

**Premorbid predictors of adolescent normative and problematic screen use: A longitudinal analysis of the Adolescent Brain Cognitive Development (ABCD) sample**

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## **Abstract**

**Aims:** This study aims to assess whether premorbid individual differences in personality (impulsivity, reward sensitivity, and punishment sensitivity), psychopathology tendencies (internalizing and externalizing), and/or neurocognitive abilities (cognitive ability, executive function, and learning/memory) predict overall screen time (ST) versus problematic screen use (PSU) in mid-adolescence. The three research aims are to test whether late childhood individual differences longitudinally predict mid adolescent ST; to test predictiveness of mid adolescent PSU; and to test variation by screen activity. **Method:** Longitudinal data from 4,754 participants with released data at the baseline and year 4 waves of the Adolescent Brain Cognitive Development (ABCD™) sample (Release 5.1) were used. Linear regression models tested whether impulsivity (UPPS-P), reward sensitivity (BAS Reward responsiveness + drive), punishment sensitivity (BIS), internalizing, externalizing (CBCL), and/or neurocognitive task performance at ages 9-10 predicted youth-reported ST or PSU of video games, social media, or smartphones at ages 12-15. Post-hoc analyses tested relative contributions of impulsivity sub-facets and replicability of PSU relationships when PSU was operationalized binarily. **Results:** Higher impulsivity and lower cognitive ability predicted longer video game ST in mid adolescence, and higher impulsivity and reward sensitivity predicted longer social media ST. Higher impulsivity predicted later PSU across screen activities. Higher punishment sensitivity and internalizing only predicted higher PSU of video games, and higher reward sensitivity only predicted higher PSU of phones. **Conclusions:** While impulsivity may underpin several forms of

PSU, different risk factors among PSU of video games, social media, and smartphones suggest the use of different intervention strategies in the treatment of each behavior.

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## **Introduction**

### **Background**

Adolescent digital media use has increased rapidly in recent years: American tweens (aged 8 to 12 years old) and teenagers (aged 13 to 18 years old) report engaging in recreational screen time (ST) for an average of 5½ hours and 8½ hours daily, respectively (Rideout et al., 2022). As young people's ST has increased, patterns of digital media use have also shifted. The proportion of adolescents' total recreational ST that is spent on 'traditional' forms of digital entertainment like television shows and movies has decreased, while the proportion spent on forms of 'new media' like video games, social media, and smartphones has increased, now constituting most of adolescents' ST (Rideout et al., 2022). This is perhaps unsurprising, as new media platforms have several design features intended to maximally reinforce user consumption and prolong user ST, including infinite scroll, variable reinforcement scheduling of rewards, and algorithmic content tailoring and suggestion (Montag et al., 2019). Though concerns have arisen that prolonged ST may be harmful to adolescents' mental health, much research on the topic is correlational. One systematic review and meta-analysis of over 159,000 youth aged twelve and under found those with longer ST to have greater internalizing problems (i.e., depression and anxiety-like symptoms) and externalizing problems (i.e., behavioral dysregulation symptoms) (Eirich et al., 2022). Similarly, one meta-analysis of 127,714 children and adolescents aged 5-18 found total ST to show dose-response associations with depression (Liu et al., 2016), while another of 55,340 adolescents aged 10-19 found similar associations between social media use and depression (Liu et al., 2022).

Some, however, counter that the construct of “screen time” lumps too many digital media use behaviors together at once, and that digital media effects on youth’s well-being are null or not concerning (Orben & Przybylski, 2019). Additionally, despite concerns of mental health harms, media use may also bring distinct benefits, such as social connectedness. One ecological momentary assessment study of 63 14- to 16-year-olds tracked over more than 2,000 assessment periods found that half of participants reported significantly elevated moods immediately after using social media (Beyens et al., 2020). In some qualitative interview work, children report that screen activities like video games allow for connection via digital ‘parallel play’ (Larivière-Bastien et al., 2022). Currently, video game, social media, and smartphone use—even for prolonged periods of time—is normative for American adolescents, as 97% of teenage boys and 83% of teenage girls reportedly play video games, 72% of teenagers use Instagram, 95% of teenagers have access to a smartphone, and 45% of all teenagers indicate that they are online “almost constantly” (Pew Research Center, 2018). Given the ubiquity of screen use and the possible benefits of such use, increases in total ST may not be universally concerning.

### **Problematic Use**

However, for a subset of adolescents, screen use may become so prolonged that it becomes uncontrollable, interfering with mental well-being. In contrast to ST, which is conceptualized neutrally as total hours of digital media use, problematic screen use (PSU) is generally conceptualized as compulsive overuse of digital media resulting in distress and/or functional impairments in daily life (Nagata et al., 2022). PSU is associated with significant harms across domains of functioning for affected individuals. Problematic video game use has been associated with massive time displacement and suicidal ideation (Baggio et al., 2016).

Problematic social media use has been associated with ‘fear of missing out’ (FOMO) and fears of becoming disconnected (Rozgonjuk et al., 2020). Problematic smartphone use has been associated with anxiety, disrupted sleep (Busch & McCarthy, 2021), and even depression symptoms (Elhai et al., 2016). Though specific consequences of PSU may vary slightly by medium, all forms of PSU are thought to share six core features: (1) intentional mood modification, (2) salience (i.e., the screen use is compelling), (3) tolerance (spending ever-increasing time using screens in order to derive the same emotional rewards), (4) withdrawal (negative feelings like irritability and anxiety when opportunities for screen use are unavailable), (5) conflict (interpersonal issues or functional consequences of screen use), and (6) relapse (tendency to return to screen use after periods of attempted abstinence) (Andreassen et al., 2012). Notably, these features resemble those of other forms of addictive behavior, like substance use (American Psychiatric Association, 2013). Of concern is the observation that PSU appears increasingly common in early adolescents: for instance, a prior analysis of the large and epidemiologically informed Adolescent Brain Cognitive Development (ABCD™) study sample found that roughly 7% of 11- to 12-year-old screen users showed problematic video game use, 3.5% showed problematic social media use, and 21.8% showed problematic smartphone use (Raney et al., 2023).

PSU’s mental health consequences and increasing prevalence make it a salient public health concern. However, to prevent PSU and formulate appropriate treatment targets, its risk factors must be better understood. Existing research is largely cross-sectional and compares problematic to non-problematic screen users (Hahn et al., 2014; Deng et al., 2022; Dong et al., 2022; Vargas et al., 2019; Ding et al., 2014). While group differences have been observed, causal inferences cannot be drawn. Specifically, it is unclear whether group differences reflect

consequences of problematic screen use or pre-existing individual differences that render some individuals vulnerable to PSU. In addition to characterizing pre-existing risk factors for PSU, greater specificity regarding predictors of ST versus PSU is needed. Most youth using video games, social media, and smartphones—even for long periods of time—will do so in a manner that does not become uncontrollable or problematic. However, for those youth whose use does become compulsive, uncontrollable, and distressing, knowledge of risk factors is essential for prevention and intervention.

Because the clinical presentation of PSU mirrors that of substance use disorders, it is possible that substance use disorders and problematic screen use share premorbid risk factors. Individual differences implicated in addiction risk, including impulsivity, approach and avoidance tendencies, internalizing and externalizing tendencies, and neurocognitive abilities, may also be relevant to the risk of video game, social media, and smartphone PSU.

### **Individual Differences Implicated in Addiction Risk**

Impulsivity, a trait encompassing poor ability to focus, plan ahead, and control oneself (Berg et al., 2015), is a well-established risk factor for the development of substance use disorders (Verdejo-Garcia & Albein-Urios, 2021; Kozak et al., 2019; Kreek et al., 2005; Samek et al., 2017) and may also predict problematic use of video games, social media, and smartphones. First, unlike old media like television, newer forms of digital media like social media deliver users a steady stream of salient notifications prompting action. Youth with higher impulsivity may struggle to inhibit the automatic impulse to immediately check and act upon notifications. Second, many rewarding stimuli (like video game points, social media “Likes,” or bright colors and satisfying sound effects on smartphones) can be obtained instantly with a quick

tap or swipe, making them easier to access than rewards from more effortful non-screen activities (like sports, academic activities, or in-person conversations). Because of their difficulty sustaining effort and attention, youth with higher impulsivity may struggle most to resist distracting notifications and may interrupt effortful activities to obtain screen rewards more frequently than peers. Third, new media are designed to capture user attention for as long as possible (Montag et al., 2019) and may require intentional self-restricting behaviors to limit use. In the context of a relatively lower ability to consider potential consequences of prolonged screen use (like exhaustion, missing out on other activities, or the feeling of lost time), youth with higher impulsivity may have difficulties in planning ahead before initiating screen use and may be more easily and unintentionally drawn into long stretches of screen use when opportunities to use become available. Finally, certain activities (like video games) offer thrills that may be unavailable in everyday life, such as the experience of launching an adventure or committing violent acts. Therefore, because sensation-seeking is conceptualized as the tendency to seek thrills despite negative consequences (Luna et al., 2014), youth with higher impulsivity and sensation-seeking may be most likely to seek out and enjoy media like video games. More broadly, youth with higher impulsivity may have a lower ability to regulate behaviors with negative consequences (Berg et al., 2015), leading to an inability to control screen use despite mounting consequences. Indeed, cross-sectional studies find adolescents with higher impulsivity to have higher internet addiction scores (Li et al., 2019), higher likelihood of meeting criteria for internet gaming disorder (Xiang et al., 2021), higher problematic social media use scores (Peris et al., 2020), and higher smartphone addiction proneness (Kim et al., 2023) than peers with lower levels of impulsivity, suggesting impulsivity to be an important predictor of PSU across new media activities. Though impulsivity stemming from low executive functioning (EF) abilities

tends to normatively decrease throughout adolescence as EF abilities mature (Ferguson et al., 2021), higher trait impulsivity may nonetheless be associated with higher risk of PSU among adolescents regardless of age.

In addition to the possibility that impulsivity could identify adolescents at highest risk of PSU, sub-facets of impulsivity could provide even greater specificity in predicting PSU types. One conceptualization of impulsivity's underlying traits is that of Whiteside & Lynam, whose analysis of over 400 young adults' personality data found robust support for four sub-facets of impulsivity: (1) urgency (rash action in response to strong affective states), (2) lack of planning (low forethought for actions' future consequences), (3) sensation-seeking (tendency towards risk-taking and thrill-seeking), and (4) lack of perseverance (low sustained attention abilities) (Whiteside & Lynam, 2001). These sub-facets are strongly tied to substance use disorders, as one meta-analytic review of 40,432 participants assessed in 115 studies found all UPPS-P sub-facets to be significantly correlated with greater alcohol and substance use, with sensation-seeking having the largest effect sizes (Berg et al., 2015). Because they relate to other forms of addiction, these four sub-facets could provide greater specificity in predicting PSU types. Youth with lower perseverance, for example, could be at elevated risk of problematic smartphone use, as smartphones may be used for intermittent self-distraction during difficult tasks requiring sustained attention. Alternatively, youth higher in sensation-seeking, who may exhibit a high fear threshold and desire for thrills, could be at higher risk of problematic video game use, as certain video games could present unique opportunities for feelings of adventure or violent behavior. Though research on specific impulsivity sub-facet relationships with video game use is scarce, sensation-seeking scores have been found to be higher in youth with higher problematic video

gaming scores compared to peers with lower scores (Hamid et al., 2022), supporting the possibility that this impulsivity facet could predict problematic video use.

Impulsivity is generally considered to be valence-free and can be expressed across different motivational conditions. Other individual difference factors perhaps relevant to understanding PSU vulnerability include motivational dispositions. Specifically, reward sensitivity and punishment sensitivity may also be relevant to ST and PSU. Reward sensitivity, or the tendency to engage in approach behaviors in response to appetitive or positive stimuli, and punishment sensitivity, or tendency to engage in avoidance behaviors in response to threatening or aversive stimuli, correspond to the orthogonal ‘Behavioral Activation System’ (BAS) and ‘Behavioral Inhibition System’ (BIS) of Gray’s Reinforcement Sensitivity Theory of Personality (Gray, 1987; Gray, 1991). Notably, reward and punishment sensitivity are already implicated as risk factors for addiction. Increases in premorbid reward sensitivity are positively associated with initiation of substance use and alcohol consumption frequency in mid-adolescence (Urošević et al., 2015). Among early adults, higher sensitivity to reward is positively associated with earlier age of first alcoholic drink (Pardo et al., 2007) and with greater urge to consume alcohol in response to alcohol cues (Kambouropoulos & Staiger, 2001). Also among emerging adults, low effortful control interacts with punishment sensitivity to predict greater alcohol use among emerging adults (Kahn et al., 2018), and higher BIS punishment sensitivity scores predict greater odds of concurrent alcohol use disorder (Studer et al., 2016).

It is possible that high reward sensitivity could predict longer screen use. Youth who are highly motivated by incentives may be highly responsive to rewarding points, Likes, notifications, and algorithmic content tailoring (Montag et al., 2019), causing them to be positively reinforced by media use. Research finding positive associations between neural reward

sensitivity and mental well-being (Blain et al., 2023) suggests that highly reward-sensitive youth may retain high drive and motivation for seeking fulfilling offline rewards, providing protection against problematic screen use. However, it is also possible that reward sensitivity could simultaneously heighten risk of problematic screen use. Youth who are more highly reward-responsive could excessively pursue digital rewards at the expense of non-digital rewards, perhaps affecting risk of problematic screen use. Likewise, punishment sensitivity could also predict higher screen use, especially problematic screen use. Avoidant of threats in offline contexts (like social situations in which rejection may occur), highly punishment-sensitive youth may retreat to screen use to cope with distress through digital escapism. In fact, one cross-sectional study of 1,195 14- to 18-year-old adolescents found self-reported screen use motivations related to coping with distress to be significantly associated with broad psychopathology symptoms (Morello et al., 2024), supporting the idea that punishment sensitivity could be linked to increased screen use through coping motivations.

Multiple studies have found reward sensitivity and punishment sensitivity to relate to ST and PSU. However, results are more mixed for reward sensitivity than for punishment sensitivity. Some cross-sectional comparisons of normative and problematic digital media users in adolescent and young-adult samples have found high Behavioral Activation System scores (as measured by Carver & White, 1994) to be unrelated to problematic internet use (Li et al., 2019; Vargas et al., 2019, Meerkerk et al., 2010) or negatively correlated with internet addiction severity scores (Xiang et al., 2021), bolstering the idea that high reward sensitivity may protect against forms of PSU. Findings for video game use are inconsistent. In some work, adults who frequently game online have lower reward sensitivity than non-gamers (Hahn et al., 2014), while in other work, adolescents who play video games more often have *higher* reward sensitivity than

peers (Vangeel et al., 2017). Results concerning punishment sensitivity are somewhat more consistent, as cross-sectional comparisons of undergraduate-age young adults with and without problematic media use have found those with higher Behavioral Inhibition System scores (Carver & White, 1994) to have higher scores on internet addiction (Vargas et al., 2019), problematic video gaming (Dong et al., 2022), and problematic smartphone use (Horwood & Anglim, 2018) measures.

Examining the roles of externalizing and internalizing tendencies in ST and/or PSU could further test whether PSU shares premorbid risk factors with other addictions. Externalizing tendencies, or behavioral dysregulation tendencies, are strongly associated with development of substance use disorders (Pedersen et al., 2018; King et al., 2004; Iacono et al. 2008; Groenman et al., 2017; Poore et al., 2023). To a lesser degree, internalizing tendencies, or emotional distress tendencies, are also implicated in development of substance use disorders (Hussong et al., 2017; Elkins et al., 2006; Measelle et al., 2006; Groenman et al., 2017). Considering that externalizing and internalizing tendencies are associated with heightened substance use disorder risk, it is reasonable to consider whether these traits also predict PSU. Also, assessing late childhood externalizing and internalizing relationships with adolescent screen use behaviors could further clarify mental health risks and consequences of PSU. If, for example, PSU is better predicted by externalizing tendencies than by internalizing, PSU treatment may be most effective when targeting behavioral dysregulation.

And finally, individual differences in neurocognitive abilities like general cognition, executive functioning (EF), and learning and memory could also be pertinent to ST and/or PSU. In particular, lower abilities in EF, a regulatory skillset encompassing cognitive control, mental flexibility, and response inhibition, are longitudinally associated with greater risk of substance

use initiation (Luciana, 2020) and greater substance use in adolescence (Jones et al., 2021; Khurana et al., 2017; Kim-Spoon et al., 2017) and could likewise be a risk factor for PSU. Furthermore, because EF abilities include neurocognitive skills underpinning the personality trait of impulsivity (Diamond, 2013), examining associations between EF and later screen use behaviors could add further nuance to potential associations between impulsivity and later ST and PSU. Because links between neurocognitive abilities and PSU are hypothesized to be specific to EF, examining associations between other neurocognitive skills and screen use may provide information about discriminant validity of EF as a predictor of PSU.

Overall, there are several reasons why premorbid individual differences associated with longer ST and greater PSU risk require further study. First, research distinguishing ST-specific predictors from PSU-specific predictors is scarce, as much research either focuses exclusively on PSU or measures ST without concurrent measurement of PSU symptoms. Because prolonged ST is not necessarily problematic, research explicitly differentiating prolonged ST from *problematic* prolonged ST is needed. Distinguishing which ST and PSU predictors are shared versus specific may shed light on existing inconsistencies in the literature surrounding which specific characteristics, and which levels of these characteristics, are linked to ST versus PSU. For example, though problematic users of new media tend to self-report higher impulsivity scores than peers (Meerkerk et al., 2010; Dong et al., 2022; Hamid et al., 2022), the two groups do not necessarily differ in behavioral impulsivity on tasks like the Go/No Go (Vargas et al., 2019; Ding et al., 2014). Furthermore, though some research links reward sensitivity to lower PSU risk and punishment sensitivity to higher PSU risk, other work finds that those with higher reward sensitivity have greater risk of some forms of PSU (Kim et al., 2016) or that highly punishment-sensitive adolescents are no more likely to use social media more than peers (Gingras et al.,

2023). Therefore, assessing shared and specific individual difference risk factors for ST and PSU may both clarify previous inconsistencies in the literature and provide greater ability to predict which adolescents' screen use may cross the threshold into problematic use, informing prevention efforts and aiding in efforts to target interventions towards youth with the greatest risk of PSU.

Second, cross-sectional research comparing youth with and without PSU cannot disentangle direction of influence. In a cross-sectional study, for example, positive associations between impulsivity and problematic video game use could indicate either that youth with higher impulsivity are at higher risk of developing problematic video gaming or that problematic video gaming increases players' impulsivity. Therefore, measuring behavioral characteristics prior to PSU onset can illuminate which individual differences are antecedents versus consequences of PSU. Third, the PSU literature is somewhat less developed for problematic social media use than for problematic smartphone use or problematic video game use, despite high rates of adolescent social media use and pressing questions surrounding negative consequences of extended social media use.

## **Research Questions**

This study proposes to fill gaps in the literature by addressing three research questions. First, do late childhood personality traits (impulsivity and its sub-facets, reward sensitivity, and punishment sensitivity), psychopathology tendencies (internalizing and externalizing), and/or neurocognitive abilities (cognitive ability, executive function, and learning/memory) longitudinally predict screen time in mid-adolescence? Second, do these individual differences also predict problematic screen use in mid-adolescence? And third, do individual differences'

associations with screen time and problematic screen use vary by screen activity (video games, social media, smartphones)?

