOCA	3.93	7.67	1.10	7.92	1.40	7.82
CA	4.48	4.14	6.00	6.82	10.23	12.51
CFQ	28.98	13.17	40.89	13.95	49.49	14.99
MRT	9.33	5.99	8.08	5.72	6.41	5.41
CRT	1.82	1.21	1.67	1.24	1.34	1.25
Phone beh.[a]	1.42	1.17	1.89	47.55	2.06	1.58
In Game $[b]	14.62[2]	46.51	17.64[3]	87.99	35.46[5]	66.19

Note.
[a] Phone use behaviors.
[b] In-Game Cash Spending.
[1] $n = 569$.
[2] $n = 566$.
[3] $n = 255$.
[4] $n = 69$.
[5] $n = 67$.

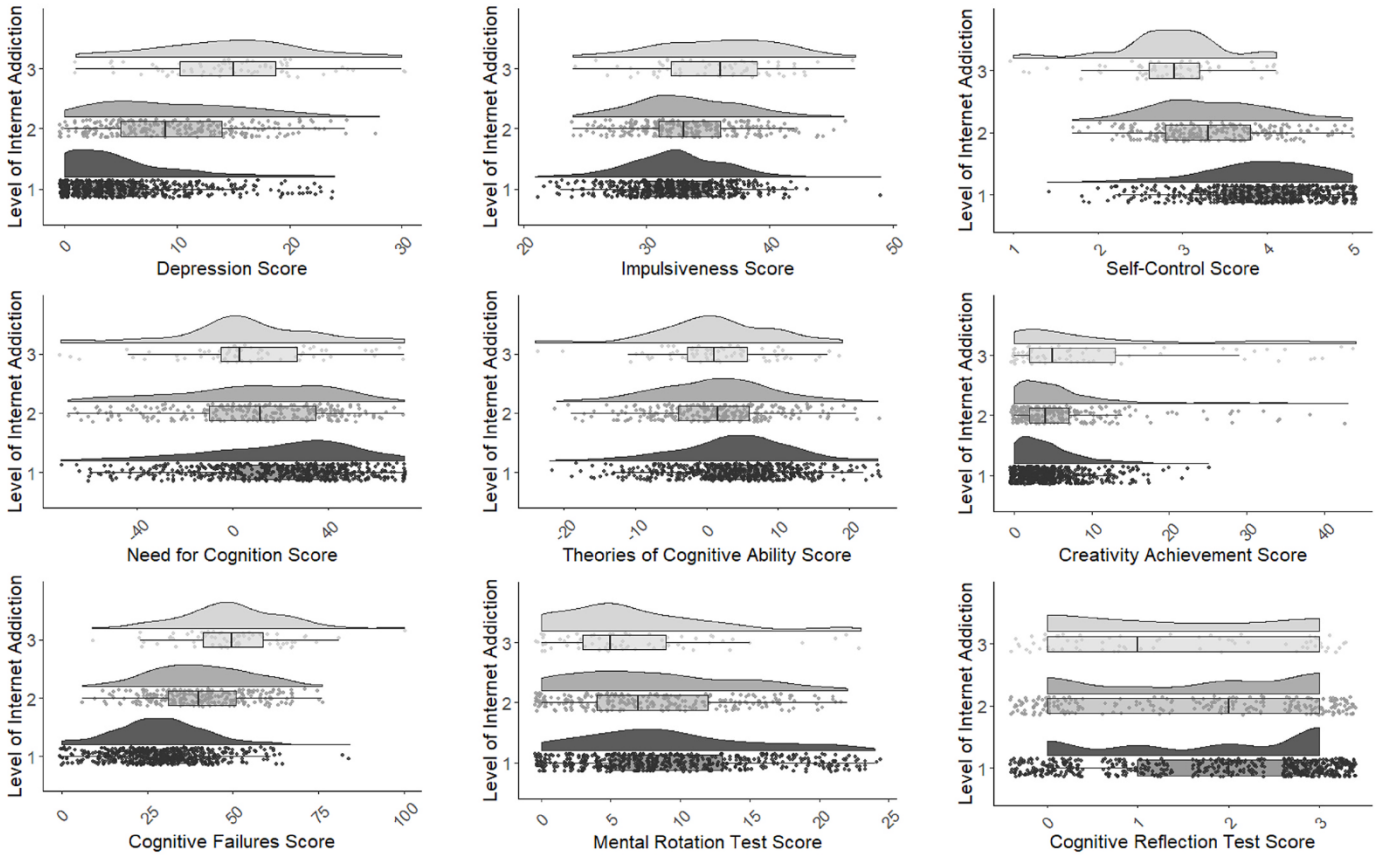
Test scores, adjusted $R^2 = 0.06$, $F(5, 892) = 12.18$, $p < .001$, $\beta = -0.11$, $p = .001$. Sex, $\beta = -0.16$, $p < .001$, and education, $\beta = 0.16$, $p < .001$, were also significant predictors. There was a negative relation between Internet Addiction and Cognitive Reflection. Users with moderate addiction ($EM = 1.36$, $SE = 0.15$) had lower cognitive reflection test scores than non-addicted users ($EM = 1.83$, $SE = 0.05$, $p < .01$). Adults with moderate addiction also had lower scores than those with mild addiction ($EM = 1.65$, $SE = 0.08$); however, there was only marginal significance ($p = .07$). Similarly, users with mild addiction had lower cognitive reflection test scores than non-addicted users, with only marginal significance for that finding ($p = .06$).

