

EMPIRICAL ARTICLE

Addictive phone use and academic performance in adolescents

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Abstract

Adolescents are among the highest utilizers of Smartphones and social media applications (apps) in the United States. There has been increased concern that youth may become dependent on (“addicted to”) Smartphones, yet limited research has considered excessive use (beyond that of hours of phone use) in adolescents. To address this gap, we measured addictive phone use and its association with academic performance in a sample of 641 adolescents. We found that our measure of addictive phone use (Addictive Patterns of Use scale [APU]) had strong psychometric properties and associated with hours of social media use and media multitasking. Additionally, APU associated with poorer academic performance, over and above hours of school day social media use and social media multitasking during homework. Thus, dependence on Smartphones may be a distinct risk factor for poor academic performance. Longitudinal research should be utilized to confirm our findings and provide evidence for directionality.

KEYWORDS

academic performance, adolescents, smartphone addiction

1 | INTRODUCTION

In the modern world, the benefits of technology are abundant and apparent. However, with increasing use one must also consider the potential negative impact that these technologies, such as mobile devices and screen media, may have on child development and functioning. The convenience and accessibility that mobile devices provide is an immutable incentive for continued and expanding use, and this trend shows no sign of slowing down. This pattern is particularly salient among children and adolescents, who are among the heaviest consumers of digital media (Rideout, 2015). Indeed, 26% of adolescents endorse spending in excess of 8 hr per day using screen media (Rideout, 2015).

Given the prevalence of excessive screen media use, parents have expressed concern that their children may be “addicted” to technology. Indeed, close to half of parents in the United States (47%) feel that their children are “addicted” their mobile devices (Common Sense Media, 2018). Although prior research has begun to investigate the potential impact of excessive Smartphone use in young adults (Elhai, Dvorak, Levine, & Hall, 2017) and specific app dependence (e.g., problematic

social media use; Albaugh & Borzekowski, 2016; Vernon, Barber, & Modecki, 2015) on adolescent well-being, limited research has examined whether adolescents experience addiction to their Smartphones, and if this associates with academic functioning.

Prior research on excessive screen media or Smartphone use typically employs asking individuals about the amount of time they spend on Smartphones or apps as an indicator of excessive use (Domoff, Borgen, Foley, & Maffett, 2019). Considering hours of Smartphone use as a sole indicator of problematic use discounts the fact that there could be positive outcomes or motivations for use (e.g., connecting with others). Similarly, technology engagement is quite normative for adolescents, who are driven to socialize with their peers (Shapka, 2019). However, recent conceptualizations of excessive use—based on symptoms of addiction to or dependence on screen media—offer an alternative way to quantify problematic phone use. Specifically, the inclusion of Internet Gaming Disorder (IGD) in the Diagnostic and Statistical Manual of Mental Disorders 5th Edition (DSM-5; American Psychiatric Association [APA], 2013) provides a set of nine symptoms that captures disordered gaming (video game addiction), that has since been utilized to capture other

types of problematic media use (e.g., Domoff et al., 2019; van den Eijnden, Lemmens, & Valkenburg, 2016). The criteria that comprise IGD include symptoms reflecting dependence and problems in functioning as a result of gaming. In this study, we apply these same criteria to measuring Smartphone addiction. That is, Smartphone addiction is measured with these nine symptoms: tolerance (needing to use Smartphone for longer amounts of time to get same effect), withdrawal, preoccupation, loss of interest in other activities, difficulty controlling use, conflict over use, using Smartphone to escape problems or negative affect, deception, psychosocial problems due to use, and substantial conflicts with others (impacting one's relationships) due to use. We understand that there is great debate regarding whether youth can become addicted to their Smartphones. In order to evaluate this, a measure of addictive Smartphone use is needed. As such, the first aim of this study is to develop and validate the Addictive Patterns of Use (APU) scale.

A core component of problematic use of any screen media is that use must cause dysfunction in a person's life (Domoff et al., 2019). For adolescents, a key area of functioning is their academic performance. The literature thus far has examined the associations between problematic Smartphone and social media usage and psychological outcomes, but much less is known about the effect that addictive phone use may have on academic performance. In our nascent understanding of the way technology and mobile devices may be affecting students, focus has been mostly directed toward social media use and how it may interact with student relationships, performance, and general psychological functioning. Currently, less is known about how addictive use of phones in general (controlling for specific app usage such as social media apps), may affect academic outcomes in youth (though much research has considered college students' academic performance, for example, Felisoni & Godoi, 2018; Giunchiglia, Zeni, Gobbi, Bignotti, & Bison, 2018; Paul, Baker, & Cochran, 2012; Wentworth & Middleton, 2014). A 2018 meta-analysis conducted by Kates, Wu, and Coryn (2018), indicated a negative correlation between cellphone use and academic performance with a small but significant effect size. While this analysis served as a useful basal for our study, the broad nature of the independent variables examined did not do enough to specifically examine general cellphone use outside of the school environment, and beyond the use of specific applications.