## **Hypotheses**

The following outcomes for the study's three research questions are hypothesized. First, longer mid-adolescent ST will be predicted by higher parent-reported CBCL externalizing total scores, higher self-reported BAS Reward Responsiveness + Drive reward sensitivity scores, and lower EF task performance component scores in late childhood. Second, like ST, higher mid-adolescent PSU will also be predicted by higher parent-reported CBCL externalizing total scores, higher self-reported BAS Reward Responsiveness + Drive reward sensitivity scores, and lower EF component scores in late childhood. However, some risk factors are hypothesized to be specific to PSU. Specifically, higher self-reported UPPS-P total impulsivity scores, BIS punishment sensitivity scores, and parent-reported CBCL internalizing total scores will predict PSU, but not ST. And third, certain relationships are hypothesized to vary by screen activity: UPPS-P lack of perseverance and sensation-seeking sub-facet scores will predict smartphone and video game use, respectively, but not social media use.

## **Method**

### **Sample**

Secondary analyses were conducted on data drawn from participants in the Adolescent Brain Cognitive Development (ABCD™) study (Release 5.1), a large, diverse longitudinal cohort study with recruitment from 21 sites across the United States. Detailed information on the ABCD study's recruitment procedures, inclusion/exclusion criteria (Garavan et al., 2018), and assessment batteries are provided elsewhere (Barch et al., 2018; Luciana et al., 2018; Bagot et al., 2022). ABCD study participants were recruited at age 9 or 10 during 2016-2018 and are being followed yearly throughout adolescence, with data collection still ongoing. Release 5.1 contains data for all 11,875 ABCD study participants at the baseline, year 1 follow-up, year 2, and year 3 follow-up waves. Within this data release, the year 4 follow-up wave includes data from 4,745 participants. Hence, these 4,372 youth with data available from the baseline to year 4 assessment waves made up the final sample (See Tables 1a through 1c for descriptive statistics). The University of California, San Diego provided centralized institutional review board (IRB) approval (protocol number: 160091AW. At each assessment wave, participants provided written assent to participate, and caregivers provided written consent.

### **Measures**

#### *Independent Variables*

#### **Impulsivity, Reward Sensitivity, and Punishment Sensitivity**

Impulsivity, reward sensitivity, and punishment sensitivity measures from the baseline wave (2016-2018), when youth were ages 9-10, were used. Use of late childhood personality measures was intended to capture personality prior to the initiation of heavy screen use.

Impulsivity was operationalized as total scores on the UPPS-P impulsivity scale (Lynam et al., 2006), an abbreviated version of the original UPPS scale (Whiteside & Lynam, 2001). The UPPS-P contains twenty items whose answer options are Likert scale responses ranging from 1 (“Not at all like me”) to 4 (“Very much like me”), with total UPPS-P scores ranging from 20 to 80. The UPPS is a reliable measure of impulsivity, and construct validity is demonstrated by work showing that the UPPS correlates externally with forms of adult psychopathology ranging from borderline personality disorder to alcohol addiction (Whiteside et al., 2005). The original UPPS total scores provide an estimate of total trait impulsivity, with four subscales—urgency, lack of planning, sensation-seeking, and lack of perseverance—providing further specificity about unique impacts of facets of impulsivity. Lack of planning, sensation-seeking, and lack of perseverance are operationalized as total scores on their respective scales. Though the development of the original UPPS measure identified a four-factor model of impulsivity, with one unified Urgency scale (Whiteside & Lynam, 2001), later authors proposed a fifth subscale, Positive Urgency, which was subsequently added to the UPPS-P model (Cyders et al., 2007). The ABCD UPPS-P scale includes separate Positive Urgency and Negative Urgency scales. However, in one study of 294 late-adolescent undergraduate students, positive urgency was associated with significantly elevated negative affect and significantly *decreased* positive affect, positive urgency did not moderate associations between positive affect and impulsivity, positive and negative urgency showed nearly identical correlates with daily-life mood variables, and positive and urgency items loaded onto a unitary factor; thus the authors recommended treating urgency as one, unitary construct (Sperry et al, 2018). Similarly, in one network analysis of questionnaire data from 18,568 non-clinical adult participants and 385 clinical adult participants, UPPS-P positive urgency and UPPS-P negative urgency items constituted one coherent cluster in

individuals with and without significant psychopathology (Billieux et al., 2021). In accordance with these findings and mirroring other research in which urgency is treated as one coherent factor (Smith et al., 2013), further analyses used one combined urgency factor. The Lack of Planning, Sensation-Seeking, and Lack of Perseverance sub-facets each have four items and possible scores ranging from 4 to 16, while the combined Urgency scale has eight items and scores ranging from 8 to 32.

Reward and punishment sensitivity were operationalized through self-reported scores on the Behavioral Activation Scale (BAS) and Behavioral Inhibition Scale (BIS) (Carver & White, 1994). The BIS/BAS scales measure orthogonal reward-driven approach and punishment-driven avoidance systems posited by Gray to underlie personality (Gray, 1987; Gray, 1991). The ABCD study used modified forms of the BIS/BAS scales with clearer wording, removal of cross-loading items, and removal of items that worsened factor fit of BIS/BAS scores among adolescents (Pagliaccio et al., 2016). For the current analyses, reward sensitivity was operationalized as total summed scores on the Drive and Reward Responsiveness subscales combined. Items from the Fun-Seeking subscale were not used in BAS scores because they have previously shown poor factor loadings for children and adolescents; removal of the fun-seeking subscale improves the BAS factor fit (Pagliaccio et al., 2016). Additionally, some confirmatory factor analytic work has found the Drive and Reward Responsiveness scales to form one factor and the Fun-seeking scale to form a second factor reflecting both reward sensitivity and impulsivity (Smillie et al., 2006). Because this study seeks to assess *unique* effects of impulsivity and reward sensitivity separately, the Fun-Seeking subscale was not used. BAS Reward Responsiveness + Drive scores ranged from 0 to 24, while punishment sensitivity was operationalized as total scores on the BIS, with values ranging from 0 to 12.

## **Internalizing and Externalizing**

Internalizing and externalizing were operationalized via the school-age version of the Child Behavior Checklist (CBCL) (Achenbach, 2009). Internalizing was operationalized as parent-reported total raw scores on the Internalizing Problems scale, which sums scores from the Anxious/Depressed, Withdrawn/Depressed, and Somatic Complaints syndrome subscales. Internalizing raw scores range from 0 to 50. Externalizing was operationalized as parent-reported total raw scores on the Externalizing Problems scale, which sums scores from the Rule-Breaking and Aggressive Behavior syndrome subscales. Externalizing raw scores also range from 0 to 50. In research norming the CBCL in national probability samples of school-age children, Internalizing and Externalizing subscales show moderate to high internal consistency (ranging from Cronbach's  $\alpha$  of 0.78 for the Somatic Complaints subscale to Cronbach's  $\alpha$  of 0.94 for the Aggressive Behavior subscale) and moderate inter-rater reliability between parents (ranging from inter-rater score correlations of  $r = 0.65$  for the Somatic Complaints subscale to  $r = 0.85$  for the Rule-Breaking Behavior subscale) (Achenbach & Rescorla, 2001).

## **Neurocognitive Abilities**

Neurocognitive abilities were operationalized as the General Ability, Executive Function, and Learning/Memory components derived from a principal component analysis of nine cognitive tasks in the ABCD study at baseline. Details regarding the ABCD neurocognition battery can be found in Luciana et al., 2018 and Thompson et al., 2018. Briefly, the battery includes seven tasks from the NIH Toolbox Cognitive battery, the Little Man Task of visuospatial reasoning, and the Rey Auditory Verbal Learning Task. Cognitive tasks loading most strongly onto the first component (General Cognitive Ability) include the NIH Toolbox Picture Vocabulary and Oral Reading tests, with the NIH List Sort Working Memory task and

Little Man Task measure of visuospatial reasoning loading moderately onto this component. Cognitive tasks loading most strongly onto the second component (Executive Functioning) include the NIH Toolbox Flanker, the NIH Toolbox Pattern Comparison Processing Speed, and NIH Toolbox Dimensional Change Card Sort tasks. Cognitive tasks loading most strongly onto the third component (Learning/Memory) include the NIH Toolbox Picture Sequence Memory task and Rey Auditory Verbal Learning Test total number of correct answers.

### *Dependent variables*

#### *Screen Time (ST)*

ST was operationalized via self-report responses to the ABCD Screen Time Questionnaire (STQ) (Bagot et al., 2022) at the year 4 follow-up wave, when youth were 12-15 years old. Video game ST is operationalized as total hours spent playing video games on a typical day. Though single-player and multiplayer video games were measured separately, this study assesses correlates of broad video game use and thus combined hours spent playing both single- and multiplayer games. Social media ST is operationalized as total hours spent visiting “social media apps (e.g., Snapchat, Facebook, Twitter, Instagram, TikTok, etc.), not including time spent editing photos or videos to post on social media,” on a typical day. The STQ asks youth about typical weekday and weekend screen use separately. Prior authors studying screen use in the ABCD sample have conceptualized weekday and weekend screen use as behaviors that are not fundamentally separate and have calculated total daily average screen time values across weekends and weekdays (Nagata et al., 2022). Likewise, in the current study, total daily average screen use values were used. The ABCD study did not measure hours spent on smartphones but did ask youth whether they owned a smartphone or smartwatch. Therefore, though smartphone

ST was not directly measured, a binary categorical variable reflecting smartphone/watch ownership vs. non-ownership was used instead. Concerning characterization of the sample's screen use at baseline, self-reported hours spent on video games and social media on an average day were measured, while smartphone/watch ownership and problematic screen use measures were not measured at this timepoint.

#### *Problematic Screen Use (PSU)*

Problematic screen use was operationalized via the Video Game Addiction Scale (VGAQ) (Bagot et al., 2022), the Social Media Addiction Scale (SMAQ) (Bagot et al., 2022), and the Mobile Phone Involvement Questionnaire (MPIQ) (Walsh et al., 2010). The VGAQ, SMAQ, and MPIQ are based on the Bergen Facebook Addiction Scale, a valid, reliable questionnaire assessing six core addictive processes (salience, intentional mood modification, tolerance, withdrawal, conflict, and relapse) in relation to Facebook use (Andreassen et al., 2012). The VGAQ contains six items whose answer options are Likert scale responses ranging from 1 (“Never”) to 6 (“Very often”), with total scores ranging from 6 (answering “Never” to all items) to 36 (answering “Very often” to all items). The VGAQ measures one unitary construct and shows full configural, metric, and scalar invariance across mid-adolescent youth of different racial/ethnic groups, supporting use of the VGAQ in diverse youth; however, intercepts of the VGAQ differ by sex, as males play video games longer than girls, suggesting that group-level mean comparisons between males and females on this measure are not encouraged (Bagot et al., 2022). The SMAQ also measures one unitary construct, and its six items are identical to the VGAQ's (with the substitution of “social media” for “video games”), as are response options and total score ranges. The SMAQ has been found to show similar, but not identical factor structure

and item loadings across males and females and youth of different racial/ethnic groups, suggesting that group-level mean comparisons between racial/ethnic groups and males and females are not encouraged (Bagot et al., 2022). Internal consistency reliability is acceptable across both measures, with the VGAQ and SMAQ showing McDonald's  $\omega$  values of .90 and .86, respectively (Bagot et al., 2022). The MPIQ measures one unitary construct and has eight items reflecting salience, intentional mood modification, tolerance, withdrawal, conflict, and relapse, as well as two items reflecting social motivations for phone usage ("I feel connected to others when I am using my phone") and disruption of daily life due to phone usage ("I interrupt whatever else I am doing when I am contacted on my phone"). Answer options are Likert scale responses ranging from 1 ("Strongly Disagree") to 7 ("Strongly Agree"), and total scores range from 8 (answering "Strongly Disagree" to all items) to 56 (answering "Strongly Agree" to all items). The MPIQ has acceptable reliability, showing Cronbach's  $\alpha$  of 0.81 in analyses of mid- to late-adolescents aged 15 to 24 (Walsh et al., 2010).

### **Statistical Analyses**

Six linear regression models were run using the "lm" package in R studio. In each model, UPPS-P total impulsivity scores, BAS Drive + Reward Responsiveness reward sensitivity scores, BIS punishment sensitivity scores, CBCL internalizing scores, CBCL externalizing scores, general cognitive ability component scores, executive functioning component scores, and learning/memory component scores at the baseline assessment wave (when youth were ages 9 to 10 years-old) were entered together as predictors of screen time and problematic use of video games, social media, and smartphones at the year four follow-up (ages 12-15). Raw CBCL internalizing and externalizing scores were entered into models as is despite considerable skew,

as linear regression is robust to non-normality of independent variables (Williams et al., 2019). Because children of different racial ethnic groups, sexes, ages, and socioeconomic status groupings are known to use screens for significantly different durations of time (Rideout et al., 2021), all analyses controlled for race/ethnicity, child natal sex, child age at baseline, ABCD testing site, household income at baseline, and maximum parental education at baseline. Thus, this study's models isolate effects of late childhood individual difference factors on mid-adolescent screen use above and beyond effects of demographic variables and socioeconomic status. To correct for false discoveries among multiple comparisons and to ensure robustness of results, a Bonferroni correction set the p value at 0.05 divided by 6 (the number of tests). To be considered robustly statistically significant, regression results required p-values under 0.0083. Regression results with p-values above 0.0083 but below 0.05 were interpreted as marginally significant results. Analyses with smartphone/watch ownership as the outcome variable were run as logistic regressions, while all others were continuous linear regressions.

Two sets of post-hoc analyses were then performed. First, age 9/10 impulsivity was split into its four sub-facets (urgency, lack of planning, sensation seeking, and lack of perseverance) and entered as simultaneous predictors of all the forms of mid-adolescent screen time and problematic screen use that were assessed in the first six linear regression models. These six post-hoc analyses incorporated the same demographic, sex, and SES covariates, controlled for all other individual differences assessed, and used the same Bonferroni-corrected p-value threshold of 0.0083 to determine statistical significance.

Second, three logistic regression analyses duplicated the original continuous linear regression analyses for problematic screen use but now predicted binarized problematic/non-problematic screen use (youth were categorized as either normative or problematic users of video

games, social media, and smartphones). Previous work comparing adolescents meeting Internet Gaming Disorder-based criteria for social media addiction to a community sample of adolescents found that Bergen Social Media Addiction Scale scores of 24 and above were highly sensitive and specific in identifying adolescents with social media addiction (Luo et al., 2021). As mentioned previously, the VGAQ and SMAQ were based directly on Bergen problematic social media use measures and have the same numbers of items, the same symptoms, and the same score ranges as these measures. Hence, youth with VGAQ and SMAQ scores of 24 out of 36 or higher (i.e., reporting experiencing problematic use symptoms at least “sometimes” or more often for all items, on average) were categorized as problematic users of video games and social media. Though also conceptually based on the Bergen Facebook or Social Media Addiction Scale, the MPIQ’s response options have a slightly wide range (1 to 7 rather than 1 to 6) and reflect agreement with symptom presence, rather than frequency of symptoms (as in the VGAQ and SMAQ). Because the MPIQ’s “Somewhat agree” answer option most directly translated to the VGAQ and SMAQ’s “Sometimes” answer option, youth with MPIQ scores of 40 or more out of 56 were therefore categorized as problematic smartphone users (with such youth answering at least 4 out of 7, or “Somewhat agree” or more, to all items on average). Previous models predicted continuous problematic screen use scores. However, in a clinical context, identifying traits predicting increases in sub-threshold problematic use scores could be less pertinent than predicting which youth will cross the cutoff into fully problematic screen use. A Bonferroni correction set the p value at 0.05 divided by 3 (the number of tests) for these analyses. Therefore, regression results with p-values under 0.017 were considered robustly statistically significant, while results with p-values above 0.017 but below 0.05 were interpreted as marginally significant results.



## **Results**

### **Descriptive statistics**

#### **Demographics**

Summary statistics of demographic characteristics of the sample, screen use, and individual difference measures are shown in Tables 1a, 1b, and 1c, respectively. The sample is roughly equally male and female and racially/ethnically diverse, and proportions of youth self-identifying with each racial/ethnic group closely approach parity with American census demographic data for children 18 and under in 2016 and 2017, the years when baseline ABCD data were collected (e.g., in 2016, 51% of American children identified as White, as did 56% of this study's sample participants) (Census Bureau, 2023). At baseline, 0.15% of the sample is 8 years old, 99.77% of the sample is 9 or 10 years old, and 0.08% of the sample is 11 years old. At year 4, 0.04% of the sample is 11 years old, 99.85% of the sample is between 12 and 15 years old, and 0.11% of the sample is 16 to 17 years old.

Socioeconomic status of participants' parents skews somewhat higher than average, as 68.63% of children had at least one parent with a bachelor's degree or higher (in 2021, only 37.39% of American adults had a bachelor's degree or higher, according to the U.S. Census Bureau). See Tables 1a-1c for summary statistics on demographic, screen use, and individual difference measures.

#### **Baseline Screen Use**

At baseline (when youth were ages 9-10), screen use was minimal (See Table 1b). At this timepoint, 50% of the sample played video games for a half hour or less each day, and 13% of the sample did not play video games at all. Social media use was even rarer in the sample at this

timepoint: 96% of the sample used social media for a half hour or less each day, and 83% of the sample did not use social media at all. Questions about smartphone ownership were not asked at baseline. Broadly, despite some video game use, the sample was largely naïve to prolonged screen use at ages 9-10. See Table 1b for screen use statistics.

#### **Year 4 Screen Use**

At year 4 (when youth were ages 12-15), screen use was significantly higher than it was at baseline. At this timepoint, 65% of the sample played video games for more than half an hour each day, with average daily hours spent on video games rising from one hour (at baseline) to nearly 3 hours (at year 4). Likewise, while 83% of the sample did not use social media at all at baseline, by year 4, only 38% of the sample did not use social media; social media hours on a typical day were now over an hour and a half on average. Though questions about smartphone ownership were not asked at baseline, by year 4, 89% of the sample owned a smartphone or smart watch. However, only a minority of participants in the sample (roughly 3 to 7%, depending on mode of use) met cutoffs for problematic screen use. See Table 1b for screen use statistics.