3.5. Smartphone behavior variables

Internet Addiction was a significant predictor of Phone Use Behaviors, adjusted $R^2 = 0.10$, $F(5, 892) = 21.17$, $p < .001$, $\beta = 0.12$, $p < .001$. Age, $\beta = -0.27$, $p < .001$ was also a significant predictor. Income, $\beta = 0.06$, $p = .09$, was a marginally significant predictor. There was a positive relation between Internet Addiction and Phone Use Behaviors. Users with moderate addiction ($EM = 1.84$, $SD = 0.15$) had higher phone behavior scores than non-addicted users ($EM = 1.48$, $SD = 0.05$, $p < .05$), and users with mild addiction ($EM = 1.83$, $SD = 0.08$) had higher scores than non-addicted users ($p < .001$), but users with moderate addiction did not have significantly different phone behavior scores than users with mild addiction ($p = .97$).

Internet Addiction was a marginally significant predictor of In Game Cash Spending, adjusted $R^2 = 0.03$, $F(5, 892) = 5.97$, $p < .001$, $\beta = 0.06$, $p = .07$. Sex, $\beta = 0.00$, $p < .01$ was also a significant predictor. There was

Raincloud Plot for Affect, Dispositional, and Cognitive Variables by Internet Addiction Group Score



Note. For Level of Internet Addiction, 1 = Non-Addicted User, 2 = Mild Level of Addiction, 3 = Moderate Level of Addiction.

Fig. 1. *Raincloud Plot for Affect, Dispositional, and Cognitive Variables by Internet Addiction Group Score.*

a positive relation between Internet Addiction and In Game Cash Spending. Users with moderate addiction ($EM = 90.42$, $SE = 15.99$) had higher in-game cash spending totals than those with mild addiction ($EM = 23.75$, $SE = 8.23$, $p < .001$) and non-addicted users ($EM = 23.96$, $SE = 5.55$, $p < .001$), but users with mild addiction and non-addicted users were not significantly different than one another ($p = .98$).

For in game cash spending – no outliers, Internet Addiction was a significant predictor, adjusted $R^2 = 0.02$, $F(5, 882) = 3.79$, $p < .01$, $\beta = 0.08$, $p < .05$. Sex, $\beta = -0.08$, $p < .05$ was also a significant predictor. Age, $\beta = -0.07$, $p = .05$ was also a marginally significant predictor. There was a positive relation between Internet Addiction and In Game Cash Spending. Users with moderate addiction ($EM = 33.58$, $SE = 6.03$) had higher in-game cash spending totals than those with mild addiction ($EM = 16.94$, $SE = 3.06$, $p < .05$) and non-addicted users ($EM = 15.16$, $SE = 2.06$, $p < .01$). Users with mild addiction and non-addicted users were not significantly different from one another ($p = .63$). Age, $F(1, 887) = 3.75$, $p = .05$, $\eta_p^2 = 0.00$ and sex, $F(1,887) = 5.30$, $p < .05$, $\eta_p^2 = 0.01$ were significant covariates.