In order to further understand the extent and method of protrusion into academic functioning that mobile device usage has, it is important to understand the effect that these devices may be having beyond specific contextual circumstances (i.e., Smartphone use during the school day) and app usage. Additional information in this area may be helpful for educators and parents who are looking to determine the appropriate course of action for students and children in school and at home. Therefore, the second aim of our study is to examine whether addictive phone use associates with poorer academic functioning, over and above social media use on school days. We predicted that addictive phone use would be associated with poorer academic performance, over and above the impact of school day social media use.

2 | METHODS

2.1 | Participants

Participants were 918 students in grades seven through 12 in a northern Midwest school district in the United States, as part of a larger study on physical education curricula and the relationship to fitness, physical activity, and autonomy. Permission was obtained to conduct the study by the school district's superintendent, the participating school principals, and the individual physical education teachers chosen. Students were recruited from two junior highs and one high school with ethnicity (82–84% White), students with disabilities (11–13%), and economically disadvantaged (25–32%) all similar among schools. Parent informational letters were sent home to students registered in selected physical education teachers' classes. Informed parental consent and adolescent assent was provided from all participants in the study. The Institutional Review Board of the authors' institution approved the study; the study conforms to the Federal Policy for the Protection of Human Subjects. Data was not collected individually on age, ethnicity, disability, and socioeconomic status, but information obtained from the school district and selected scheduling procedures indicated that the classes coincided with school data distribution.

Participants completed all measures within their physical education classrooms over a 2-week period at the start of the Fall semester 2017 and Spring semester 2018. Order of testing was prescribed and consistent among all three-school buildings. All survey measures were completed on laptop computers. Only participants who reported using Smartphones were included with a final $N = 641$ (53.8% female). A total of 198 seventh and eighth grade students participated (approximately 31%); 84 ninth grade students (13%), 157 10th graders (25%), 120 10th graders (19%), and 82 12th graders (13%) participated.

2.2 | Measures

2.2.1 | APU scale

APU scale is a screening tool developed to capture symptoms of Smartphone addiction. The nine items on this scale were based on criteria for other screen-media addictions (e.g., IGD and Social Media Dependence; Lemmens, Valkenburg, & Gentile, 2015; van den Eijnden et al., 2016), consistent with criteria set forth in DSM-5 (APA, 2013). Adolescents reported on the frequency of endorsement of symptoms of addictive phone use on a Likert scale from 1 (*never*) to 5 (*always*). Sample items include "During the last year, how often have there been times when all you could think about was using your phone?" and "During the last year, how often have you felt restless or tense when you were unable to use your phone?" After completing the nine items, adolescents identify which features of the phone they use most, in order to identify which types of apps or functions are most problematic for the adolescent. Details on the item content and psychometric properties are provided in section 3.

2.2.2 | Application usage and media multitasking

Adolescents were asked, "On an average school day, how many hours do you use social media (Facebook, Twitter, or Instagram)?" Responses were provided on a 5-point Likert scale, ranging from 0 to more than 5 hr per day. As a measure of media multitasking, we additionally asked adolescents to report on how frequently, while doing homework, they used "social networking at the same time (such as Facebook, Twitter, Instagram)?" Responses were provided on a 4-point Likert scale ranging from 1 (*never*) to 4 (*often*).

2.2.3 | Academic achievement

Adolescents reported on the types of grades they typically receive, ranging from 1 (mostly A's) to 4 (mostly D's). Most youth in this study reported receiving mostly A's and B's, with approximately 7% receiving mostly C's or D's.

2.3 | Statistical analyses

The first aim of this study was to examine the psychometric properties and factor structure of the APU. To do so, first, we completed an exploratory factor analysis (EFA) on half of the sample, and then confirmatory factor analysis (CFA) on the second half of the sample (as per Reis & Judd, 2000). To perform the EFA, we conducted a principal components analysis with Promax rotation. For the CFA, Mplus (Muthén & Muthén, 2012) was used based on the factor structure that emerged from the EFA. To determine adequate fit, Hu and Bentler's (1999) fit criteria were utilized: root mean square error of approximation (RMSEA) \leq .06, standardized root mean residual (SRMR) \leq .09, and comparative fit index (CFI) $>$.95.