**Table 1a***Demographic characteristics of the longitudinal sample (n = 4,754)*

	<b>Percentage or mean (SD)</b>
<b>Age at baseline (years)</b>	9.51 (0.50)
<b>Age range at baseline (years)</b>	8-11
<b>Age at year 4 (years)</b>	13.64 (0.73)
<b>Age range at year 4 (years)</b>	11-17
<b>Sex</b>	
Male	52.34%
Female	47.64%
<b>Race/Ethnicity</b>	
White	56.42%
Hispanic	20.59%
Black	10.71%
Other	9.97%
Asian	2.31%
<b>Highest parental education at baseline</b>	
Less than high school	2.53%
High school degree or GED	5.64%
Associate's degree or some college	23.20%
Bachelor's degree	29.00%
Master's degree	26.94%
Professional or doctoral degree	12.69%
Refused to answer	0.06%
<b>Household income at baseline</b>	
Less than \$12,000	5.30%
\$12,000 - \$24,999	5.85%
\$25,000 - \$49,999	13.49%
\$50,000 - \$99,999	27.34%
\$100,000 - \$199,999	29.58%
\$200,000 and greater	11.09%
Refused to answer/don't know	7.36%

**Table 1b***Screen use summary statistics of the sample at baseline and year 4.*

<b>Baseline Screen Use</b>	
<b>Screen time at baseline</b>	<b>Percentage or mean (SD)</b>
Does not play video games	12.92%
Plays video games for 30 minutes/day or less	49.69%
Does not use social media	82.65%
Uses social media for 30 minutes/day or less	95.86%
<b>Average daily screen time (in hours)</b>	
Video games	0.99 (1.07)
Social media	0.10 (0.36)
<b>Year 4 Screen use</b>	
<b>Screen time at year 4 follow-up</b>	<b>Percentage or mean (SD)</b>
Does not play video games	27.22%
Plays video games for 30 minutes/day or less	35.84%
Does not use social media	38.31%
Uses social media for 30 minutes/day or less	45.02%
Does not own a smartphone/watch	10.90%
Owns a smartphone/watch	89.10%
<b>Average daily screen time (in hours)</b>	
Video games	2.75 (3.61)
Social media	1.59 (2.20)
<b>Problematic screen use at year 4 follow-up</b>	
VGAQ score (range: 6-36, problematic cutoff = 24)	12.82 (6.23)
SMAQ score (range: 6-36, problematic cutoff = 24)	11.72 (5.56)
MPIQ score (range: 8-56, problematic cutoff = 40)	26.52 (8.77)
<b>Youth meeting criteria for problematic use</b>	
Video games	6.65%
Social media	3.37%
Smartphones	6.78%

**Table 1c**

*Individual difference summary statistics of the sample at baseline (ages 9-10).*

<b>Individual differences at baseline</b>	<b>Mean (SD)</b>
<b>BIS total score</b>	5.52 (2.82)
<b>BAS Reward Responsiveness + Drive score</b>	13.01 (4.58)
Reward responsiveness subscale	8.86 (2.33)
Drive subscale	4.15 (3.05)
<b>UPPS-P total score</b>	40.65 (7.66)
Urgency subscale	16.20 (4.76)
Lack of Planning subscale	7.69 (2.36)
Sensation-seeking subscale	9.80 (2.67)
Lack of Perseverance subscale	6.97 (2.22)
<b>CBCL internalizing total raw score</b>	4.23 (5.49)
<b>CBCL externalizing total raw score</b>	5.01 (5.42)
<b>General cognitive ability</b> component score	0.07 (0.77)
<b>Executive Function</b> component score	0.06 (0.75)
<b>Learning/Memory</b> component score	0.07 (0.69)

### **Intercorrelations among measures**

Intercorrelations among measures are shown in Table 2. Interestingly, at year 4, hours spent playing video games and using social media only correlate  $r = 0.28$  and  $r = 0.27$  with concurrent VGAQ and SMAQ scores, respectively, supporting the idea that prolonged ST is not necessarily equivalent to PSU. Impulsivity sub-facets also show intriguing patterns of associations. Lack of planning and lack of perseverance are highly correlated, urgency correlates moderately with all three other impulsivity sub-facets, and sensation-seeking correlates positively with some sub-facets (urgency and lack of planning) and yet negatively with another (lack of perseverance).

**Table 2**

*Intercorrelations between personality, psychopathology, neurocognition, and ST measures*

	Baseline UPPS-P	Baseline U	Baseline LO Planning	Baseline SS	Baseline LOP	Baseline BAS D + RR	Baseline BIS	Baseline CBCL-I	Baseline CBCL-E	Baseline GCA	Baseline EF	Baseline L/M	Year 4 VG	Year 4 VGAQ	Year 4 SM	Year 4 SMAQ	Year 4 MPIQ
Baseline UPPS-P	1																
Baseline U	0.81***	1															
Baseline LO Planning	0.60***	0.21***	1														
Baseline SS	0.47***	0.19***	0.07***	1													
Baseline LOP	0.52***	0.19***	0.45***	-0.08***	1												
Baseline BAS D + RR	0.19***	0.24***	-0.01	0.18***	-0.08***	1											
Baseline BIS	0.10***	0.23***	0.02	0.02	-0.05***	0.27***	1										
Baseline CBCL-I	0.07***	0.08***	0.03	-0.05***	0.10***	0.00	0.09***	1									
Baseline CBCL-E	0.20***	0.18***	0.13***	0.02	0.13***	0.11***	0.01	0.58***	1								
Baseline GCA	-0.05***	-0.14***	0.05***	0.11***	-0.05***	-0.14***	-0.02	-0.01	-0.12***	1							
Baseline EF	-0.03*	-0.04***	0.02	0.04*	-0.08***	-0.03*	-0.02	-0.05***	-0.07***	0.17***	1						
Baseline L/M	-0.09***	-0.11***	0.00	0.00	-0.09***	-0.12***	0.00	-0.03	-0.11***	0.32***	0.16***	1					
Year 4 VG	0.14***	0.15***	0.04***	0.02	0.10***	0.13***	0.00	0.04***	0.12***	-0.2***	-0.11***	-0.17***	1				
Year 4 VGAQ	0.10***	0.10***	0.05***	0.00	0.08***	0.05***	0.06***	0.06***	0.06***	0.01	-0.02	-0.05***	0.28***	1			
Year 4 SM	0.06***	0.09***	0.01	-0.01	0.02	0.12***	0.04*	0.02	0.05***	-0.18***	-0.05***	-0.11***	0.27***	0.00	1		
Year 4 SMAQ	0.04*	0.05***	0.02	-0.02	0.03	0.02	0.06***	0.03*	0.02	-0.02	-0.02	-0.02	0.04*	0.24***	0.27***	1	
Year 4 MPIQ	0.10***	0.11***	0.04*	0.01	0.06***	0.07***	0.09***	0.03	0.04*	-0.05***	-0.02	-0.04*	0.05***	0.17***	0.28***	0.46***	1

*Note.* \* =  $p < 0.05$ , \*\* =  $p < 0.01$ , \*\*\* =  $p < 0.001$ , U = Baseline Urgency, LO Planning = Lack of Planning, SS = Sensation Seeking, LOP = Lack of Perseverance, BAS D + RR = BAS Drive + Reward Responsiveness, CBCL-I = CBCL Internalizing, CBCL-E = CBCL Externalizing, GCA = General Cognitive Ability, EF = Executive Functioning, L/M = Learning/Memory, VG = video game hours, SM = social media hours).

**Predictors of Screen Time**

Table 3 shows main effects and model statistics from three linear regression analyses testing late childhood individual differences’ ability to predict mid-adolescent ST (full ST regression results available in Appendix Tables 1a-1c). All analyses controlled for child race/ethnicity, child natal sex, child age at baseline, ABCD testing site, household income at baseline, and maximum parental education at baseline.

*Video game use*

Video game hours were predicted by impulsivity and general cognitive ability. Specifically, higher self-reported UPPS-P total impulsivity scores at baseline predicted longer time playing video games at year 4. Also contrary to the study’s hypotheses, impulsivity

associations with video game hours were not predicted by sensation-seeking sub-facet scores, but rather by higher urgency and lack of perseverance sub-facet scores (See Table 4). Concerning relationships with baseline cognition, higher scores on the baseline general cognitive ability task performance component were associated with shorter video game hours. Higher BAS Reward Responsiveness + Drive reward sensitivity scores at baseline showed a marginally significant positive association with longer video game hours at year 4.

#### *Social media use*

Social media hours were predicted by impulsivity and reward sensitivity. Namely, higher self-reported UPPS-P total impulsivity scores (particularly, high scores on the urgency and lack of planning sub-facets, see Table 4) at baseline predicted greater time using social media at year 4, as did higher self-reported BAS Reward Responsiveness + Drive reward sensitivity scores at baseline. Higher scores on the baseline general cognitive ability and learning/memory task performance components were marginally significantly associated with greater use of social media.

#### *Smartphone ownership*

As mentioned earlier, direct measurements of hours spent using smartphones were not measured; instead, smartphone/watch ownership was measured. Greater parent-reported CBCL externalizing scores at baseline predicted lower odds of owning a smartphone/watch at year 4; other late childhood individual differences were unrelated to this variable.

### **Predictors of Problematic Screen Use**

Table 3 shows main effects and model statistics from linear regression analyses testing late childhood individual differences' ability to predict mid-adolescent PSU (full PSU regression results available in Appendix tables 2a-2c). All analyses controlled for child race/ethnicity, child

natal sex, child age at baseline, ABCD testing site, household income at baseline, and maximum parental education at baseline. Three regression analyses were conducted.

#### *Problematic video game use*

Problematic video game use was predicted by total impulsivity, punishment sensitivity, and internalizing, supporting hypotheses that these variables would predict PSU. Specifically, higher self-reported UPPS-P total impulsivity scores (specifically, urgency sub-facet scores, see Table 4), higher BIS punishment sensitivity scores, and higher parent-reported CBCL internalizing total scores at baseline predicted higher VGAQ scores at year 4. Intriguingly, counter to hypotheses, baseline parent-rated externalizing scores, reward sensitivity, and neurocognitive abilities were not significantly related to year 4 VGAQ scores in these models.

#### *Problematic social media use*

Problematic social media use was significantly predicted by impulsivity, with higher baseline UPPS-P total impulsivity scores predicting higher year 4 SMAQ scores. Other late childhood individual differences were unrelated to later SMAQ scores.

#### *Problematic phone use*

Problematic phone use was predicted by impulsivity and reward sensitivity. Specifically, higher baseline UPPS-P total impulsivity scores (specifically, urgency sub-facet scores, see Table 4). Higher baseline BAS Reward Responsiveness + Drive reward sensitivity scores predicted higher year 4 MPIQ scores. Higher BIS punishment sensitivity scores were a marginally significant predictor of higher MPIQ scores.

**Table 3**

Main effects in regression analyses (see Appendix Tables 1a-1c and 2a-2c for full regression results).

<b>Screen Time</b>				<b>Problematic Screen Use</b>			
<b>Video game hours</b>				<b>Problematic Video game use</b>			
<i>Predictor</i>	<i>Beta</i>	<i>SE</i>	<i>p</i>	<i>Effect</i>	<i>Beta</i>	<i>SE</i>	<i>p</i>
(Intercept)	1.61	1.65	0.329	(Intercept)	9.56	3.17	.00253
Impulsivity	+0.04	0.01	<0.001	Impulsivity	+0.05	0.01	<0.001
Reward sensitivity	+0.03	0.01	0.0113	Reward sensitivity	-0.02	0.02	0.312
Punishment sensitivity	+0.01	0.02	0.586	Punishment sensitivity	+0.14	0.03	<0.001
General Cognitive Ability	-0.32	0.08	<0.001	General Cognitive Ability	+0.36	0.15	0.0173
Executive Functioning	-0.10	0.07	0.152	Executive Functioning	+0.02	0.13	0.893
Learning/Memory	-0.11	0.08	0.134	Learning/Memory	-0.05	0.14	0.721
Internalizing	+0.01	0.01	0.489	Internalizing	+0.06	0.02	0.004
Externalizing	+0.02	0.01	0.168	Externalizing	-0.01	0.02	0.784
<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>	<b>Overall model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>
	21.38	0.22	<2.2e-16		6.24	0.07	<2.2e-16
<b>Social media hours</b>				<b>Problematic social media use</b>			
<i>Predictor</i>	<i>Beta</i>	<i>SE</i>	<i>p</i>	<i>Predictor</i>	<i>Beta</i>	<i>SE</i>	<i>p</i>
(Intercept)	-4.34	1.08	<0.001	(Intercept)	10.15	2.88	<0.001
Impulsivity	+0.02	0.00	<0.001	Impulsivity	+0.04	0.01	0.0013
Reward sensitivity	+0.04	0.01	<0.001	Reward sensitivity	+0.02	0.02	0.269
Punishment sensitivity	-0.02	0.01	0.194	Punishment sensitivity	+0.05	0.03	0.0884
General Cognitive Ability	-0.15	0.05	0.00227	General Cognitive Ability	+0.12	0.13	0.374
Executive Functioning	-0.06	0.04	0.206	Executive Functioning	-0.19	0.12	0.119
Learning & Memory	-0.13	0.05	0.0100	Learning & Memory	-0.08	0.13	0.558
Internalizing	+0.00	0.01	0.933	Internalizing	+0.01	0.02	0.460
Externalizing	+0.01	0.01	0.359	Externalizing	+0.02	0.02	0.360
<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>	<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>
	12.90	0.14	<2.2e-16		3.37	0.03	<2.2e-16
<b>Smartphone/watch ownership</b>				<b>Problematic smartphone use</b>			
<i>Predictor</i>	<i>Beta</i>	<i>SE</i>	<i>p</i>	<i>Predictor</i>	<i>Beta</i>	<i>SE</i>	<i>p</i>
(Intercept)	0.06	0.16	0.711	(Intercept)	15.99	4.49	<0.001
Impulsivity	-0.001	0.001	0.269	Impulsivity	+0.13	0.02	<0.001
Reward sensitivity	+0.001	0.001	0.227	Reward sensitivity	+0.09	0.03	0.00377
Punishment sensitivity	-0.001	0.001	0.659	Punishment sensitivity	+0.12	0.05	0.0186
General Cognitive Ability	-0.01	0.01	0.319	General Cognitive Ability	-0.29	0.21	0.173
Executive Functioning	+0.01	0.01	0.195	Executive Functioning	-0.22	0.18	0.222
Learning & Memory	-0.00	0.01	0.959	Learning & Memory	-0.16	0.20	0.433
Internalizing	+0.00	0.00	0.409	Internalizing	+0.002	0.03	0.947
Externalizing	-0.004	0.001	<0.001	Externalizing	+0.04	0.03	0.177
<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>	<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>
	3.56	0.04	<2.2e-16		5.81	0.06	<2.2e-16

Note. Significant results (p under corrected value of 0.0083) highlighted in dark grey and marginally significant results (p under 0.05 but above 0.0083) highlighted in light grey.

**Table 4**

Main effects of UPPS-P impulsivity sub-facet regression analyses (see Appendix Tables 3a-3f for full regression results)

Screen Time				Problematic Screen Use			
Video game hours				Problematic Video game use			
Predictor	Beta	SE	p	Effect	Beta	SE	p
(Intercept)	1.62	1.65	0.32	(Intercept)	9.82	3.17	0.002
Urgency	+0.04	0.01	<0.001	Urgency	+0.08	0.02	<0.001
Lack of Planning	+0.00	0.02	0.99	Lack of Planning	+0.04	0.05	0.39
Sensation Seeking	-0.01	0.02	0.53	Sensation Seeking	-0.08	0.04	0.03
Lack of Perseverance	+0.12	0.02	<0.001	Lack of Perseverance	+0.12	0.05	0.02
<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>	<b>Overall model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>
	20.79	0.23	<2.2e-16		6.24	0.07	<2.2e-16

  

Social media hours				Problematic Social media use			
Predictor	Beta	SE	p	Effect	Beta	SE	p
(Intercept)	-4.31	1.08	<0.001	(Intercept)	10.16	2.89	<0.001
Urgency	+0.02	0.01	0.02	Urgency	+0.03	0.02	0.12
Lack of Planning	+0.03	0.02	0.03	Lack of Planning	+0.07	0.04	0.07
Sensation Seeking	-0.00	0.01	0.78	Sensation Seeking	-0.01	0.03	0.83
Lack of Perseverance	+0.02	0.02	0.27	Lack of Perseverance	+0.05	0.04	0.21
<b>Overall Model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>	<b>Overall model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>
	12.37	0.14	<2.2e-16		3.27	0.03	<2.2e-16

  

Smartphone/watch ownership				Problematic Smartphone use			
Predictor	Beta	SE	p	Effect	Beta	SE	p
(Intercept)	-6.52	1.59	<0.001	(Intercept)	16.11	4.49	<0.001
Urgency	+0.00	0.01	0.85	Urgency	+0.14	0.03	<0.001
Lack of Planning	-0.01	0.02	0.68	Lack of Planning	+0.13	0.06	0.04
Sensation Seeking	+0.01	0.02	0.96	Sensation Seeking	+0.04	0.05	0.44
Lack of Perseverance	-0.05	0.03	0.06	Lack of Perseverance	+0.18	0.07	0.009
<b>Overall Model</b>		<i>Adjusted R<sup>2</sup></i>	<i>p</i>	<b>Overall model</b>	<i>F-statistic</i>	<i>Adjusted R<sup>2</sup></i>	<i>p</i>
		0.15	<2.2e-16		5.604	0.06	<2.2e-16

Note. Significant results (p under corrected value of 0.0083) highlighted in dark grey and marginally significant results (p under 0.05 but above 0.0083) highlighted in light grey.

### Post-hoc analyses

#### Problematic Screen Use as a Categorical Variable

Re-running individual difference/PSU analyses with a case/control model (in which problematic screen use outcomes were binarized “problematic user/normative user” variables) produced a different pattern of results (See Appendix Tables 4a-4c).

Of all the individual differences assessed, only higher baseline UPPS-P total impulsivity scores predicted whether a participant met the cutoff for problematic video game use at year 4. Punishment sensitivity and internalizing scores, which predicted continuous problematic video game use scores, did not significantly predict problematic video game user status.

Despite impulsivity significantly predicting continuous SMAQ scores, only lower baseline learning/memory component scores predicted whether a participant met the cutoff for problematic social media use at year 4.

As with problematic video game use, higher baseline UPPS-P total impulsivity scores predicted whether a participant met the cutoff for problematic phone use at year 4, as did lower baseline learning/memory component and higher CBCL externalizing scores. Punishment sensitivity, which predicted continuous problematic phone use scores, was only a marginally significant predictor of meeting the problematic use cutoff for phone use.

## Discussion

In a large, diverse sample of American adolescents, longitudinal analyses controlling for demographic characteristics and family SES found the following relationships between late childhood individual differences and ST and PSU in mid adolescence. First, longer ST was broadly predicted by higher impulsivity. Video game ST was also specifically predicted by lower cognitive ability, and social media ST by higher reward sensitivity. Second, as with ST, all three forms of PSU were predicted by higher impulsivity. However, other predictors of PSU—namely, punishment sensitivity and internalizing tendencies, which predicted problematic video game use—showed no relationships with any form of ST. In case/control models where PSU was operationalized dichotomously, impulsivity remained predictive of later PSU, while reward and punishment sensitivity and internalizing did not. Post-hoc analyses of both ST and PSU revealed urgency, and to a lesser degree lack of perseverance, to be the sub-facets of impulsivity most consistently associated with variation in screen use. Lack of planning and sensation-seeking showed no significant associations with screen use.

Taken together, results indicate that mid-adolescent ST and PSU alike are robustly predicted by higher premorbid levels of impulsivity, especially tendencies to respond rashly to affective states and to lack focus. Additionally, punishment sensitivity and internalizing emerged as predictors of problematic video game use alone. Late childhood executive functioning and externalizing tendencies did not predict any form of mid adolescent screen use. Notably, because this sample's individual differences were measured when screen use was minimal, they capture levels of traits prior to the development of PSU.