3.6. Internet addiction and age

In our lifespan sample, there was a significant effect of age on internet addiction ($F(2,895) = 30.69$, $p < .001$), such that younger people had higher levels of addiction than older people. Specifically, individuals with moderate levels of addiction ($M = 30.96$, $SD = 9.41$) were on average younger than both individuals with mild levels of addiction ($M = 36.94$, $SD = 12.88$, $p < .01$) and non-addicted users ($M = 42.19$, $SD = 13.86$, $p < .001$). There was no significant effect of sex on internet addiction and there were similar patterns of sex distribution across all three levels of internet addiction, with approximately 55% of each group being female; this may also reflect demographic patterns within the Mechanical Turk user base. We note that, given the lifespan nature of our dataset, we also ran post-hoc analyses to examine age effects. Specifically, we ran regression analyses using internet addiction level as the independent variable with each of our outcomes, including age as a moderator; surprisingly, however, there were no models with both significant findings and adequate model fit (adjusted $R^2 > 0.1$). It may be that there are not interactive effects between age and internet addiction, however, we note this sample had relatively few older adults with moderate internet addiction (see Table 1). This is discussed in further detail within the *Limitations* section of the discussion.

4. Discussion

Much of the previous work in the space has been conducted in younger populations across European and Asian cultures (Duong, Liaw, & Augustin, 2020). Furthermore, studies of internet addiction have typically focused on a more limited set of outcomes or phenomena related to internet addiction such as psychological and epidemiological comorbidities (Duong et al., 2020), rather than considering cognitive and affective variables in a single design. We note again that our work is cross-sectional: we examined internet addiction within a US sample distributed across adulthood. While this work is exploratory in nature, with a goal of establishing profiles of key cognitive, affective, and dispositional variables by internet addiction status, prior work on internet use guided our initial expectations. We found that problematic internet use has been associated with difficulties in cognitive function, affective health, and well-being, including an increased likelihood of depression. However, the dispositional correlates of internet addiction may be more nuanced: for example, we found that individuals who rated higher on the internet addiction questionnaire may also have been more likely to have experienced higher creative achievement in their lives.

Importantly, we found that there were not always direct, linear relations between our variables of interest and increased internet addiction, i.e., we did not necessarily find differences across outcome variables with each threshold of internet addiction. In many cases, we saw differences between individuals not addicted to the internet and those who were moderately and severely addicted; in other cases, we only saw differences among individuals who reached the threshold for severe internet addiction. These findings suggest that the associations between internet addiction and cognitive and dispositional variables are nuanced: further studies should explore the specific mechanisms through which these patterns may develop.

Given the correlations (shown in Table 3), we found there are sometimes links between outcome variables. Thus, we also conducted a set of exploratory analyses, adding correlated measures to each model, to examine whether these effects would remain in the presence of any possible confounds. In most cases, the results were the same, with the exceptions of Need for Cognition, Theory of Cognitive Ability, and Cognitive Reflection, where Internet Addiction did not remain a significant predictor when the model included other correlated variables as predictors. For Need for Cognition, included correlates were Depression, Impulsiveness, Self-Control, Theory of Cognitive Ability, Creativity Achievement, and Cognitive Failures. For Theory of Cognitive Ability, included correlates were Depression, Impulsiveness, Need for Cognition, Creativity Achievement, and Cognitive Failures. For Cognitive Reflection, included correlates were Depression, Impulsiveness, Need for Cognition, Cognitive Failures, and Cash Spending. Theory of Cognitive Ability, Creative Achievement and Cognitive Failures explained much of the variance in Need for Cognition. Similarly, Need for Cognition and Depression explained much of the variance in Theory of Cognitive Ability. Need for Cognition and Impulsiveness explained much of the variance in Cognitive Reflection. These findings are likely related to the fact that many of these outcomes are closely linked. However, we note again that the purpose of these analyses was to examine how internet addiction level predicted a wide variety of different outcomes within a lifespan sample — this particular exploratory finding, however, may provide some impetus to future researchers to include specific variables, such as Need for Cognition, in internet addiction studies.