The second aim of this study was to examine how APU associates with academic outcomes in adolescents, controlling for school day social media use and social media multitasking during homework. To examine this, linear regression was utilized with gender (1 = female, 2 = male), hours of school social media use, and social media multitasking during homework entered as covariates in Step 1 and total APU score entered in Step 2.

3 | RESULTS

In a random half of the sample ($n = 316$), an EFA was conducted (see Table 1). Two factors emerged with Eigenvalues greater than 1.0. The first factor consisted of items reflecting cognitive-emotional symptoms of addictive phone use (five items), with the second factor consisting of four items reflecting social problems associated with use. All items had factor loadings above .40 on their respective factors.

In the other half of the sample, a CFA was conducted. The two-factor model demonstrated appropriate fit, $\chi^2(26) = 54.196$, $p < .01$; RMSEA = .058, CFI = .973, SRMR = .039). The five items on the cognitive-emotional factor and four items on the social problems factor loaded above .60 on their respective factors ($p < .001$; see Figure 1), providing further support of the factor structure. The two subscales were significantly correlated ($r = .72$, $p < .001$).

Regarding the internal consistency of the APU, Cronbach's alphas were calculated for the overall sample. The total, cognitive-emotional, social problems subscales each had excellent internal consistency (α 's = .89, .84, and .86, respectively). Correlations were next examined between the APU total score and subscales with school day social media use and phone use while doing homework. The total score and subscales each significantly correlated with school day social media use and phone use while doing homework (see Table 2), providing

TABLE 1 Exploratory factor analysis of the Addictive Patterns of Use (APU scale)

	Factor 1 (social problems)	Factor 2 (cognitive and emotional symptoms)
9. Have you experienced serious conflicts with family, friends, or partner because of your phone use?	.93	-.10
7. Have you tried to hide how much you used your phone from family or friends?	.91	-.08
5. Have you spent less time with friends, or doing other activities, in order to use your phone?	.76	.07
4. Have you had arguments with others about your phone use, but have continued to use your phone excessively?	.75	.13
1. Have there been times when all you could think about was using your phone?	-.17	.94
3. Have you felt the need to use your phone for longer amounts of time?	-.05	.90
2. Have you felt restless or tense when you were unable to use your phone?	.19	.70
8. Have you used your phone to forget about personal problems or other things that were bothering you?	.13	.56
4. Have you felt that you should use your phone less, but have been unable to cut back on your phone use?	.39	.43
% of Variance	53.69	12.45
Eigenvalue	4.83	1.12
Cronbach's alpha	.86	.83
M (SD)	1.82 (0.92)	2.53 (0.88)

Note: Promax with Kaiser Normalization rotation method. Question stem begins with "During the last year how often." Response options range from 1 = *never* to 5 = *always*. The bold simply represents the higher loading value.

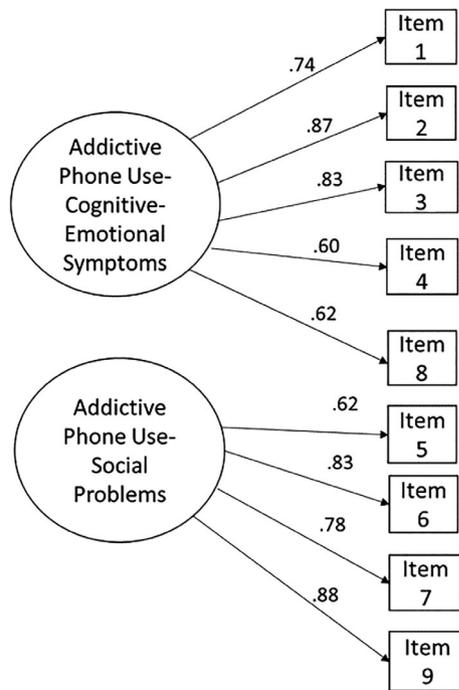


FIGURE 1 Confirmatory factor analysis of the Addictive Patterns of Use scale. Note: See Table 1 for items. Standardized estimates are listed above the arrows, all $p < .01$

support for the convergent validity of the APU measure. Given the high intercorrelation between the subscales, the total APU score was used in subsequent analyses.