Individual differences associated with later ST included impulsivity, reward sensitivity, and lower general cognitive ability. Though impulsivity was hypothesized to predict PSU and not ST, youth with higher levels of impulsivity had longer ST four years later than peers with lower levels of impulsivity, cohering with prior research finding youth with higher impulsivity at baseline to play video games longer at follow-up (Gentile et al., 2012) and with prior research finding youth with higher impulsivity to have longer ST (McArthur et al., 2022). As mentioned earlier, youth with higher impulsivity could have longer ST because they are more easily distracted by screen stimuli and are less capable of self-limiting prolonged screen use, regardless of whether such use is problematic or not. Rather than being a distinctive risk factor of PSU, impulsivity may predispose children to greater screen use across media formats more generally, with other individual differences being more distinctive to PSU.

In addition to impulsivity, higher reward sensitivity also predicted social media ST. Highly reward-sensitive youth may be more drawn to prolonged social media usage due to the immediacy, availability, and social salience of rewards on social media platforms. Large-scale computational reward learning research conducted on social media posting behaviors finds that social media posting behavior follows classical reinforcement learning patterns—i.e., that users’ posting frequency increases in close tandem with increasing provision of “Likes” (Lindstrom et al., 2021). Though speculative, it is possible that youth with higher reward sensitivity are especially keen to initiate social media use in early adolescence, perhaps explaining prior research finding cross-sectional associations between reward sensitivity and greater social media involvement (Lyvers et al., 2019). As social media use normatively increases throughout the teenage years, youth with higher reward sensitivity could be especially driven by social media reinforcers, leading to greater social media engagement (i.e., posting, liking, and commenting).

As with ST, late childhood impulsivity positively predicted mid-adolescent PSU across all three screen use formats examined, reinforcing prior cross-sectional literature finding individuals with greater PSU to have higher impulsivity (Li et al., 2019; Peris et al., 2020; Xiang et al., 2021; Guo et al., 2022; Kim et al., 2016; Horwood & Anglim, 2018; Meerkerk et al., 2010). This study's longitudinal results shed new light on previous cross-sectional results by informing interpretation about these results' possible direction of causality. Rather than being solely a consequence of heavy screen use, high impulsivity may be a pre-existing individual difference predisposing some youth towards selecting screen activities and developing increasingly compulsive screen use over time. When attempting to determine consequences of prolonged screen use, research will ideally quantify and account for pre-existing differences in impulsivity between those who go on to use screens problematically and those who do not.

In contrast to impulsivity, which predicted both ST and PSU, late childhood punishment sensitivity and internalizing predicted mid-adolescent PSU, but not ST. Specifically, youth with higher punishment sensitivity in late childhood had significantly higher problematic video game scores in mid-adolescence, as well as marginally higher smartphone use scores. Youth with higher parent-reported internalizing tendencies in late childhood also had higher problematic video game scores in mid-adolescence. Results affirm prior research finding associations between elevated punishment sensitivity and PSU (Vargas et al., 2019), as well as research finding youth with both high impulsivity and high punishment sensitivity to have greater PSU (Xiang et al., 2021), though it is important to note that interactions between traits were not directly measured in the current study. Impulsivity's links to both ST and PSU and internalizing and punishment sensitivity's specificity to PSU suggest an interesting possibility: while impulsivity may broadly predispose youth to longer screen use, perhaps tendencies towards

emotional distress and avoidance are the traits distinctly associated with prolonged screen use becoming problematic. Motivations underlying screen use may be important to understanding PSU risk. Youth with higher impulsivity may be more easily distracted by screen-based rewards but may use screens normatively, so long as their motivations for screen use center around leisure or social connection. On the other hand, youth with higher punishment sensitivity and internalizing tendencies may be at higher risk of developing PSU, as their motivations to use screen may center around coping with anxiety and distress. As youth facing high levels of distress habitually use screens more and more, screens may become an irresistible and unhealthy coping mechanism, gradually morphing into problematic use. Supporting this speculation, prior research has associated fear of missing out with problematic social media use (Blackwell et al., 2017) and has found emotion-focused coping to mediate positive associations between high punishment sensitivity and higher problematic internet use scores (Li et al., 2019). Again, because trait interactions were not assessed in the current study, it is unknown whether youth high in impulsivity, punishment sensitivity *and* internalizing are at particular risk. Future research may clarify punishment sensitivity- and internalizing-related pathways to PSU by longitudinally surveying adolescents about their motivations for screen use and directly testing whether the use of screens to cope with distress is associated with greater subsequent PSU.

One interesting finding of this study was that sensation-seeking (or a high desire for thrills and tolerance for risk) was hypothesized to be associated with problematic video game use, but in this sample, children high in sensation-seeking had *lower* problematic video gaming scores in mid-adolescence. This result contradicts prior literature finding individuals with higher levels of sensation-seeking to have higher problematic video game scores (Hamid et al., 2022) and may suggest that video games are not a form of thrill-seeking behavior in youth.

Importantly, losses or risks in video games carry only symbolic value and may simulate risk-taking behaviors (like using firearms and driving recklessly) without real-life risks. Conversely, analytical differences could also have contributed to discrepant results between the current study and prior research. While Hamid & colleagues assessed effects of sensation-seeking alone on problematic video game use, the current study assessed effects of sensation-seeking on problematic video game use while controlling for other impulsivity sub-facet effects. Therefore, it is possible that sensation-seeking relationships previously observed could reflect broad relationships between impulsivity and video gaming, rather than effects distinct to sensation-seeking.

Another striking finding of this study was that engagement with different screen activities in mid adolescence showed unique relationships with specific individual differences in childhood. Surprisingly, while problematic video game use in mid-adolescence was predicted by several late-childhood individual differences, problematic social media use was unrelated to all late-childhood individual differences except impulsivity. The current study's null relationship between late-childhood internalizing and mid-adolescent social media use coheres with prior longitudinal research in mid adolescents, which has found baseline anxiety symptoms to be unrelated to subsequent problematic social media use at follow-up (Gingras et al., 2023). Additionally, this study's null finding contribute to the interpretation of existing research finding associations between internalizing and social media use (Liu et al., 2022) by suggesting that associations between internalizing and social media use may not be bidirectional. Specifically, if late-childhood internalizing is unrelated to subsequent social media use, then heightened internalizing symptomatology among heavy social media users later in adolescence may indicate

internalizing to be a consequence, and not a predictor, of social media use, as suggested by some researchers (Liu et al, 2022; Fors & Barch, 2019; Keles et al., 2020; Twenge et al., 2022).

Notably, no relationships between childhood personality traits and mid-adolescent smartphone/watch ownership were statistically significant (except for parent-rated externalizing, which was negatively associated with likelihood of smartphone/watch ownership). Child smartphone/watch ownership does not capture parameters of use and may depend on family variables, such as having the funds to purchase an extra smartphone, rather than on child variables. Membership in the highest household income bracket was associated with greater likelihood of child smartphone/watch ownership (See Appendix, Table 1c), lending credence to the idea that parents determine phone ownership status in mid-adolescence, rather than children. On the other hand, large-scale survey data reports that 95% of all American 13- to 17-year-olds own their own smartphone, with virtually no differences by family income (Pew Research Center, 2023). Considering the near-universality of smartphone ownership by the mid-to-late teenage years, future research may aid understanding of smartphone use patterns by directly assessing hours and activity patterns of smartphone use.

Additionally, results differed among models in which PSU was modelled as a continuous or binary categorical variable. In models where individual differences predicted continuous numeric scores on later PSU measures, impulsivity predicted all three forms of PSU, and punishment sensitivity and internalizing specifically predicted problematic video game use. Alternatively, in models where individual differences predicted whether youth exceeded a PSU threshold or not, results changed. Impulsivity was the only individual difference still significantly predictive of problematic video game and phone use, and no individual differences predicted whether a participant exceeded PSU threshold for social media, specifically. Such

case/control analyses further support the robustness of late childhood impulsivity as a predictor of mid-adolescent PSU, while admittedly challenging the idea that punishment sensitivity and internalizing tendencies are important predictors of later PSU.

Taken together, results suggest that impulsivity is a robust predictor of ST and PSU across screen activities. In contrast to impulsivity, which related equally to ST and PSU, punishment sensitivity and internalizing tendencies appear related to PSU alone, specifically of video games. This study's results have intriguing implications for similarities and differences between PSU and substance use disorders. Certain substance use disorder risk factors like impulsivity (Verdejo-Garcia & Albein-Urios, 2021; Kozak et al., 2019; Kreek et al., 2005; Samek et al., 2017) and internalizing tendencies (Hussong et al., 2017; Elkins et al., 2006; Measelle et al., 2006; Groenman et al., 2017) appear to be associated with greater risk of developing PSU, based on the results of the current study. However, externalizing is considered a core risk factor for the development of substance use disorders (Krueger et al., 2021), and in the current study, late childhood externalizing did not significantly predict adolescent PSU. Likewise, though low EF abilities are a well-established risk factor for substance use (Luciana, 2020; Jones et al., 2021; Khurana et al., 2017; Kim-Spoon et al., 2017), EF task performance scores were unrelated to PSU in the current study. Therefore, though PSU and substance use risk factors may share some similarities, pathways to PSU appear to differ markedly from those to substance use disorders.

This study is characterized by several strengths bolstering confidence in findings. First, this study's longitudinal design allowed for testing of prospective associations between baseline individual differences, assessed prior to the onset of most screen use, and later screen use, rather than cross-sectional associations comparing characteristics of heavy and light screen users. Second, this study tested specificity of individual differences' associations with three distinct

forms of screen media popular among teenagers, assessing both shared and specific predictors of problematic use among all three media types. Third, this study's holistic measure of impulsivity allowed for testing of which specific impulsive traits contribute most to the development of later problematic screen use. And fourth, this study's individual difference measures are highly comprehensive, with self-report, parent-report, and behavioral measures encompassing domains of personality, psychopathology, and neurocognition.

However, limitations of this study require acknowledgement. All personality and screen use measures were self-reported measures, making them vulnerable to recall bias. In prior research on screen use in the ABCD study, objective passive-sensing measurements of time spent on smartphones were found to correlate only  $r=0.49$  with children's self-reported smartphone use time, with 79% of children under-reporting their own time spent on smartphones (Wade et al., 2021). Thus, self-reported ST measures may have lacked precision, considering that children at these age groups sometimes demonstrate low awareness of their own screen use. Likewise, parent-reported psychopathology measures may have also lacked precision, as some work finds significant discrepancies between parent- and child-reported internalizing measures (van de Looij-Jansen et al., 2011). Also, due to measurement issues, PSU findings may not fully generalize to individuals with conditions like Internet Gaming Disorder or to individuals with severe distress/impairment from screen use. Despite containing one item measuring clinically significant impairment from PSU ("I play video games/use social media so much it has had a bad effect on my schoolwork or job"), VGAQ and SMAQ items measuring distress associated with excessive screen use ("I've become stressed or upset if I am not allowed to play video games/use social media" and "I play video games/use social media so I can forget about my problems") appear more related to withdrawal and coping than to distress caused by excessive screen use,

per se. Other items in this study's PSU measures may also reflect aspects of screen use that have become more culturally normative over time, especially for younger cohorts. Considering that nearly half of American teenagers now report being online "almost constantly" (Pew Research Center, 2018), using one's phone "for no particular reason" and "losing track" of phone use may no longer be behaviors that adolescents consider problematic. Finally, as indicated above, this analysis did not consider interactions among traits that may be meaningful in predicting which individuals go on to develop PSU or possible sex differences in developmental pathways to PSU.

## **Conclusions**

Prolonged duration of screen time appears to be an imprecise indicator of whether an adolescent's screen use is problematic in nature. Rather, the development of problematic screen use may depend on adolescents' pre-existing individual differences, especially their levels of personality traits related to disinhibition and distress. Results have implications for the consequences of heavy screen use. Robust associations of late childhood impulsivity with screen time and problematic use of several screen activities suggest that impulsivity and screen use behaviors may bidirectionally impact each other throughout adolescence. On the other hand, null associations between internalizing symptoms and later problematic social media use suggest that social media and internalizing do not demonstrate a bidirectional relationship—rather, social media associations with internalizing may instead reflect a causal relationship. Results also have implications for prevention and treatment of problematic screen use in youth. Youth with high levels of impulsivity, as well as youth with greater internalizing tendencies, may benefit from extra parental monitoring and guidance of their screen use.

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## Appendix

### Tables 1a-1c: Main regression analyses, Normative Screen Use (NSU)

**Table 1a**

*Individual differences predicting normative video game use*

<i>Predictors</i>	<b>Year 4 Video Game Hours</b>				
	<i>Beta</i>	<i>Standard Error</i>	<i>Standardized Beta</i>	<i>Standard Error</i>	<i>p</i>
(Intercept)	1.61	1.65	0.61	0.38	0.329
UPPS-P total	0.04	0.01	0.08	0.01	<b>&lt;0.001</b>
BAS Reward Responsiveness + Drive	0.03	0.01	0.04	0.01	<b>0.011</b>
BIS	0.01	0.02	0.01	0.01	0.586
GENERAL COGNITIVE ABILITY	-0.32	0.08	-0.07	0.02	<b>&lt;0.001</b>
EXECUTIVE FUNCTIONING	-0.10	0.07	-0.02	0.01	0.152
LEARNING/MEMORY	-0.11	0.08	-0.02	0.01	0.134
CBCL Internalizing	0.01	0.01	0.01	0.02	0.489
CBCL Externalizing	0.02	0.01	0.02	0.02	0.168
Sex (Female)	-2.01	0.10	-0.57	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	1.56	3.15	0.44	0.89	0.620
Race/Ethnicity (Black)	1.50	0.18	0.42	0.05	<b>&lt;0.001</b>
Race/Ethnicity (Hispanic)	0.33	0.16	0.09	0.04	<b>0.038</b>
Race/Ethnicity (Asian)	-0.20	0.33	-0.06	0.09	0.547
Race/Ethnicity (Other)	0.55	0.17	0.16	0.05	<b>0.001</b>

Household Income (\$5,000-\$11,999)	-1.15	0.42	-0.32	0.12	<b>0.006</b>
Household Income (\$12,000-\$15,999)	-0.29	0.46	-0.08	0.13	0.528
Household Income (\$16,000-\$24,999)	0.34	0.39	0.10	0.11	0.394
Household Income (\$25,000-\$34,999)	-0.24	0.37	-0.07	0.10	0.521
Household Income (\$35,000-\$49,999)	-0.77	0.35	-0.22	0.10	<b>0.029</b>
Household Income (\$50,000-\$74,999)	-0.76	0.34	-0.21	0.10	<b>0.027</b>
Household Income (\$75,000-\$99,999)	-0.75	0.35	-0.21	0.10	<b>0.030</b>
Household Income (\$100,000 - \$199,999)	-0.87	0.34	-0.24	0.10	<b>0.011</b>
Household Income (\$200,000 and greater)	-1.01	0.37	-0.28	0.10	<b>0.006</b>
Household Income (Refuse to answer)	-0.60	0.40	-0.17	0.11	0.130
Household Income (Don't know)	-0.53	0.40	-0.15	0.11	0.184
Child Age	0.13	0.10	0.02	0.01	0.209
Parents' maximum education (7th grade)	-2.53	3.39	-0.72	0.96	0.455
Parents' maximum education (8th grade)	-0.65	1.62	-0.18	0.46	0.690

Parents' maximum education (9th grade)	0.39	1.48	0.11	0.42	0.794
Parents' maximum education (10th grade)	0.55	1.46	0.15	0.41	0.709
Parents' maximum education (11th grade)	-1.38	1.51	-0.39	0.43	0.363
Parents' maximum education (12th grade)	-1.10	1.38	-0.31	0.39	0.426
Parents' maximum education (High school graduate)	0.25	1.30	0.07	0.37	0.845
Parents' maximum education (GED or equivalent)	-0.14	1.33	-0.04	0.38	0.915
Parents' maximum education (Some college)	0.27	1.29	0.08	0.37	0.833
Parents' maximum education (Associate degree × Occupational)	-0.11	1.30	-0.03	0.37	0.933
Parents' maximum education (Associate degree × Academic Program)	0.11	1.30	0.03	0.37	0.934
Parents' maximum education (Bachelor's degree)	-0.69	1.29	-0.19	0.36	0.594
Parents' maximum education (Master's degree)	-0.86	1.29	-0.24	0.37	0.504
Parents' maximum education (Professional school degree like MD)	-0.97	1.30	-0.27	0.37	0.457

Parents' maximum education (Doctoral degree like PhD)	-0.95	1.30	-0.27	0.37	0.464
Study Site #2	-0.46	0.36	-0.13	0.10	0.203
Study Site #3	0.14	0.36	0.04	0.10	0.685
Study Site #4	0.14	0.34	0.04	0.10	0.674
Study Site #5	-0.00	0.41	-0.00	0.12	0.997
Study Site #6	-0.38	0.36	-0.11	0.10	0.299
Study Site #7	0.16	0.71	0.04	0.20	0.825
Study Site #8	-0.64	0.42	-0.18	0.12	0.128
Study Site #9	0.29	0.44	0.08	0.12	0.510
Study Site #10	-0.02	0.34	-0.00	0.10	0.963
Study Site #11	0.40	0.48	0.11	0.13	0.400
Study Site #12	-0.14	0.38	-0.04	0.11	0.708
Study Site #13	-0.26	0.36	-0.07	0.10	0.470
Study Site #14	-0.72	0.40	-0.20	0.11	0.072
Study Site #15	1.19	0.42	0.34	0.12	<b>0.005</b>
Study Site #16	-1.11	0.35	-0.31	0.10	<b>0.002</b>
Study Site #17	-0.83	0.41	-0.23	0.12	<b>0.043</b>
Study Site #18	0.01	0.40	0.00	0.11	0.985
Study Site #19	-0.71	0.37	-0.20	0.10	0.051
Study Site #20	-0.12	0.37	-0.03	0.10	0.741
Study Site #21	0.07	0.36	0.02	0.10	0.856

Study Site #22	-0.61	0.82	-0.17	0.23	0.457
<hr/>	<hr/>				
R <sup>2</sup> / R <sup>2</sup> adjusted	0.235 / 0.224				

**Table 1b***Individual differences predicting normative social media use*

<i>Predictors</i>	<b>Year 4 Social Media Hours</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	-4.34	1.08	-0.55	0.40	<b>&lt;0.001</b>
Baseline UPPS-P total	0.02	0.00	0.06	0.01	<b>&lt;0.001</b>
BAS Reward Responsiveness + Drive	0.04	0.01	0.08	0.02	<b>&lt;0.001</b>
Baseline BIS	-0.02	0.01	-0.02	0.02	0.194
GENERAL COGNITIVE ABILITY	-0.15	0.05	-0.05	0.02	<b>0.002</b>
EXECUTIVE FUNCTIONING	-0.06	0.04	-0.02	0.01	0.206
LEARNING/MEMORY	-0.13	0.05	-0.04	0.02	<b>0.010</b>
CBCL Internalizing	0.00	0.01	0.00	0.02	0.933
CBCL Externalizing	0.01	0.01	0.02	0.02	0.359
Sex (Female)	0.86	0.06	0.39	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	-1.23	2.05	-0.56	0.94	0.550
Race/Ethnicity (Black)	1.00	0.12	0.46	0.05	<b>&lt;0.001</b>
Race/Ethnicity (Hispanic)	0.48	0.10	0.22	0.05	<b>&lt;0.001</b>
Race/Ethnicity (Asian)	-0.11	0.21	-0.05	0.10	0.600
Race/Ethnicity (Other)	0.27	0.11	0.12	0.05	<b>0.013</b>
Household Income (\$5,000-\$11,999)	0.60	0.27	0.27	0.12	<b>0.028</b>