4.1. Internet addiction and affect

We did find a significant, and somewhat linear, association between internet addiction and depression, with higher levels of internet addiction coinciding with more depressive symptoms. Importantly, moderate addicts had the highest self-reported depression scores. It is unclear to what extent this association may be causal; indeed, the association between internet addiction and depression may be complex and multidirectional in nature – and thus it is an important candidate for future research. Regardless of the nature of this link, however, in some circumstances, clinical approaches that address *both* internet addiction and depression may be useful when they occur simultaneously.

4.1. Internet addiction and dispositional factors

Our findings replicate existing patterns between impulsiveness and internet addiction (Lee et al., 2012; Li et al., 2014). Users with moderate addiction had higher impulsiveness scores than both users with mild and non-addicted users. There were also significant differences in impulsivity between mild and non-addicted users. Similarly, there was a negative relation between self-control and internet addiction, such that users in the moderate addiction category had the lowest self-control scores of all groups, while those in the mild addiction also had lower scores than non-addicted users.

Research that conceptualizes internet addiction as an impulse control condition may help to further contextualize these differences and explore specific mechanisms of problematic use; however, motivational factors may also be at play. Users with moderate addiction had lower Need for Cognition scores than mild or non-addicted users, though here were significant differences in need for cognition scores among all three groups. We also found that there was an association between theories of

cognitive abilities and internet addiction. Non-addicted users had more flexible mindsets with regard to cognition than both users with mild and moderate addiction. This finding suggests that certain dispositional factors are modulated by any internet addictive behaviors, but that there are not necessarily more serious effects for more addicted users.

Furthermore, we found significant differences in creative achievement by internet addiction, but the pattern was somewhat surprising: individuals with moderate addiction actually reported *more* creative achievement than both mild addicts and non-addicted users. This may make sense, however, in light of the fact that creativity has been associated with technology and social media use (Jimaima & Simungala, 2019), though these findings extend the associations between increased internet use and creativity in the context of personal achievement and engagement in creative endeavors. These dispositional and affective findings highlight how differences did not always systematically vary between all levels of internet addiction, but rather that there were often important cut-off points for maladaptive (or, in the case of creativity, adaptive) outcomes.

4.3. Internet addiction and cognition

We observed that internet users with moderate addiction had lower scores on the mental rotation test than both users with mild addiction and non-addicted users. Similar findings appear for cognitive flexibility, in that those with moderate levels of addiction had the lower scores on the cognitive reflection test, but those with mild addiction and non-addicted users did not demonstrate significant differences. The finding related to cognitive flexibility may have implications for intervention and treatment of internet addiction, for example, as cognitive flexibility was found to be an important factor in developing feelings of autonomy over social media use (Turel, 2020). Individuals with moderate addiction in the presence of impaired cognitive flexibility may have more difficulty in controlling their internet, and intervention pathways that target these executive function processes may be worthwhile avenues of exploration.

4.4. Internet addiction and phone behaviors

We found that individuals with moderate levels of addiction also had higher phone behavior scores, indicating more engagement with inappropriate or undesirable phone use, than users with mild addiction and non-addicted users, with significant differences between all three groups. Internet users with moderate levels of addiction also spent significantly more money on smartphone games than other users. Though literature asserts that generalized internet addiction and specific gaming disorders are distinct (Griffiths & Pontes, 2014), these findings do suggest that there may be overlap in internet use and gaming behaviors, at least within certain populations and specific contexts. Furthermore, if internet addiction is conceptualized as an impulse control issue (Lee et al., 2012), it stands to reason that more addicted users might also demonstrate a lack of impulse control or more problematic behaviors with other forms of media use, such as smartphones and video games. While we did not assess perceived interference in daily life or problematic spending specifically, we consider these initial findings to be a starting point to explore further associations between internet addiction and problematic smartphone and gaming behaviors.