To address the second aim of this study, linear regression was conducted to examine if APU scores associated with academic performance, over and above school day social media use. We found that adolescent gender and school day social media use associated with academic performance ($B = .13$ and $B = .17$, respectively; $p < .01$), explaining 4% of the variance (see Table 3). In the second step, APU accounted for a significant increase in variance explained in academic performance ($p < .01$); APU significantly associated with academic performance ($B = .13$, $p < .01$), and the association between school day social media use and academic performance decreased. Thus, APU scores associated with academic performance, over and above school day social media use.

4 | DISCUSSION

The purpose of this study was to develop a reliable and valid measure of addictive phone use, and to examine the association between

TABLE 3 Social media use and addictive phone use predicting academic performance

	ΔR^2	β
Step 1	.04	
Gender (1 = female, 2 = male)		.13**
School day social media use		.17**
Social media multitasking		.03
	$F(3, 621) = 9.04^{**}$	
Step 2	.01	
Gender (1 = female, 2 = male)		.12**
School day social media use		.14**
Social media multitasking		-.02
Addictive Patterns of Use scale total score		.13**
	$F(4, 620) = 8.88^{**}$	

** $p < .01$.

addictive phone use and academic performance in adolescents. With the APU scale, we found that addictive phone use can be reliably measured and appears to consist of two separate domains—cognitive-emotional symptoms and social problems. These categories emerged in the EFA and were confirmed subsequently in this sample. Additionally, we found that addictive phone use associated with poorer academic performance, over and above the impact of school day social media use. These results indicate that addictive use of cell phones may be a risk factor for decreased academic performance and is distinct from other technology-related risk factors (e.g., social media use during school days).

Our findings are consistent with research examining excessive phone use and academic outcomes in young adults (e.g., Felisoni & Godoi, 2018; Giunchiglia et al., 2018; Paul et al., 2012; Wentworth & Middleton, 2014). That is, prior research has demonstrated that greater dependence on Smartphones is associated with lower GPA in college students. Similarly, we found that it is the nature of adolescents' Smartphone use (e.g., dependence), and not solely hours of social media use that best associates with academic performance. Similar findings have been reported when examining problematic media use in younger children and psychosocial outcomes (Domoff et al., 2019).

This study provides preliminary evidence linking addictive use of Smartphones and reduced academic performance among adolescents but does not provide insights into how such use confers this risk. Future research should consider examining sleep health as potential mediator,

TABLE 2 Correlations between Addictive Patterns of Use (APU), social media use, and grades

	School day social media use	Social media multitasking during homework	Academic performance
APU total score	.42**	.48**	.17**
APU social problems subscale	.29**	.34**	.16**
APU cognitive-emotional symptoms subscale	.45**	.46**	.16**

Note: Academic performance is scored such that higher scores indicate poorer academic performance (i.e., lower grades).

** $p < .01$.

as this has been supported in youth outside the United States (Vernon et al., 2015). Additionally, researchers may seek to utilize different measures to replicate results. For example, using objective academic outcome data (e.g., school records) and passive sensing applications to objectively measure phone use would enhance methodological rigor.

One of the strengths of this study was the large sample of participants—which provided sufficient power to address our study aims. However, limitations of this study should be addressed in future research. For example, all measures utilized were based on self-report, which may be prone to reporter bias. Given that the data was collected at one time point, directionality of effects could not be determined (e.g., poorer academic performance may predict greater APU, though unlikely). Additionally, since this sample was not representative of youth in the US, generalizability is limited. Given these limitations, this study should be treated as a preliminary examination of the associations between addictive phone use and academic achievement. Future research should employ longitudinal and experimental methodology to ascertain temporal precedence and causality. Nonetheless, our study suggests that addictive phone use is a distinct risk factor for poorer academic performance in adolescents.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest.

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Ryan Foley is a doctoral student in the Clinical Psychology program at Central Michigan University. His research interests include digital device usage and related health and social outcomes. Mr Foley is currently investigating the role of problematic phone and media usage on health and educational outcomes in adolescents, as well as current issues surrounding loot boxes and microtransactions. Mr Foley's clinical interests include health psychology, addiction, and development of treatment protocols for problematic media usage. He is passionate about making a difference in individuals' lives and has relevant clinical experience working in educational and medical settings.



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How to cite this article: Domoff SE, Foley RP, Ferkel R. Addictive phone use and academic performance in adolescents. *Hum Behav & Emerg Tech.* 2019;1–6. <https://doi.org/10.1002/hbe2.171>