Household Income (\$12,000-\$15,999)	0.77	0.30	0.35	0.14	<b>0.011</b>
Household Income (\$16,000-\$24,999)	0.43	0.26	0.20	0.12	0.094
Household Income (\$25,000-\$34,999)	0.22	0.24	0.10	0.11	0.361
Household Income (\$35,000-\$49,999)	0.23	0.23	0.11	0.11	0.316
Household Income (\$50,000-\$74,999)	0.20	0.22	0.09	0.10	0.365
Household Income (\$75,000-\$99,999)	0.21	0.23	0.09	0.10	0.358
Household Income (\$100,000 - \$199,999)	0.15	0.22	0.07	0.10	0.504
Household Income (\$200,000 and greater)	0.21	0.24	0.09	0.11	0.385
Household Income (Refuse to answer)	0.68	0.26	0.31	0.12	<b>0.009</b>
Household Income (Don't know)	0.17	0.26	0.08	0.12	0.517
Child Age	0.38	0.07	0.09	0.01	<b>&lt;0.001</b>
Parents' maximum education (7th grade)	0.73	2.21	0.33	1.01	0.742
Parents' maximum education (8th grade)	0.61	1.05	0.28	0.48	0.566
Parents' maximum education (9th grade)	1.17	0.96	0.53	0.44	0.224

Parents' maximum education (10th grade)	0.36	0.95	0.17	0.43	0.702
Parents' maximum education (11th grade)	0.12	0.99	0.05	0.45	0.904
Parents' maximum education (12th grade)	-0.08	0.90	-0.04	0.41	0.928
Parents' maximum education (High school graduate)	0.50	0.85	0.23	0.39	0.556
Parents' maximum education (GED or equivalent)	0.57	0.87	0.26	0.40	0.512
Parents' maximum education (Some college)	0.62	0.84	0.28	0.38	0.464
Parents' maximum education (Associate degree × Occupational	0.53	0.85	0.24	0.39	0.527
Parents' maximum education (Associate degree × Academic Program	0.31	0.85	0.14	0.39	0.716
Parents' maximum education (Bachelor's degree)	0.08	0.84	0.04	0.38	0.923
Parents' maximum education (Master's degree)	0.13	0.84	0.06	0.38	0.879
Parents' maximum education (Professional school degree like MD)	0.15	0.85	0.07	0.39	0.860

Parents' maximum education (Doctoral degree like PhD)	-0.15	0.85	-0.07	0.39	0.862
Study Site #2	-0.08	0.24	-0.04	0.11	0.739
Study Site #3	0.17	0.23	0.08	0.11	0.454
Study Site #4	0.50	0.22	0.23	0.10	<b>0.027</b>
Study Site #5	0.35	0.27	0.16	0.12	0.189
Study Site #6	-0.02	0.24	-0.01	0.11	0.935
Study Site #7	0.20	0.46	0.09	0.21	0.668
Study Site #8	-0.16	0.27	-0.07	0.12	0.556
Study Site #9	0.31	0.28	0.14	0.13	0.275
Study Site #10	-0.09	0.22	-0.04	0.10	0.697
Study Site #11	0.49	0.31	0.22	0.14	0.114
Study Site #12	0.38	0.25	0.17	0.11	0.124
Study Site #13	0.27	0.23	0.12	0.11	0.243
Study Site #14	0.22	0.26	0.10	0.12	0.399
Study Site #15	0.49	0.28	0.22	0.13	0.077
Study Site #16	-0.50	0.23	-0.23	0.10	<b>0.028</b>
Study Site #17	-0.02	0.27	-0.01	0.12	0.939
Study Site #18	0.14	0.26	0.07	0.12	0.584
Study Site #19	0.03	0.24	0.01	0.11	0.895
Study Site #20	0.39	0.24	0.18	0.11	0.102
Study Site #21	0.37	0.24	0.17	0.11	0.122

Study Site #22	-0.09	0.53	-0.04	0.24	0.867
<hr/> R <sup>2</sup> / R <sup>2</sup> adjusted	<hr/> 0.157 / 0.144				

**Table 1c***Individual differences predicting smartphone/watch ownership*

<i>Predictors</i>	<b>Year 4 Smartphone/watch ownership</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	0.06	0.16	-0.47	0.42	0.711
Baseline UPPS-P total	-0.00	0.00	-0.02	0.02	0.269
BAS Reward Responsiveness + Drive	0.00	0.00	0.02	0.02	0.227
Baseline BIS	-0.00	0.00	-0.01	0.02	0.659
GENERAL COGNITIVE ABILITY	-0.01	0.01	-0.02	0.02	0.319
EXECUTIVE FUNCTIONING	0.01	0.01	0.02	0.02	0.195
LEARNING/MEMORY	-0.00	0.01	-0.00	0.02	0.959
CBCL Internalizing	0.00	0.00	0.02	0.02	0.409
CBCL Externalizing	-0.00	0.00	-0.08	0.02	<b>&lt;0.001</b>
Sex (Female)	0.02	0.01	0.07	0.03	<b>0.027</b>
Sex (Intersex Male)	0.01	0.31	0.03	0.99	0.972
Race/Ethnicity (Black)	0.03	0.02	0.10	0.06	0.096
Race/Ethnicity (Hispanic)	0.03	0.02	0.09	0.05	0.077
Race/Ethnicity (Asian)	-0.01	0.03	-0.04	0.10	0.669
Race/Ethnicity (Other)	0.04	0.02	0.11	0.05	<b>0.031</b>

Household Income (\$5,000-\$11,999)	0.11	0.04	0.35	0.13	<b>0.009</b>
Household Income (\$12,000-\$15,999)	0.07	0.05	0.21	0.15	0.139
Household Income (\$16,000-\$24,999)	0.09	0.04	0.29	0.12	<b>0.021</b>
Household Income (\$25,000-\$34,999)	0.11	0.04	0.37	0.12	<b>0.002</b>
Household Income (\$35,000-\$49,999)	0.10	0.03	0.32	0.11	<b>0.004</b>
Household Income (\$50,000-\$74,999)	0.10	0.03	0.33	0.11	<b>0.002</b>
Household Income (\$75,000-\$99,999)	0.10	0.03	0.33	0.11	<b>0.002</b>
Household Income (\$100,000 - \$199,999)	0.11	0.03	0.35	0.11	<b>0.001</b>
Household Income (\$200,000 and greater)	0.15	0.04	0.48	0.12	<b>&lt;0.001</b>
Household Income (Refuse to answer)	0.09	0.04	0.30	0.13	<b>0.017</b>
Household Income (Don't know)	0.14	0.04	0.44	0.13	<b>&lt;0.001</b>
Child Age	0.08	0.01	0.12	0.02	<b>&lt;0.001</b>
Parents' maximum education (7th grade)	0.23	0.33	0.74	1.07	0.487
Parents' maximum education (8th grade)	-0.07	0.16	-0.22	0.51	0.661

Parents' maximum education (9th grade)	0.04	0.14	0.14	0.47	0.766
Parents' maximum education (10th grade)	0.02	0.14	0.07	0.46	0.873
Parents' maximum education (11th grade)	0.07	0.15	0.22	0.48	0.641
Parents' maximum education (12th grade)	0.03	0.14	0.09	0.43	0.835
Parents' maximum education (High school graduate)	0.05	0.13	0.15	0.41	0.722
Parents' maximum education (GED or equivalent)	0.11	0.13	0.35	0.42	0.399
Parents' maximum education (Some college)	0.05	0.13	0.17	0.41	0.668
Parents' maximum education (Associate degree × Occupational)	0.08	0.13	0.26	0.41	0.522
Parents' maximum education (Associate degree × Academic Program)	0.10	0.13	0.31	0.41	0.451
Parents' maximum education (Bachelor's degree)	0.03	0.13	0.11	0.41	0.782
Parents' maximum education (Master's degree)	0.02	0.13	0.07	0.41	0.860

Parents' maximum education (Professional school degree like MD)	0.06	0.13	0.18	0.41	0.664
Parents' maximum education (Doctoral degree like PhD)	0.03	0.13	0.10	0.41	0.801
Study Site #2	0.02	0.04	0.07	0.11	0.569
Study Site #3	-0.03	0.03	-0.09	0.11	0.438
Study Site #4	-0.04	0.03	-0.13	0.11	0.220
Study Site #5	0.03	0.04	0.10	0.13	0.439
Study Site #6	-0.07	0.04	-0.22	0.11	0.053
Study Site #7	-0.20	0.07	-0.64	0.22	<b>0.004</b>
Study Site #8	-0.03	0.04	-0.08	0.13	0.526
Study Site #9	0.05	0.04	0.15	0.14	0.280
Study Site #10	-0.03	0.03	-0.09	0.11	0.402
Study Site #11	0.01	0.05	0.03	0.15	0.841
Study Site #12	-0.06	0.04	-0.21	0.12	0.081
Study Site #13	-0.03	0.04	-0.11	0.11	0.339
Study Site #14	-0.02	0.04	-0.07	0.13	0.593
Study Site #15	0.01	0.04	0.04	0.13	0.745
Study Site #16	-0.06	0.03	-0.20	0.11	0.070
Study Site #17	0.02	0.04	0.06	0.13	0.642
Study Site #18	-0.00	0.04	-0.00	0.13	0.973
Study Site #19	-0.07	0.04	-0.23	0.12	<b>0.044</b>

Study Site #20	-0.01	0.04	-0.04	0.12	0.715
Study Site #21	0.01	0.04	0.05	0.11	0.689
Study Site #22	0.01	0.08	0.03	0.26	0.918
R <sup>2</sup> / R <sup>2</sup> adjusted	0.049 / 0.035				

**Tables 2a-2c: Main regression analyses, Problematic Screen Use (PSU)**

**Table 2a**

*Individual differences predicting problematic video game use*

<i>Predictors</i>	<b>Year 4 VGAQ scores</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	9.58	3.17	0.44	0.41	<b>0.003</b>
Baseline UPPS-P total	0.05	0.01	0.06	0.02	<b>&lt;0.001</b>
BAS Reward Responsiveness + Drive	-0.02	0.02	-0.02	0.02	0.312
Baseline BIS	0.14	0.03	0.06	0.02	<b>&lt;0.001</b>
GENERAL COGNITIVE ABILITY	0.36	0.15	0.04	0.02	<b>0.017</b>
EXECUTIVE FUNCTIONING	0.02	0.13	0.00	0.02	0.893
LEARNING/MEMORY	-0.05	0.14	-0.01	0.02	0.721
CBCL Internalizing	0.06	0.02	0.05	0.02	<b>0.004</b>
CBCL Externalizing	-0.01	0.02	-0.01	0.02	0.784

Sex (Female)	-2.50	0.19	-0.40	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	-1.12	6.05	-0.18	0.98	0.854
Race/Ethnicity (Black)	0.01	0.36	0.00	0.06	0.969
Race/Ethnicity (Hispanic)	0.16	0.30	0.03	0.05	0.595
Race/Ethnicity (Asian)	0.64	0.63	0.10	0.10	0.305
Race/Ethnicity (Other)	0.23	0.32	0.04	0.05	0.472
Household Income (\$5,000-\$11,999)	-1.20	0.80	-0.19	0.13	0.136
Household Income (\$12,000-\$15,999)	-0.78	0.88	-0.13	0.14	0.378
Household Income (\$16,000-\$24,999)	1.14	0.76	0.18	0.12	0.133
Household Income (\$25,000-\$34,999)	-0.29	0.71	-0.05	0.11	0.683
Household Income (\$35,000-\$49,999)	-0.60	0.68	-0.10	0.11	0.376
Household Income (\$50,000-\$74,999)	-0.86	0.66	-0.14	0.11	0.191
Household Income (\$75,000-\$99,999)	-0.80	0.66	-0.13	0.11	0.228
Household Income (\$100,000 - \$199,999)	-1.05	0.65	-0.17	0.11	0.107
Household Income (\$200,000 and greater)	-1.15	0.70	-0.19	0.11	0.102
Household Income (Refuse to answer)	-1.02	0.76	-0.16	0.12	0.183

Household Income (Don't know)	-0.74	0.76	-0.12	0.12	0.329
Child Age	0.33	0.19	0.03	0.02	0.087
Parents' maximum education (7th grade)	-9.69	6.52	-1.56	1.05	0.137
Parents' maximum education (8th grade)	-0.16	3.11	-0.03	0.50	0.958
Parents' maximum education (9th grade)	-3.68	2.84	-0.59	0.46	0.195
Parents' maximum education (10th grade)	0.23	2.81	0.04	0.45	0.935
Parents' maximum education (11th grade)	-3.86	2.91	-0.62	0.47	0.185
Parents' maximum education (12th grade)	0.12	2.65	0.02	0.43	0.963
Parents' maximum education (High school graduate)	-0.04	2.51	-0.01	0.40	0.986
Parents' maximum education (GED or equivalent)	-0.70	2.56	-0.11	0.41	0.784
Parents' maximum education (Some college)	-0.19	2.49	-0.03	0.40	0.939

Parents' maximum education (Associate degree × Occupational	-0.69	2.49	-0.11	0.40	0.782
Parents' maximum education (Associate degree × Academic Program	-0.17	2.51	-0.03	0.40	0.946
Parents' maximum education (Bachelor's degree)	-0.86	2.48	-0.14	0.40	0.728
Parents' maximum education (Master's degree)	-1.18	2.48	-0.19	0.40	0.635
Parents' maximum education (Professional school degree like MD)	-1.15	2.51	-0.18	0.40	0.648
Parents' maximum education (Doctoral degree like PhD)	-1.19	2.51	-0.19	0.40	0.635
Study Site #2	-0.12	0.70	-0.02	0.11	0.864
Study Site #3	0.88	0.69	0.14	0.11	0.197
Study Site #4	-0.18	0.66	-0.03	0.11	0.782
Study Site #5	-0.06	0.80	-0.01	0.13	0.940
Study Site #6	0.28	0.70	0.04	0.11	0.692
Study Site #7	-1.12	1.36	-0.18	0.22	0.411
Study Site #8	-0.16	0.81	-0.03	0.13	0.838
Study Site #9	0.83	0.84	0.13	0.14	0.325
Study Site #10	0.66	0.66	0.11	0.11	0.315
Study Site #11	0.50	0.92	0.08	0.15	0.582

Study Site #12	1.11	0.73	0.18	0.12	0.125
Study Site #13	-0.36	0.69	-0.06	0.11	0.604
Study Site #14	-1.01	0.77	-0.16	0.12	0.189
Study Site #15	1.18	0.81	0.19	0.13	0.148
Study Site #16	-0.90	0.68	-0.15	0.11	0.184
Study Site #17	-1.13	0.79	-0.18	0.13	0.153
Study Site #18	1.07	0.78	0.17	0.13	0.167
Study Site #19	-0.46	0.70	-0.07	0.11	0.511
Study Site #20	0.17	0.71	0.03	0.11	0.806
Study Site #21	-0.43	0.70	-0.07	0.11	0.537
Study Site #22	0.91	1.57	0.15	0.25	0.564
R <sup>2</sup> / R <sup>2</sup> adjusted	0.082 / 0.069				

**Table 2b**

*Individual differences predicting problematic social media use*

<i>Predictors</i>	<b>Year 4 SMAQ scores</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	10.15	2.88	0.21	0.42	<b>&lt;0.001</b>
Baseline UPPS-P total	0.04	0.01	0.05	0.02	<b>0.001</b>
BAS Reward Responsiveness + Drive	0.02	0.02	0.02	0.02	0.269

Baseline BIS	0.05	0.03	0.03	0.02	0.088
GENERAL COGNITIVE ABILITY	0.12	0.14	0.02	0.02	0.374
EXECUTIVE FUNCTIONING	-0.18	0.12	-0.02	0.02	0.119
LEARNING/MEMORY	-0.08	0.13	-0.01	0.02	0.558
CBCL Internalizing	0.01	0.02	0.01	0.02	0.460
CBCL Externalizing	0.02	0.02	0.02	0.02	0.360
Sex (Female)	1.68	0.17	0.30	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	1.31	5.51	0.24	0.99	0.811
Race/Ethnicity (Black)	0.53	0.32	0.10	0.06	0.099
Race/Ethnicity (Hispanic)	0.37	0.28	0.07	0.05	0.174
Race/Ethnicity (Asian)	1.19	0.57	0.22	0.10	<b>0.037</b>
Race/Ethnicity (Other)	0.71	0.29	0.13	0.05	<b>0.016</b>
Household Income (\$5,000-\$11,999)	0.43	0.73	0.08	0.13	0.560
Household Income (\$12,000-\$15,999)	1.01	0.80	0.18	0.15	0.210
Household Income (\$16,000-\$24,999)	1.54	0.69	0.28	0.12	<b>0.025</b>
Household Income (\$25,000-\$34,999)	1.07	0.65	0.19	0.12	0.098
Household Income (\$35,000-\$49,999)	0.74	0.62	0.13	0.11	0.233
Household Income (\$50,000-\$74,999)	1.08	0.60	0.19	0.11	0.072

Household Income (\$75,000-\$99,999)	1.27	0.60	0.23	0.11	<b>0.035</b>
Household Income (\$100,000 - \$199,999)	0.69	0.59	0.12	0.11	0.246
Household Income (\$200,000 and greater)	1.18	0.64	0.21	0.12	0.066
Household Income (Refuse to answer)	1.13	0.69	0.20	0.13	0.104
Household Income (Don't know)	-0.08	0.69	-0.01	0.13	0.911
Child Age	0.05	0.17	0.00	0.02	0.768
Parents' maximum education (7th grade)	-6.61	5.93	-1.19	1.07	0.265
Parents' maximum education (8th grade)	-2.91	2.83	-0.53	0.51	0.303
Parents' maximum education (9th grade)	-2.10	2.58	-0.38	0.47	0.415
Parents' maximum education (10th grade)	-2.85	2.55	-0.51	0.46	0.265
Parents' maximum education (11th grade)	-4.43	2.65	-0.80	0.48	0.095
Parents' maximum education (12th grade)	-1.97	2.41	-0.36	0.44	0.413