4.5. Internet addiction and age

We observed an inverse association between age and internet addiction, such that older adults had a lower prevalence of internet addiction than younger adults. This makes sense given that children and adolescents have likely had exposure to these technologies during key periods of development, rather than adopting them later in life. It also may be that this pattern will shift as individuals with early exposure to these technologies enter middle and late adulthood.

The same middle-aged and older adults who were less likely to have moderate or severe internet addiction in the present sample might demonstrate more frequent internet addiction after an extended period of time spent online during isolation and closures due to the COVID-19 pandemic. Future research should specifically recruit older adult individuals who experience internet addiction, and specifically explore the influence of online work and social interaction related to the COVID-19 pandemic. Finally, virtually nothing is known about potential intersections between internet use and mild cognitive impairment; however, given the growth of internet access among older adults this should also be a topic of focus in future research.

4.6. Limitations

Individuals within this study were recruited from Amazon's Mechanical Turk platform. It is important to note that MTurk participants may be predisposed to problematic internet use behaviors simply because of increased time spent online; furthermore, prior work comparing samples recruited from MTurk and a nationally representative provides caution against overgeneralizing findings from MTurk samples to the larger population (Ogletree & Katz, 2020). However, we also note our MTurk sample did not show an obvious ceiling effect for internet addiction; in fact, there were fewer participants in the severely internet addicted group than either of the other groups. Thus, we were still able to examine links between psychological factors and internet addiction across a varied sample. Our respondents were compensated for their time, which may have impacted engagement with our study; however, we note that the level of compensation was not excessive (approximately $4 per participant). Additionally, previous research from our group has found only limited effects of compensation in MTurk studies (Ogletree & Katz, 2020).

Our work did not assess demographic differences in race or ethnicity and internet usage. More recently, disparities among white, Black and Hispanic households with regard to home-based broadband internet access have emerged (Pew, 2021); some of these differences in access may also be linked to socioeconomic status. It is important to understand how factors such as gentrification, redlining, and other urban planning policies may influence internet access and use, and how these factors may be related to rates of internet addiction.

Our participants also completed the Creativity Achievement Score (Carson, Peterson, & Higgins, 2005). This questionnaire is meant to have a hierarchical rank-order scoring system, wherein a higher score in one area precludes respondents from selecting other experience scores in a given area; however, due to a technical issue with the administration of the questionnaire, participants were able to select multiple options for each area of creativity. While interpretation of this particular finding should be limited, summary scores were calculated from the highest indicated response in each section and are thus at least somewhat proximal to scores from the rank-order scoring system.

We also note again that this work is correlational in nature. We are able to examine relations between internet addiction and dispositional and cognitive factors and phone use behaviors; however, we are unable to determine causal relations between these variables; furthermore, possible cohort effects are not fully examined here. Future work could examine these same links longitudinally, or as part of a large, nationally representative dataset, to see if there are changes how factors are associated over time.

4.7. Conclusion

In aggregate, this work suggests that internet addiction is associated with differences in cognitive, affective, dispositional outcomes among an online sample of adults within the United States. More work will be required to explore the mechanisms underlying these connections and to expand on the clinical implications of internet addiction among middle age and older adults. Experimental and longitudinal work with

individuals across the lifespan and from varied backgrounds will improve our understanding of the mechanisms through which these patterns occur and may help to identify pathways for treatment and intervention. Furthermore, comparisons of online and in-person samples may also be important to fully understand these associations, given potential differences in these populations at different points throughout the life course. This study demonstrates that while the nature of internet addiction and associated psychological and behavioral factors among individuals of different ages is complex, it is a worthy topic of continued research.

Declaration of competing interest

The authors have no conflicts of interest to report.

Acknowledgments

The authors would like to thank Jefferson Salan for his assistance in creating the Raincloud Plots seen in Figure 1. The authors would also like to acknowledge the Virginia Tech Open Access Subvention Fund for supporting the Open Access publication of this article.

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