Parents' maximum education (High school graduate)	-2.61	2.28	-0.47	0.41	0.252
Parents' maximum education (GED or equivalent)	-2.74	2.33	-0.50	0.42	0.239
Parents' maximum education (Some college)	-2.65	2.26	-0.48	0.41	0.241
Parents' maximum education (Associate degree × Occupational)	-3.23	2.27	-0.58	0.41	0.154
Parents' maximum education (Associate degree × Academic Program)	-3.28	2.28	-0.59	0.41	0.151
Parents' maximum education (Bachelor's degree)	-3.32	2.26	-0.60	0.41	0.141
Parents' maximum education (Master's degree)	-3.45	2.26	-0.62	0.41	0.127
Parents' maximum education (Professional school degree like MD)	-3.24	2.28	-0.59	0.41	0.155
Parents' maximum education (Doctoral degree like PhD)	-3.42	2.28	-0.62	0.41	0.134
Study Site #2	-0.79	0.63	-0.14	0.11	0.213
Study Site #3	0.31	0.62	0.06	0.11	0.618
Study Site #4	-0.15	0.60	-0.03	0.11	0.803
Study Site #5	-0.24	0.72	-0.04	0.13	0.740

Study Site #6	0.41	0.63	0.07	0.11	0.520
Study Site #7	-0.92	1.24	-0.17	0.22	0.456
Study Site #8	0.11	0.73	0.02	0.13	0.880
Study Site #9	0.90	0.76	0.16	0.14	0.240
Study Site #10	0.09	0.60	0.02	0.11	0.879
Study Site #11	1.07	0.83	0.19	0.15	0.198
Study Site #12	1.07	0.66	0.19	0.12	0.106
Study Site #13	-0.10	0.62	-0.02	0.11	0.874
Study Site #14	-0.63	0.70	-0.11	0.13	0.364
Study Site #15	0.38	0.74	0.07	0.13	0.604
Study Site #16	-0.28	0.62	-0.05	0.11	0.649
Study Site #17	0.86	0.72	0.15	0.13	0.231
Study Site #18	0.58	0.71	0.10	0.13	0.414
Study Site #19	-0.19	0.64	-0.03	0.12	0.772
Study Site #20	0.30	0.65	0.05	0.12	0.647
Study Site #21	0.41	0.64	0.07	0.11	0.517
Study Site #22	0.49	1.43	0.09	0.26	0.733
<hr/>					
R <sup>2</sup> / R <sup>2</sup> adjusted	0.046 / 0.032				

**Table 2c**

*Individual differences predicting problematic phone use*

<i>Predictors</i>	<b>Year 4 MPIQ scores</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	15.99	4.49	0.07	0.42	<b>&lt;0.001</b>
Baseline UPPS-P total	0.13	0.02	0.11	0.02	<b>&lt;0.001</b>
BAS Reward Responsiveness + Drive	0.09	0.03	0.05	0.02	<b>0.004</b>
Baseline BIS	0.12	0.05	0.04	0.02	<b>0.019</b>
GENERAL COGNITIVE ABILITY	0.29	0.21	0.03	0.02	0.173
EXECUTIVE FUNCTIONING	-0.22	0.18	-0.02	0.02	0.222
LEARNING/MEMORY	-0.16	0.20	-0.01	0.02	0.433
CBCL Internalizing	-0.00	0.03	-0.00	0.02	0.947
CBCL Externalizing	0.04	0.03	0.03	0.02	0.177
Sex (Female)	3.33	0.27	0.38	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	-0.11	8.58	-0.01	0.98	0.990
Race/Ethnicity (Black)	1.56	0.50	0.18	0.06	<b>0.002</b>
Race/Ethnicity (Hispanic)	0.67	0.43	0.08	0.05	0.119
Race/Ethnicity (Asian)	1.25	0.89	0.14	0.10	0.160
Race/Ethnicity (Other)	0.45	0.46	0.05	0.05	0.332
Household Income (\$5,000-\$11,999)	2.11	1.14	0.24	0.13	0.064
Household Income (\$12,000-\$15,999)	1.80	1.25	0.21	0.14	0.151

Household Income (\$16,000-\$24,999)	2.56	1.07	0.29	0.12	<b>0.017</b>
Household Income (\$25,000-\$34,999)	1.67	1.01	0.19	0.11	0.097
Household Income (\$35,000-\$49,999)	1.86	0.97	0.21	0.11	0.054
Household Income (\$50,000-\$74,999)	1.21	0.93	0.14	0.11	0.195
Household Income (\$75,000-\$99,999)	1.91	0.94	0.22	0.11	<b>0.043</b>
Household Income (\$100,000 - \$199,999)	1.11	0.93	0.13	0.11	0.233
Household Income (\$200,000 and greater)	2.01	1.00	0.23	0.11	<b>0.044</b>
Household Income (Refuse to answer)	1.13	1.08	0.13	0.12	0.295
Household Income (Don't know)	1.90	1.08	0.22	0.12	0.079
Child Age	0.41	0.27	0.02	0.02	0.133
Parents' maximum education (7th grade)	-12.62	9.23	-1.44	1.05	0.172
Parents' maximum education (8th grade)	-3.67	4.40	-0.42	0.50	0.405
Parents' maximum education (9th grade)	-4.41	4.02	-0.50	0.46	0.273

Parents' maximum education (10th grade)	-1.47	3.98	-0.17	0.45	0.711
Parents' maximum education (11th grade)	-4.97	4.13	-0.57	0.47	0.228
Parents' maximum education (12th grade)	-2.36	3.76	-0.27	0.43	0.530
Parents' maximum education (High school graduate)	-2.40	3.55	-0.27	0.41	0.499
Parents' maximum education (GED or equivalent)	-4.10	3.63	-0.47	0.41	0.258
Parents' maximum education (Some college)	-3.80	3.52	-0.43	0.40	0.281
Parents' maximum education (Associate degree × Occupational)	-3.32	3.53	-0.38	0.40	0.348
Parents' maximum education (Associate degree × Academic Program)	-4.43	3.55	-0.50	0.40	0.212
Parents' maximum education (Bachelor's degree)	-4.42	3.52	-0.50	0.40	0.209
Parents' maximum education (Master's degree)	-4.68	3.52	-0.53	0.40	0.184

Parents' maximum education (Professional school degree like MD)	-4.09	3.55	-0.47	0.41	0.249
Parents' maximum education (Doctoral degree like PhD)	-4.67	3.55	-0.53	0.41	0.189
Study Site #2	-0.68	0.99	-0.08	0.11	0.491
Study Site #3	0.74	0.97	0.08	0.11	0.444
Study Site #4	0.24	0.94	0.03	0.11	0.798
Study Site #5	-0.13	1.13	-0.02	0.13	0.905
Study Site #6	0.68	0.99	0.08	0.11	0.492
Study Site #7	-1.73	1.93	-0.20	0.22	0.369
Study Site #8	-1.00	1.14	-0.11	0.13	0.379
Study Site #9	1.17	1.19	0.13	0.14	0.324
Study Site #10	0.64	0.93	0.07	0.11	0.491
Study Site #11	1.08	1.30	0.12	0.15	0.405
Study Site #12	0.43	1.03	0.05	0.12	0.674
Study Site #13	-0.03	0.97	-0.00	0.11	0.972
Study Site #14	-1.09	1.08	-0.12	0.12	0.313
Study Site #15	-0.53	1.15	-0.06	0.13	0.643
Study Site #16	-1.36	0.96	-0.16	0.11	0.156
Study Site #17	0.11	1.12	0.01	0.13	0.924
Study Site #18	0.88	1.10	0.10	0.13	0.424
Study Site #19	0.35	1.00	0.04	0.11	0.726

Study Site #20	0.96	1.01	0.11	0.11	0.341
Study Site #21	1.12	0.99	0.13	0.11	0.259
Study Site #22	-0.60	2.23	-0.07	0.25	0.789
R <sup>2</sup> / R <sup>2</sup> adjusted	0.077 / 0.064				

**Tables 3a-3f: Impulsivity sub-facets predicting NSU and PSU**

**Table 3a**

*Impulsivity sub-facets predicting normative video game use*

<i>Predictors</i>	<b>Year 4 Video Game Hours</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	1.62	1.65	0.61	0.38	0.325
Urgency	0.04	0.01	0.06	0.02	<b>&lt;0.001</b>
Lack of Planning	0.00	0.02	0.00	0.02	0.992
Sensation Seeking	-0.01	0.02	-0.01	0.01	0.533
Lack of Perseverance	0.12	0.02	0.07	0.02	<b>&lt;0.001</b>
BAS Reward Responsiveness + Drive	0.04	0.01	0.05	0.01	<b>0.001</b>
Baseline BIS	0.01	0.02	0.00	0.01	0.769
GENERAL COGNITIVE ABILITY	-0.29	0.08	-0.06	0.02	<b>&lt;0.001</b>
EXECUTIVE FUNCTIONING	-0.07	0.07	-0.02	0.01	0.270
LEARNING/MEMORY	-0.10	0.08	-0.02	0.01	0.199

CBCL Internalizing	0.00	0.01	0.01	0.02	0.756
CBCL Externalizing	0.02	0.01	0.02	0.02	0.156
Sex (Female)	-2.02	0.10	-0.57	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	1.21	3.14	0.34	0.89	0.701
Race/Ethnicity (Black)	1.50	0.18	0.42	0.05	<b>&lt;0.001</b>
Race/Ethnicity (Hispanic)	0.30	0.16	0.09	0.04	0.053
Race/Ethnicity (Asian)	-0.23	0.33	-0.07	0.09	0.476
Race/Ethnicity (Other)	0.53	0.17	0.15	0.05	<b>0.002</b>
Household Income (\$5,000-\$11,999)	-1.15	0.42	-0.33	0.12	<b>0.006</b>
Household Income (\$12,000-\$15,999)	-0.28	0.46	-0.08	0.13	0.540
Household Income (\$16,000-\$24,999)	0.30	0.39	0.08	0.11	0.445
Household Income (\$25,000-\$34,999)	-0.30	0.37	-0.09	0.10	0.410
Household Income (\$35,000-\$49,999)	-0.82	0.35	-0.23	0.10	<b>0.020</b>
Household Income (\$50,000-\$74,999)	-0.81	0.34	-0.23	0.10	<b>0.019</b>
Household Income (\$75,000-\$99,999)	-0.77	0.34	-0.22	0.10	<b>0.025</b>
Household Income (\$100,000 - \$199,999)	-0.90	0.34	-0.25	0.10	<b>0.008</b>

Household Income (\$200,000 and greater)	-1.02	0.37	-0.29	0.10	<b>0.005</b>
Household Income (Refuse to answer)	-0.63	0.40	-0.18	0.11	0.115
Household Income (Don't know)	-0.56	0.40	-0.16	0.11	0.156
Child Age	0.13	0.10	0.02	0.01	0.192
Parents' maximum education (7th grade)	-2.21	3.38	-0.63	0.96	0.513
Parents' maximum education (8th grade)	-0.67	1.61	-0.19	0.46	0.677
Parents' maximum education (9th grade)	0.38	1.47	0.11	0.42	0.798
Parents' maximum education (10th grade)	0.60	1.46	0.17	0.41	0.682
Parents' maximum education (11th grade)	-1.33	1.51	-0.38	0.43	0.377
Parents' maximum education (12th grade)	-0.99	1.38	-0.28	0.39	0.471
Parents' maximum education (High school graduate)	0.25	1.30	0.07	0.37	0.848
Parents' maximum education (GED or equivalent)	-0.10	1.33	-0.03	0.38	0.940

Parents' maximum education (Some college)	0.29	1.29	0.08	0.36	0.822
Parents' maximum education (Associate degree × Occupational)	-0.10	1.29	-0.03	0.37	0.938
Parents' maximum education (Associate degree × Academic Program)	0.15	1.30	0.04	0.37	0.910
Parents' maximum education (Bachelor's degree)	-0.68	1.29	-0.19	0.36	0.600
Parents' maximum education (Master's degree)	-0.83	1.29	-0.24	0.36	0.519
Parents' maximum education (Professional school degree like MD)	-0.96	1.30	-0.27	0.37	0.460
Parents' maximum education (Doctoral degree like PhD)	-0.92	1.30	-0.26	0.37	0.478
Study Site #2	-0.40	0.36	-0.11	0.10	0.263
Study Site #3	0.18	0.36	0.05	0.10	0.612
Study Site #4	0.19	0.34	0.05	0.10	0.573
Study Site #5	0.05	0.41	0.01	0.12	0.899
Study Site #6	-0.34	0.36	-0.10	0.10	0.352
Study Site #7	0.13	0.71	0.04	0.20	0.858
Study Site #8	-0.60	0.42	-0.17	0.12	0.148
Study Site #9	0.35	0.44	0.10	0.12	0.424

Study Site #10	0.01	0.34	0.00	0.10	0.969
Study Site #11	0.44	0.48	0.13	0.13	0.353
Study Site #12	-0.13	0.38	-0.04	0.11	0.721
Study Site #13	-0.23	0.36	-0.06	0.10	0.526
Study Site #14	-0.67	0.40	-0.19	0.11	0.091
Study Site #15	1.24	0.42	0.35	0.12	<b>0.003</b>
Study Site #16	-1.08	0.35	-0.31	0.10	<b>0.002</b>
Study Site #17	-0.79	0.41	-0.22	0.12	0.054
Study Site #18	0.00	0.40	0.00	0.11	0.996
Study Site #19	-0.70	0.37	-0.20	0.10	0.054
Study Site #20	-0.10	0.37	-0.03	0.10	0.792
Study Site #21	0.09	0.36	0.03	0.10	0.795
Study Site #22	-0.60	0.82	-0.17	0.23	0.459
R <sup>2</sup> / R <sup>2</sup> adjusted	0.239 / 0.227				

**Table 3b**

*Impulsivity sub-facets predicting normative social media use*

<i>Predictors</i>	<b>Year 4 Social Media Hours</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	-4.31	1.08	-0.55	0.40	<b>&lt;0.001</b>
Urgency	0.02	0.01	0.04	0.02	<b>0.027</b>

Lack of Planning	0.03	0.02	0.04	0.02	<b>0.027</b>
Sensation Seeking	-0.00	0.01	-0.00	0.02	0.777
Lack of Perseverance	0.02	0.02	0.02	0.02	0.266
BAS Reward Responsiveness + Drive	0.04	0.01	0.08	0.02	<b>&lt;0.001</b>
Baseline BIS	-0.01	0.01	-0.02	0.02	0.247
GENERAL COGNITIVE ABILITY	-0.15	0.05	-0.05	0.02	<b>0.004</b>
EXECUTIVE FUNCTIONING	-0.05	0.04	-0.02	0.01	0.224
LEARNING/MEMORY	-0.13	0.05	-0.04	0.02	<b>0.009</b>
CBCL Internalizing	0.00	0.01	0.00	0.02	0.984
CBCL Externalizing	0.01	0.01	0.01	0.02	0.406
Sex (Female)	0.85	0.06	0.39	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	-1.28	2.05	-0.58	0.94	0.534
Race/Ethnicity (Black)	1.01	0.12	0.46	0.05	<b>&lt;0.001</b>
Race/Ethnicity (Hispanic)	0.48	0.10	0.22	0.05	<b>&lt;0.001</b>
Race/Ethnicity (Asian)	-0.11	0.21	-0.05	0.10	0.608
Race/Ethnicity (Other)	0.27	0.11	0.12	0.05	<b>0.014</b>
Household Income (\$5,000-\$11,999)	0.60	0.27	0.27	0.12	<b>0.029</b>
Household Income (\$12,000-\$15,999)	0.78	0.30	0.35	0.14	<b>0.010</b>
Household Income (\$16,000-\$24,999)	0.43	0.26	0.20	0.12	0.094

Household Income (\$25,000-\$34,999)	0.22	0.24	0.10	0.11	0.372
Household Income (\$35,000-\$49,999)	0.23	0.23	0.10	0.11	0.324
Household Income (\$50,000-\$74,999)	0.20	0.22	0.09	0.10	0.377
Household Income (\$75,000-\$99,999)	0.20	0.23	0.09	0.10	0.368
Household Income (\$100,000 - \$199,999)	0.14	0.22	0.06	0.10	0.523
Household Income (\$200,000 and greater)	0.20	0.24	0.09	0.11	0.396
Household Income (Refuse to answer)	0.68	0.26	0.31	0.12	<b>0.008</b>
Household Income (Don't know)	0.17	0.26	0.08	0.12	0.523
Child Age	0.38	0.07	0.09	0.01	<b>&lt;0.001</b>
Parents' maximum education (7th grade)	0.85	2.21	0.39	1.01	0.701
Parents' maximum education (8th grade)	0.60	1.05	0.27	0.48	0.569
Parents' maximum education (9th grade)	1.15	0.96	0.52	0.44	0.234
Parents' maximum education (10th grade)	0.34	0.95	0.16	0.43	0.719

Parents' maximum education (11th grade)	0.12	0.99	0.05	0.45	0.905
Parents' maximum education (12th grade)	-0.08	0.90	-0.04	0.41	0.926
Parents' maximum education (High school graduate)	0.49	0.85	0.22	0.39	0.563
Parents' maximum education (GED or equivalent)	0.57	0.87	0.26	0.40	0.511
Parents' maximum education (Some college)	0.62	0.84	0.28	0.38	0.465
Parents' maximum education (Associate degree × Occupational	0.53	0.85	0.24	0.39	0.531
Parents' maximum education (Associate degree × Academic Program	0.31	0.85	0.14	0.39	0.716
Parents' maximum education (Bachelor's degree)	0.08	0.84	0.04	0.38	0.927
Parents' maximum education (Master's degree)	0.12	0.84	0.06	0.38	0.883
Parents' maximum education (Professional school degree like MD)	0.15	0.85	0.07	0.39	0.859

Parents' maximum education (Doctoral degree like PhD)	-0.15	0.85	-0.07	0.39	0.862
Study Site #2	-0.06	0.24	-0.03	0.11	0.809
Study Site #3	0.19	0.23	0.09	0.11	0.412
Study Site #4	0.52	0.22	0.24	0.10	<b>0.021</b>
Study Site #5	0.38	0.27	0.17	0.12	0.162
Study Site #6	-0.01	0.24	-0.00	0.11	0.982
Study Site #7	0.20	0.46	0.09	0.21	0.665
Study Site #8	-0.15	0.27	-0.07	0.12	0.594
Study Site #9	0.33	0.28	0.15	0.13	0.242
Study Site #10	-0.08	0.22	-0.04	0.10	0.727
Study Site #11	0.51	0.31	0.23	0.14	0.104
Study Site #12	0.40	0.25	0.18	0.11	0.108
Study Site #13	0.28	0.23	0.13	0.11	0.233
Study Site #14	0.23	0.26	0.11	0.12	0.370
Study Site #15	0.51	0.28	0.23	0.13	0.067
Study Site #16	-0.49	0.23	-0.22	0.10	<b>0.034</b>
Study Site #17	0.00	0.27	0.00	0.12	0.987
Study Site #18	0.15	0.26	0.07	0.12	0.557
Study Site #19	0.04	0.24	0.02	0.11	0.876
Study Site #20	0.41	0.24	0.18	0.11	0.093
Study Site #21	0.38	0.24	0.17	0.11	0.113

Study Site #22	-0.08	0.53	-0.04	0.24	0.884
R <sup>2</sup> / R <sup>2</sup> adjusted	0.157 / 0.145				

**Table 3c**

*Impulsivity sub-facets predicting smartphone/watch ownership*

<b>Year 4 smartphone/watch ownership</b>					
<i>Predictors</i>	<i>Odds Ratios</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>P</i>
(Intercept)	0.00	0.00	2.51	2.99	<b>&lt;0.001</b>
Urgency	1.00	0.01	1.01	0.06	0.849
Lack of Planning	0.99	0.02	0.98	0.06	0.682
Sensation Seeking	1.00	0.02	1.00	0.05	0.956
Lack of Perseverance	0.95	0.02	0.90	0.05	0.058
BAS Reward Responsiveness + Drive	1.01	0.01	1.04	0.06	0.438
Baseline BIS	0.99	0.02	0.97	0.05	0.603
GENERAL COGNITIVE ABILITY	0.91	0.08	0.93	0.06	0.256
EXECUTIVE FUNCTIONING	1.10	0.08	1.07	0.06	0.183
LEARNING/MEMORY	1.01	0.08	1.01	0.06	0.919
CBCL Internalizing	1.01	0.01	1.05	0.06	0.427
CBCL Externalizing	0.96	0.01	0.81	0.05	<b>&lt;0.001</b>

Sex (Female)	1.28	0.14	1.28	0.14	<b>0.020</b>
Sex (Intersex Male)	5316.85	1726619.90	5316.85	1726619.90	0.979
Race/Ethnicity (Black)	1.45	0.30	1.45	0.30	0.073
Race/Ethnicity (Hispanic)	1.37	0.24	1.37	0.24	0.068
Race/Ethnicity (Asian)	0.87	0.29	0.87	0.29	0.682
Race/Ethnicity (Other)	1.47	0.28	1.47	0.28	<b>0.047</b>
Household Income (\$5,000-\$11,999)	2.77	1.14	2.77	1.14	<b>0.013</b>
Household Income (\$12,000-\$15,999)	1.80	0.75	1.80	0.75	0.157
Household Income (\$16,000-\$24,999)	2.15	0.78	2.15	0.78	<b>0.036</b>
Household Income (\$25,000-\$34,999)	2.88	1.02	2.88	1.02	<b>0.003</b>
Household Income (\$35,000-\$49,999)	2.55	0.84	2.55	0.84	<b>0.005</b>
Household Income (\$50,000-\$74,999)	2.53	0.78	2.53	0.78	<b>0.003</b>
Household Income (\$75,000-\$99,999)	2.55	0.79	2.55	0.79	<b>0.003</b>
Household Income (\$100,000 - \$199,999)	2.74	0.83	2.74	0.83	<b>0.001</b>
Household Income (\$200,000 and greater)	4.45	1.57	4.45	1.57	<b>&lt;0.001</b>
Household Income (Refuse to answer)	2.21	0.82	2.21	0.82	<b>0.033</b>

Household Income (Don't know)	4.08	1.68	4.08	1.68	<b>0.001</b>
Child Age	2.29	0.25	1.52	0.08	<b>&lt;0.001</b>
Parents' maximum education (7th grade)	66095.67	21464296.52	66095.67	21464296.52	0.973
Parents' maximum education (8th grade)	0.54	0.75	0.54	0.75	0.655
Parents' maximum education (9th grade)	1.42	1.93	1.42	1.93	0.797
Parents' maximum education (10th grade)	1.21	1.64	1.21	1.64	0.891
Parents' maximum education (11th grade)	2.14	3.33	2.14	3.33	0.624
Parents' maximum education (12th grade)	1.24	1.53	1.24	1.53	0.863
Parents' maximum education (High school graduate)	1.50	1.73	1.50	1.73	0.726
Parents' maximum education (GED or equivalent)	3.94	4.92	3.94	4.92	0.271
Parents' maximum education (Some college)	1.73	1.98	1.73	1.98	0.632

Parents' maximum education (Associate degree × Occupational	2.49	2.87	2.49	2.87	0.429
Parents' maximum education (Associate degree × Academic Program	3.01	3.51	3.01	3.51	0.345
Parents' maximum education (Bachelor's degree)	1.44	1.64	1.44	1.64	0.748
Parents' maximum education (Master's degree)	1.26	1.43	1.26	1.43	0.842
Parents' maximum education (Professional school degree like MD)	1.79	2.08	1.79	2.08	0.616
Parents' maximum education (Doctoral degree like PhD)	1.41	1.63	1.41	1.63	0.768
Study Site #2	1.33	0.61	1.33	0.61	0.530
Study Site #3	0.70	0.29	0.70	0.29	0.397
Study Site #4	0.59	0.24	0.59	0.24	0.189
Study Site #5	1.44	0.75	1.44	0.75	0.491
Study Site #6	0.47	0.19	0.47	0.19	0.064
Study Site #7	0.21	0.13	0.21	0.13	<b>0.010</b>
Study Site #8	0.68	0.33	0.68	0.33	0.433

Study Site #9	3.37	2.71	3.37	2.71	0.132
Study Site #10	0.68	0.27	0.68	0.27	0.333
Study Site #11	1.08	0.65	1.08	0.65	0.898
Study Site #12	0.48	0.20	0.48	0.20	0.079
Study Site #13	0.64	0.26	0.64	0.26	0.272
Study Site #14	0.69	0.33	0.69	0.33	0.437
Study Site #15	1.07	0.55	1.07	0.55	0.887
Study Site #16	0.50	0.20	0.50	0.20	0.089
Study Site #17	1.09	0.52	1.09	0.52	0.852
Study Site #18	0.90	0.42	0.90	0.42	0.824
Study Site #19	0.44	0.18	0.44	0.18	<b>0.046</b>
Study Site #20	0.78	0.34	0.78	0.34	0.569
Study Site #21	1.12	0.49	1.12	0.49	0.794
Study Site #22	1.11	1.22	1.11	1.22	0.928
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R <sup>2</sup> Tjur	0.056				

**Table 3d**

*Impulsivity sub-facets predicting problematic video game use*

<i>Predictors</i>	<b>Year 4 VGAQ scores</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	9.82	3.17	0.44	0.41	<b>0.002</b>

Urgency	0.08	0.02	0.06	0.02	<b>&lt;0.001</b>
Lack of Planning	0.04	0.05	0.01	0.02	0.389
Sensation Seeking	-0.08	0.04	-0.03	0.02	<b>0.029</b>
Lack of Perseverance	0.12	0.05	0.04	0.02	<b>0.016</b>
BAS Reward Responsiveness + Drive	-0.01	0.02	-0.01	0.02	0.688
Baseline BIS	0.13	0.04	0.06	0.02	<b>&lt;0.001</b>
GENERAL COGNITIVE ABILITY	0.43	0.15	0.05	0.02	<b>0.004</b>
EXECUTIVE FUNCTIONING	0.04	0.13	0.01	0.02	0.728
LEARNING/MEMORY	-0.04	0.14	-0.00	0.02	0.783
CBCL Internalizing	0.05	0.02	0.05	0.02	<b>0.011</b>
CBCL Externalizing	-0.01	0.02	-0.01	0.02	0.743
Sex (Female)	-2.54	0.19	-0.41	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	-1.70	6.04	-0.27	0.97	0.779
Race/Ethnicity (Black)	0.01	0.36	0.00	0.06	0.988
Race/Ethnicity (Hispanic)	0.13	0.30	0.02	0.05	0.673
Race/Ethnicity (Asian)	0.61	0.63	0.10	0.10	0.333
Race/Ethnicity (Other)	0.20	0.32	0.03	0.05	0.539
Household Income (\$5,000-\$11,999)	-1.18	0.80	-0.19	0.13	0.140
Household Income (\$12,000-\$15,999)	-0.72	0.88	-0.12	0.14	0.414

Household Income (\$16,000-\$24,999)	1.11	0.76	0.18	0.12	0.143
Household Income (\$25,000-\$34,999)	-0.38	0.71	-0.06	0.11	0.597
Household Income (\$35,000-\$49,999)	-0.67	0.68	-0.11	0.11	0.328
Household Income (\$50,000-\$74,999)	-0.92	0.66	-0.15	0.11	0.160
Household Income (\$75,000-\$99,999)	-0.83	0.66	-0.13	0.11	0.212
Household Income (\$100,000 - \$199,999)	-1.09	0.65	-0.18	0.11	0.094
Household Income (\$200,000 and greater)	-1.17	0.70	-0.19	0.11	0.097
Household Income (Refuse to answer)	-1.02	0.76	-0.16	0.12	0.180
Household Income (Don't know)	-0.77	0.76	-0.12	0.12	0.309
Child Age	0.34	0.19	0.03	0.02	0.075
Parents' maximum education (7th grade)	-9.17	6.51	-1.48	1.05	0.159
Parents' maximum education (8th grade)	-0.22	3.10	-0.04	0.50	0.944
Parents' maximum education (9th grade)	-3.72	2.83	-0.60	0.46	0.189

Parents' maximum education (10th grade)	0.28	2.80	0.04	0.45	0.921
Parents' maximum education (11th grade)	-3.84	2.91	-0.62	0.47	0.187
Parents' maximum education (12th grade)	0.20	2.65	0.03	0.43	0.940
Parents' maximum education (High school graduate)	-0.09	2.50	-0.01	0.40	0.972
Parents' maximum education (GED or equivalent)	-0.66	2.56	-0.11	0.41	0.795
Parents' maximum education (Some college)	-0.18	2.48	-0.03	0.40	0.943
Parents' maximum education (Associate degree × Occupational	-0.69	2.49	-0.11	0.40	0.781
Parents' maximum education (Associate degree × Academic Program	-0.13	2.50	-0.02	0.40	0.957
Parents' maximum education (Bachelor's degree)	-0.85	2.48	-0.14	0.40	0.731
Parents' maximum education (Master's degree)	-1.15	2.48	-0.19	0.40	0.642

Parents' maximum education (Professional school degree like MD)	-1.13	2.50	-0.18	0.40	0.651
Parents' maximum education (Doctoral degree like PhD)	-1.14	2.50	-0.18	0.40	0.648
Study Site #2	0.03	0.70	0.00	0.11	0.968
Study Site #3	1.00	0.69	0.16	0.11	0.143
Study Site #4	-0.06	0.66	-0.01	0.11	0.925
Study Site #5	0.06	0.79	0.01	0.13	0.940
Study Site #6	0.37	0.69	0.06	0.11	0.598
Study Site #7	-1.17	1.36	-0.19	0.22	0.387
Study Site #8	-0.09	0.81	-0.01	0.13	0.913
Study Site #9	0.94	0.84	0.15	0.14	0.263
Study Site #10	0.70	0.65	0.11	0.11	0.283
Study Site #11	0.60	0.91	0.10	0.15	0.510
Study Site #12	1.17	0.73	0.19	0.12	0.107
Study Site #13	-0.30	0.69	-0.05	0.11	0.661
Study Site #14	-0.94	0.76	-0.15	0.12	0.220
Study Site #15	1.25	0.81	0.20	0.13	0.125
Study Site #16	-0.82	0.68	-0.13	0.11	0.226
Study Site #17	-1.00	0.79	-0.16	0.13	0.206
Study Site #18	1.08	0.78	0.17	0.12	0.162
Study Site #19	-0.44	0.70	-0.07	0.11	0.536

Study Site #20	0.21	0.71	0.03	0.11	0.766
Study Site #21	-0.36	0.70	-0.06	0.11	0.607
Study Site #22	1.00	1.57	0.16	0.25	0.524
R <sup>2</sup> / R <sup>2</sup> adjusted	0.086 / 0.072				

**Table 3e**

*Impulsivity sub-facets predicting problematic social media use*

<i>Predictors</i>	<b>Year 4 SMAQ scores</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	10.16	2.89	0.21	0.42	<b>&lt;0.001</b>
Urgency	0.03	0.02	0.03	0.02	0.122
Lack of Planning	0.07	0.04	0.03	0.02	0.072
Sensation Seeking	-0.01	0.03	-0.00	0.02	0.825
Lack of Perseverance	0.05	0.04	0.02	0.02	0.210
BAS Reward Responsiveness + Drive	0.03	0.02	0.02	0.02	0.163
Baseline BIS	0.06	0.03	0.03	0.02	0.072
GENERAL COGNITIVE ABILITY	0.13	0.14	0.02	0.02	0.327
EXECUTIVE FUNCTIONING	-0.18	0.12	-0.02	0.02	0.135
LEARNING/MEMORY	-0.08	0.13	-0.01	0.02	0.555
CBCL Internalizing	0.01	0.02	0.01	0.02	0.505

CBCL Externalizing	0.02	0.02	0.02	0.02	0.396
Sex (Female)	1.67	0.17	0.30	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	1.19	5.51	0.21	0.99	0.829
Race/Ethnicity (Black)	0.55	0.32	0.10	0.06	0.090
Race/Ethnicity (Hispanic)	0.37	0.28	0.07	0.05	0.179
Race/Ethnicity (Asian)	1.19	0.57	0.22	0.10	<b>0.037</b>
Race/Ethnicity (Other)	0.71	0.29	0.13	0.05	<b>0.017</b>
Household Income (\$5,000-\$11,999)	0.42	0.73	0.08	0.13	0.567
Household Income (\$12,000-\$15,999)	1.02	0.80	0.19	0.15	0.203
Household Income (\$16,000-\$24,999)	1.53	0.69	0.28	0.12	<b>0.026</b>
Household Income (\$25,000-\$34,999)	1.05	0.65	0.19	0.12	0.105
Household Income (\$35,000-\$49,999)	0.73	0.62	0.13	0.11	0.243
Household Income (\$50,000-\$74,999)	1.06	0.60	0.19	0.11	0.077
Household Income (\$75,000-\$99,999)	1.26	0.60	0.23	0.11	<b>0.037</b>
Household Income (\$100,000 - \$199,999)	0.67	0.59	0.12	0.11	0.260
Household Income (\$200,000 and greater)	1.16	0.64	0.21	0.12	0.070

Household Income (Refuse to answer)	1.13	0.70	0.20	0.13	0.105
Household Income (Don't know)	-0.09	0.69	-0.02	0.13	0.897
Child Age	0.05	0.17	0.00	0.02	0.764
Parents' maximum education (7th grade)	-6.28	5.93	-1.13	1.07	0.289
Parents' maximum education (8th grade)	-2.92	2.83	-0.53	0.51	0.301
Parents' maximum education (9th grade)	-2.16	2.58	-0.39	0.47	0.402
Parents' maximum education (10th grade)	-2.90	2.55	-0.52	0.46	0.256
Parents' maximum education (11th grade)	-4.42	2.65	-0.80	0.48	0.095
Parents' maximum education (12th grade)	-1.96	2.41	-0.35	0.44	0.416
Parents' maximum education (High school graduate)	-2.63	2.28	-0.47	0.41	0.249
Parents' maximum education (GED or equivalent)	-2.73	2.33	-0.49	0.42	0.241
Parents' maximum education (Some college)	-2.66	2.26	-0.48	0.41	0.240

Parents' maximum education (Associate degree × Occupational	-3.24	2.27	-0.58	0.41	0.153
Parents' maximum education (Associate degree × Academic Program	-3.27	2.28	-0.59	0.41	0.151
Parents' maximum education (Bachelor's degree)	-3.33	2.26	-0.60	0.41	0.140
Parents' maximum education (Master's degree)	-3.45	2.26	-0.62	0.41	0.127
Parents' maximum education (Professional school degree like MD)	-3.24	2.28	-0.59	0.41	0.155
Parents' maximum education (Doctoral degree like PhD)	-3.42	2.28	-0.62	0.41	0.134
Study Site #2	-0.74	0.63	-0.13	0.11	0.241
Study Site #3	0.34	0.62	0.06	0.11	0.583
Study Site #4	-0.10	0.60	-0.02	0.11	0.867
Study Site #5	-0.18	0.72	-0.03	0.13	0.800
Study Site #6	0.44	0.63	0.08	0.11	0.489
Study Site #7	-0.92	1.24	-0.17	0.22	0.460
Study Site #8	0.15	0.73	0.03	0.13	0.840
Study Site #9	0.96	0.76	0.17	0.14	0.210
Study Site #10	0.12	0.60	0.02	0.11	0.846
Study Site #11	1.10	0.83	0.20	0.15	0.186

Study Site #12	1.10	0.66	0.20	0.12	0.095
Study Site #13	-0.08	0.62	-0.02	0.11	0.893
Study Site #14	-0.59	0.70	-0.11	0.13	0.394
Study Site #15	0.44	0.74	0.08	0.13	0.552
Study Site #16	-0.24	0.62	-0.04	0.11	0.693
Study Site #17	0.91	0.72	0.16	0.13	0.204
Study Site #18	0.60	0.71	0.11	0.13	0.395
Study Site #19	-0.17	0.64	-0.03	0.12	0.788
Study Site #20	0.33	0.65	0.06	0.12	0.612
Study Site #21	0.43	0.64	0.08	0.11	0.497
Study Site #22	0.50	1.43	0.09	0.26	0.729
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R <sup>2</sup> / R <sup>2</sup> adjusted	0.047 / 0.033				

**Table 3f**

*Impulsivity sub-facets predicting problematic phone use*

<i>Predictors</i>	<b>Year 4 MPIQ scores</b>				
	<i>Estimates</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	16.11	4.49	0.07	0.42	<b>&lt;0.001</b>
Urgency	0.14	0.03	0.08	0.02	<b>&lt;0.001</b>
Lack of Planning	0.13	0.06	0.04	0.02	<b>0.036</b>
Sensation Seeking	0.04	0.05	0.01	0.02	0.440

Lack of Perseverance	0.18	0.07	0.04	0.02	<b>0.009</b>
BAS Reward Responsiveness + Drive	0.10	0.03	0.05	0.02	<b>0.002</b>
Baseline BIS	0.11	0.05	0.04	0.02	<b>0.027</b>
GENERAL COGNITIVE ABILITY	0.33	0.21	0.03	0.02	0.118
EXECUTIVE FUNCTIONING	-0.20	0.18	-0.02	0.02	0.266
LEARNING/MEMORY	-0.15	0.20	-0.01	0.02	0.456
CBCL Internalizing	-0.01	0.03	-0.00	0.02	0.839
CBCL Externalizing	0.04	0.03	0.02	0.02	0.189
Sex (Female)	3.31	0.27	0.38	0.03	<b>&lt;0.001</b>
Sex (Intersex Male)	-0.49	8.58	-0.06	0.98	0.954
Race/Ethnicity (Black)	1.56	0.50	0.18	0.06	<b>0.002</b>
Race/Ethnicity (Hispanic)	0.65	0.43	0.07	0.05	0.131
Race/Ethnicity (Asian)	1.23	0.89	0.14	0.10	0.167
Race/Ethnicity (Other)	0.42	0.46	0.05	0.05	0.355
Household Income (\$5,000-\$11,999)	2.11	1.14	0.24	0.13	0.064
Household Income (\$12,000-\$15,999)	1.84	1.25	0.21	0.14	0.143
Household Income (\$16,000-\$24,999)	2.54	1.07	0.29	0.12	<b>0.018</b>
Household Income (\$25,000-\$34,999)	1.62	1.01	0.18	0.12	0.109

Household Income (\$35,000-\$49,999)	1.82	0.97	0.21	0.11	0.060
Household Income (\$50,000-\$74,999)	1.17	0.93	0.13	0.11	0.212
Household Income (\$75,000-\$99,999)	1.89	0.94	0.22	0.11	<b>0.045</b>
Household Income (\$100,000 - \$199,999)	1.07	0.93	0.12	0.11	0.247
Household Income (\$200,000 and greater)	2.00	1.00	0.23	0.11	<b>0.045</b>
Household Income (Refuse to answer)	1.13	1.08	0.13	0.12	0.298
Household Income (Don't know)	1.87	1.08	0.21	0.12	0.083
Child Age	0.42	0.27	0.02	0.02	0.126
Parents' maximum education (7th grade)	-12.19	9.24	-1.39	1.05	0.187
Parents' maximum education (8th grade)	-3.71	4.40	-0.42	0.50	0.400
Parents' maximum education (9th grade)	-4.45	4.02	-0.51	0.46	0.268
Parents' maximum education (10th grade)	-1.47	3.98	-0.17	0.45	0.712
Parents' maximum education (11th grade)	-4.95	4.13	-0.56	0.47	0.230

Parents' maximum education (12th grade)	-2.30	3.76	-0.26	0.43	0.540
Parents' maximum education (High school graduate)	-2.43	3.55	-0.28	0.41	0.494
Parents' maximum education (GED or equivalent)	-4.08	3.63	-0.46	0.41	0.261
Parents' maximum education (Some college)	-3.79	3.52	-0.43	0.40	0.282
Parents' maximum education (Associate degree × Occupational)	-3.32	3.53	-0.38	0.40	0.347
Parents' maximum education (Associate degree × Academic Program)	-4.40	3.55	-0.50	0.40	0.215
Parents' maximum education (Bachelor's degree)	-4.42	3.52	-0.50	0.40	0.209
Parents' maximum education (Master's degree)	-4.66	3.52	-0.53	0.40	0.185
Parents' maximum education (Professional school degree like MD)	-4.08	3.55	-0.47	0.41	0.250
Parents' maximum education (Doctoral degree like PhD)	-4.65	3.55	-0.53	0.41	0.191
Study Site #2	-0.58	0.99	-0.07	0.11	0.556

Study Site #3	0.82	0.97	0.09	0.11	0.400
Study Site #4	0.33	0.94	0.04	0.11	0.728
Study Site #5	-0.05	1.13	-0.01	0.13	0.968
Study Site #6	0.74	0.99	0.08	0.11	0.453
Study Site #7	-1.76	1.93	-0.20	0.22	0.362
Study Site #8	-0.95	1.14	-0.11	0.13	0.407
Study Site #9	1.26	1.19	0.14	0.14	0.290
Study Site #10	0.68	0.93	0.08	0.11	0.467
Study Site #11	1.15	1.30	0.13	0.15	0.377
Study Site #12	0.48	1.03	0.05	0.12	0.643
Study Site #13	0.00	0.97	0.00	0.11	0.997
Study Site #14	-1.04	1.09	-0.12	0.12	0.339
Study Site #15	-0.47	1.15	-0.05	0.13	0.684
Study Site #16	-1.31	0.96	-0.15	0.11	0.175
Study Site #17	0.20	1.12	0.02	0.13	0.860
Study Site #18	0.90	1.10	0.10	0.13	0.416
Study Site #19	0.37	1.00	0.04	0.11	0.711
Study Site #20	0.99	1.01	0.11	0.11	0.324
Study Site #21	1.16	0.99	0.13	0.11	0.240
Study Site #22	-0.55	2.23	-0.06	0.25	0.805
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R <sup>2</sup> / R <sup>2</sup> adjusted	0.078 / 0.064				

**Tables 4a-4c: Post-hoc logistic regression analyses**

<i>Predictors</i>	<b>Problematic video game user status</b>				
	<i>Odds Ratios</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	0.01	0.01	0.14	0.17	<b>0.003</b>
Baseline UPPS-P total	1.03	0.01	1.21	0.08	<b>0.003</b>
BAS Reward Responsiveness + Drive	1.01	0.02	1.04	0.07	0.593
Baseline BIS	1.04	0.02	1.13	0.07	0.070
GENERAL COGNITIVE ABILITY	0.97	0.10	0.97	0.08	0.734
EXECUTIVE FUNCTIONING	0.90	0.08	0.92	0.06	0.227
LEARNING/MEMORY	0.97	0.10	0.98	0.07	0.764
CBCL Internalizing	1.00	0.01	1.02	0.08	0.780
CBCL Externalizing	1.01	0.01	1.06	0.08	0.435
Sex (Female)	0.61	0.08	0.61	0.08	<b>&lt;0.001</b>
Sex (Intersex Male)	0.00	0.00	0.00	0.00	0.995
Race/Ethnicity (Black)	1.56	0.35	1.56	0.35	<b>0.045</b>
Race/Ethnicity (Hispanic)	1.27	0.25	1.27	0.25	0.243
Race/Ethnicity (Asian)	1.55	0.63	1.55	0.63	0.274
Race/Ethnicity (Other)	1.11	0.25	1.11	0.25	0.659
Household Income (\$5,000-\$11,999)	0.70	0.35	0.70	0.35	0.466

Household Income (\$12,000-\$15,999)	0.66	0.38	0.66	0.38	0.466
Household Income (\$16,000-\$24,999)	2.06	0.83	2.06	0.83	0.072
Household Income (\$25,000-\$34,999)	1.05	0.43	1.05	0.43	0.909
Household Income (\$35,000-\$49,999)	0.90	0.36	0.90	0.36	0.801
Household Income (\$50,000-\$74,999)	1.08	0.41	1.08	0.41	0.843
Household Income (\$75,000-\$99,999)	0.96	0.38	0.96	0.38	0.926
Household Income (\$100,000 - \$199,999)	1.01	0.39	1.01	0.39	0.980
Household Income (\$200,000 and greater)	0.72	0.32	0.72	0.32	0.454
Household Income (Refuse to answer)	0.74	0.36	0.74	0.36	0.527
Household Income (Don't know)	0.76	0.35	0.76	0.35	0.547
Child Age	1.21	0.16	1.10	0.07	0.144
Parents' maximum education (7th grade)	0.00	0.00	0.00	0.00	0.995
Parents' maximum education (8th grade)	0.48	0.74	0.48	0.74	0.632
Parents' maximum education (9th grade)	0.60	0.77	0.60	0.77	0.690

Parents' maximum education (10th grade)	0.23	0.35	0.23	0.35	0.333
Parents' maximum education (11th grade)	0.00	0.00	0.00	0.00	0.980
Parents' maximum education (12th grade)	0.41	0.52	0.41	0.52	0.479
Parents' maximum education (High school graduate)	0.53	0.61	0.53	0.61	0.581
Parents' maximum education (GED or equivalent)	0.29	0.35	0.29	0.35	0.307
Parents' maximum education (Some college)	0.52	0.59	0.52	0.59	0.567
Parents' maximum education (Associate degree × Occupational	0.52	0.59	0.52	0.59	0.566
Parents' maximum education (Associate degree × Academic Program	0.51	0.59	0.51	0.59	0.557
Parents' maximum education (Bachelor's degree)	0.43	0.49	0.43	0.49	0.458
Parents' maximum education (Master's degree)	0.33	0.37	0.33	0.37	0.328

Parents' maximum education (Professional school degree like MD)	0.46	0.54	0.46	0.54	0.509
Parents' maximum education (Doctoral degree like PhD)	0.38	0.44	0.38	0.44	0.407
Study Site #2	0.92	0.49	0.92	0.49	0.873
Study Site #3	1.37	0.66	1.37	0.66	0.513
Study Site #4	1.22	0.59	1.22	0.59	0.676
Study Site #5	1.76	0.96	1.76	0.96	0.304
Study Site #6	1.45	0.73	1.45	0.73	0.466
Study Site #7	0.00	0.00	0.00	0.00	0.977
Study Site #8	1.37	0.82	1.37	0.82	0.596
Study Site #9	1.75	1.01	1.75	1.01	0.330
Study Site #10	1.84	0.85	1.84	0.85	0.188
Study Site #11	1.52	0.94	1.52	0.94	0.502
Study Site #12	2.34	1.17	2.34	1.17	0.089
Study Site #13	0.80	0.42	0.80	0.42	0.671
Study Site #14	0.38	0.28	0.38	0.28	0.194
Study Site #15	1.55	0.83	1.55	0.83	0.420
Study Site #16	0.69	0.37	0.69	0.37	0.493
Study Site #17	0.82	0.53	0.82	0.53	0.764
Study Site #18	2.09	1.12	2.09	1.12	0.166
Study Site #19	0.77	0.43	0.77	0.43	0.640

Study Site #20	1.23	0.63	1.23	0.63	0.692
Study Site #21	0.81	0.44	0.81	0.44	0.698
Study Site #22	2.94	2.59	2.94	2.59	0.222
R <sup>2</sup> Tjur	0.039				

**Table 4b**

*Logistic regression analyses predicting problematic social media use*

<i>Predictors</i>	<b>Problematic social media user status</b>				
	<i>Odds Ratios</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	0.06	0.14	0.15	0.19	0.209
Baseline UPPS-P total	1.01	0.01	1.09	0.10	0.307
BAS Reward Responsiveness + Drive	1.01	0.02	1.03	0.10	0.734
Baseline BIS	1.06	0.03	1.17	0.11	0.077
GENERAL COGNITIVE ABILITY	1.03	0.15	1.02	0.11	0.849
EXECUTIVE FUNCTIONING	1.03	0.12	1.02	0.09	0.833
LEARNING/MEMORY	0.62	0.09	0.72	0.07	<b>0.001</b>
CBCL Internalizing	0.99	0.02	0.96	0.10	0.664
CBCL Externalizing	1.03	0.02	1.15	0.12	0.161
Sex (Female)	2.12	0.39	2.12	0.39	<b>&lt;0.001</b>
Sex (Intersex Male)	0.00	0.00	0.00	0.00	0.996

Race/Ethnicity (Black)	1.30	0.39	1.30	0.39	0.391
Race/Ethnicity (Hispanic)	1.42	0.40	1.42	0.40	0.211
Race/Ethnicity (Asian)	0.65	0.49	0.65	0.49	0.571
Race/Ethnicity (Other)	1.49	0.42	1.49	0.42	0.149
Household Income (\$5,000-\$11,999)	0.35	0.26	0.35	0.26	0.156
Household Income (\$12,000-\$15,999)	0.66	0.49	0.66	0.49	0.570
Household Income (\$16,000-\$24,999)	0.77	0.48	0.77	0.48	0.676
Household Income (\$25,000-\$34,999)	0.78	0.44	0.78	0.44	0.656
Household Income (\$35,000-\$49,999)	0.78	0.42	0.78	0.42	0.646
Household Income (\$50,000-\$74,999)	0.84	0.44	0.84	0.44	0.731
Household Income (\$75,000-\$99,999)	1.16	0.61	1.16	0.61	0.773
Household Income (\$100,000 - \$199,999)	1.09	0.56	1.09	0.56	0.873
Household Income (\$200,000 and greater)	0.73	0.44	0.73	0.44	0.604
Household Income (Refuse to answer)	1.10	0.66	1.10	0.66	0.875
Household Income (Don't know)	0.35	0.26	0.35	0.26	0.158

Child Age	0.99	0.18	1.00	0.09	0.961
Parents' maximum education (7th grade)	0.00	0.00	0.00	0.00	0.995
Parents' maximum education (8th grade)	0.00	0.00	0.00	0.00	0.983
Parents' maximum education (9th grade)	0.00	0.00	0.00	0.00	0.977
Parents' maximum education (10th grade)	0.23	0.36	0.23	0.36	0.352
Parents' maximum education (11th grade)	0.00	0.00	0.00	0.00	0.980
Parents' maximum education (12th grade)	0.15	0.21	0.15	0.21	0.171
Parents' maximum education (High school graduate)	0.17	0.20	0.17	0.20	0.143
Parents' maximum education (GED or equivalent)	0.11	0.15	0.11	0.15	0.099
Parents' maximum education (Some college)	0.10	0.12	0.10	0.12	0.057
Parents' maximum education (Associate degree × Occupational	0.13	0.16	0.13	0.16	0.093

Parents' maximum education (Associate degree × Academic Program	0.08	0.10	0.08	0.10	<b>0.042</b>
Parents' maximum education (Bachelor's degree)	0.13	0.16	0.13	0.16	0.093
Parents' maximum education (Master's degree)	0.07	0.09	0.07	0.09	<b>0.033</b>
Parents' maximum education (Professional school degree like MD)	0.14	0.18	0.14	0.18	0.117
Parents' maximum education (Doctoral degree like PhD)	0.07	0.09	0.07	0.09	<b>0.035</b>
Study Site #2	0.46	0.39	0.46	0.39	0.357
Study Site #3	1.05	0.72	1.05	0.72	0.941
Study Site #4	1.69	1.12	1.69	1.12	0.427
Study Site #5	0.94	0.81	0.94	0.81	0.943
Study Site #6	1.06	0.75	1.06	0.75	0.940
Study Site #7	2.57	3.10	2.57	3.10	0.433
Study Site #8	1.12	0.96	1.12	0.96	0.892
Study Site #9	2.89	2.15	2.89	2.15	0.154
Study Site #10	1.14	0.75	1.14	0.75	0.848
Study Site #11	1.73	1.49	1.73	1.49	0.523
Study Site #12	2.68	1.84	2.68	1.84	0.150
Study Site #13	1.01	0.74	1.01	0.74	0.985

Study Site #14	0.87	0.75	0.87	0.75	0.872
Study Site #15	1.05	0.85	1.05	0.85	0.957
Study Site #16	0.81	0.59	0.81	0.59	0.768
Study Site #17	2.61	1.97	2.61	1.97	0.204
Study Site #18	2.73	1.95	2.73	1.95	0.159
Study Site #19	1.00	0.73	1.00	0.73	1.000
Study Site #20	1.49	1.05	1.49	1.05	0.573
Study Site #21	1.34	0.95	1.34	0.95	0.682
Study Site #22	2.37	2.89	2.37	2.89	0.480

R<sup>2</sup> Tjur 0.025

**Table 4c**

*Logistic regression analyses predicting problematic phone use*

<i>Predictors</i>	<b>Problematic phone user status</b>				
	<i>Odds Ratios</i>	<i>std. Error</i>	<i>Std Beta (SE)</i>	<i>standardized std. Error</i>	<i>p</i>
(Intercept)	0.01	0.02	0.16	0.20	<b>0.015</b>
Baseline UPPS-P total	1.03	0.01	1.23	0.08	<b>0.001</b>
BAS Reward Responsiveness + Drive	1.00	0.02	1.01	0.07	0.886
Baseline BIS	1.05	0.02	1.15	0.08	<b>0.032</b>
GENERAL COGNITIVE ABILITY	1.07	0.11	1.05	0.08	0.525

EXECUTIVE FUNCTIONING	0.90	0.08	0.92	0.06	0.219
LEARNING/MEMORY	0.74	0.07	0.81	0.06	<b>0.002</b>
CBCL Internalizing	1.01	0.01	1.03	0.08	0.646
CBCL Externalizing	1.03	0.01	1.19	0.08	<b>0.013</b>
Sex (Female)	2.79	0.39	2.79	0.39	<b>&lt;0.001</b>
Sex (Intersex Male)	0.00	0.00	0.00	0.00	0.993
Race/Ethnicity (Black)	1.36	0.30	1.36	0.30	0.160
Race/Ethnicity (Hispanic)	1.12	0.23	1.12	0.23	0.580
Race/Ethnicity (Asian)	1.44	0.56	1.44	0.56	0.349
Race/Ethnicity (Other)	0.92	0.21	0.92	0.21	0.715
Household Income (\$5,000-\$11,999)	0.71	0.35	0.71	0.35	0.491
Household Income (\$12,000-\$15,999)	0.61	0.36	0.61	0.36	0.403
Household Income (\$16,000-\$24,999)	1.06	0.49	1.06	0.49	0.899
Household Income (\$25,000-\$34,999)	0.98	0.42	0.98	0.42	0.963
Household Income (\$35,000-\$49,999)	1.03	0.43	1.03	0.43	0.939
Household Income (\$50,000-\$74,999)	0.88	0.35	0.88	0.35	0.746
Household Income (\$75,000-\$99,999)	1.03	0.42	1.03	0.42	0.940

Household Income (\$100,000 - \$199,999)	0.82	0.33	0.82	0.33	0.618
Household Income (\$200,000 and greater)	0.69	0.31	0.69	0.31	0.416
Household Income (Refuse to answer)	1.12	0.52	1.12	0.52	0.800
Household Income (Don't know)	0.93	0.43	0.93	0.43	0.870
Child Age	1.10	0.15	1.05	0.07	0.448
Parents' maximum education (7th grade)	0.00	0.00	0.00	0.00	0.992
Parents' maximum education (8th grade)	0.00	0.00	0.00	0.00	0.974
Parents' maximum education (9th grade)	0.70	0.89	0.70	0.89	0.781
Parents' maximum education (10th grade)	0.21	0.33	0.21	0.33	0.312
Parents' maximum education (11th grade)	0.16	0.24	0.16	0.24	0.228
Parents' maximum education (12th grade)	0.23	0.29	0.23	0.29	0.246
Parents' maximum education (High school graduate)	0.46	0.53	0.46	0.53	0.501

Parents' maximum education (GED or equivalent)	0.13	0.17	0.13	0.17	0.114
Parents' maximum education (Some college)	0.18	0.21	0.18	0.21	0.143
Parents' maximum education (Associate degree × Occupational)	0.32	0.37	0.32	0.37	0.322
Parents' maximum education (Associate degree × Academic Program)	0.18	0.21	0.18	0.21	0.145
Parents' maximum education (Bachelor's degree)	0.28	0.32	0.28	0.32	0.262
Parents' maximum education (Master's degree)	0.27	0.31	0.27	0.31	0.249
Parents' maximum education (Professional school degree like MD)	0.35	0.42	0.35	0.42	0.377
Parents' maximum education (Doctoral degree like PhD)	0.30	0.35	0.30	0.35	0.306
Study Site #2	0.68	0.33	0.68	0.33	0.431
Study Site #3	1.13	0.49	1.13	0.49	0.781
Study Site #4	0.85	0.37	0.85	0.37	0.706
Study Site #5	1.29	0.65	1.29	0.65	0.608
Study Site #6	0.81	0.38	0.81	0.38	0.659
Study Site #7	0.71	0.79	0.71	0.79	0.759

Study Site #8	1.00	0.53	1.00	0.53	0.994
Study Site #9	1.41	0.74	1.41	0.74	0.508
Study Site #10	0.98	0.42	0.98	0.42	0.962
Study Site #11	1.43	0.79	1.43	0.79	0.513
Study Site #12	0.99	0.47	0.99	0.47	0.978
Study Site #13	0.61	0.29	0.61	0.29	0.302
Study Site #14	0.51	0.31	0.51	0.31	0.272
Study Site #15	0.57	0.32	0.57	0.32	0.312
Study Site #16	0.49	0.24	0.49	0.24	0.143
Study Site #17	0.98	0.53	0.98	0.53	0.966
Study Site #18	0.98	0.51	0.98	0.51	0.973
Study Site #19	0.60	0.29	0.60	0.29	0.298
Study Site #20	1.20	0.55	1.20	0.55	0.687
Study Site #21	1.11	0.51	1.11	0.51	0.814
Study Site #22	0.00	0.00	0.00	0.00	0.969

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R<sup>2</sup> Tjur                      0.044

