Development and Validation of the Problematic Media Use Measure: A Parent Report Measure of Screen Media "Addiction" in Children

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Abstract

Although problematic media use among adolescents is of wide interest, less is known regarding problematic media use among younger children. The current study reports on the development and validation of a parent-report measure of one potential aspect of children's problematic use-screen media addiction-via the Problematic Media Use Measure (PMUM). Items were based on the nine criteria for Internet Gaming Disorder in the DSM-5. The first study describes the development and preliminary validation of the PMUM in a sample of 291 mothers. Mothers (80.8% identified as White) of children 4 through 11 years of age completed the PMUM and measures of child screen time and child psychosocial functioning. EFA indicated a unidimensional construct of screen media addiction. The final versions of the PMUM (27 items) and PMUM Short Form (PMUM-SF, 9 items) evidenced high internal consistency (Cronbach $\alpha = .97$ and $\alpha = .93$, respectively). Regression analyses were conducted to examine convergent validity of the PMUM with indicators of child psychosocial functioning. Convergent validity was supported and the PMUM scales also independently predicted children's total difficulties in functioning, over and above hours of screen time, indicating incremental validity. The second study sought to confirm the factor structure of the PMUM-SF and test for measurement invariance across gender. In a sample of 632 parents, we

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confirmed the factor structure of the PMUM-SF and found measurement invariance for boys and girls. These studies support the use of the PMUM-SF as a measure of screen media addiction in children ages 4 through 11 years old.

Keywords

problematic media use; screen addiction; internet gaming disorder; children; mobile device

At increasingly younger ages, children have access to mobile media devices (e.g., tablets and smartphones (Rideout, 2013) and evidence suggests that mobile device ownership and usage is growing even among toddler- and preschool-aged children (Kabali et al., 2015). Given the increased use of screen media, public health experts and researchers have advocated for increased research on "addiction" to the internet and electronic screen products in children (Felt & Robb, 2016; World Health Organization, 2015). Although research on problematic media use among adolescent and young adult samples has grown, limited research has considered whether younger children exhibit addictive media use. The aim of this study, therefore, is to develop and validate a parent-report measure that could be used to screen for addictive media use in children under age 12 years.

Defining Problematic and Addictive Media Use in Children

Problematic media use in adolescents has been studied across many types of screen media (e.g., pathological gaming or game addiction: (Gentile, 2009; Rehbein, Kleimann, & Mößle, 2010; Spekman, Konijn, Roelofsma, & Griffiths, 2013; problematic internet use: Jelenchick et al., 2014; Moreno, Jelenchick, Cox, Young, & Christakis, 2011; Moreno, Jelenchick, & Christakis, 2013; compulsive texting: Foerster, Roser, Schoeni, & Röösli, 2015; Lister-Landman, Domoff, & Dubow, 2015; and problematic mobile phone use: Foerster et al., 2015). One of the most widely studied types of problematic media use among adolescents is pathological gaming. Pathological gaming consists of excessive and persistent involvement with video games that interferes with a youth's psychological, social, family, and school functioning (Gentile, 2009). Criteria used to measure pathological gaming include symptoms such as salience or preoccupation with playing video games, tolerance (the need to use video games for increasingly longer times to achieve the same effect), unsuccessful attempts to control use, loss of interest in other activities, and use to improve mood or escape negative feelings (Lemmens, Valkenburg, & Peter, 2011). Recently, the American Psychiatric Association (APA) has listed these criteria, and others, as proposed symptoms of Internet Gaming Disorder (IGD) in Section 3 of the DSM-5 (APA, 2013).

The inclusion of IGD in Section 3 of the DSM-5 has provided the field with a consensus of criteria that *may* underlie internet- or screen-based behavioral addictions. As such, these criteria have been applied to other types of behavioral addictions (e.g., social media addiction: (van den Eijnden, Lemmens, & Valkenburg, 2016) and provide the theoretical basis for the present study. As has been noted by others (e.g., van den Eijnden et al., 2016), the underlying assumption of using IGD criteria to examine various screen media addictions is the premise that addictions to screen media consist of the same diagnostic criteria, because they reflect different types of the overarching construct of Internet Addiction (van den

Eijnden et al., 2016). IGD criteria have primarily been examined in adolescents (> age 12 years) outside of the United States (e.g., Netherlands: Lemmens, Valkenburg, & Gentile, 2015; Hungary: Király et al., 2015; Finland: Männikkö, Billieux, & Kääriäinen, 2015; Spain: Fuster, Carbonell, Pontes, & Griffiths, 2016). As the etiology of IGD or other addictive screen media use in adolescents is unknown (Groves et al., 2015) it is important to determine whether signs of problematic media use can be identified and measured earlier in development.

Addictive media use symptoms in children (< 12 years) may present differently than in adolescents. Children are more reliant on parents for media access compared to adolescents, who have relatively more autonomy in their media use and have higher personal media ownership rates (Rideout, 2015). Therefore, the IGD symptom of "preoccupation" in younger children may be experienced by parents as frequent or persistent requests or strategies to access media, whereas "preoccupation" in adolescents is defined as intrusive cognitions about playing video games (Groves et al., 2015). Addictive use in children may also manifest as vehement resistance to limit setting by parents regarding media use. Such behaviors may interfere with home life (e.g., conflict with siblings about media use, disruption of family routines, parent-child conflict) as well as school functioning (e.g., delaying or avoiding school work in order to use media). Screen media addiction may also disrupt a child's social functioning and possibly interfere with longer-term development of social competence (e.g., by displacing face-to-face peer interaction; Uhls et al., 2014). Unlike adolescents, who have the capacity to self-reflect and may be able to report on whether problematic media use disrupts their functioning in these areas, children are likely unaware of such impact. Therefore, adults in the child's life (e.g., parents, teachers) who witness the potential dysfunction associated with the child's media use are the preferred reporters for problematic media use in younger children. Taken together, assessment of problematic media use in children will need to consider the potential developmental differences in problematic use in this younger demographic and, like other measures of child psychosocial difficulties, is best measured using caregiver reports.

Current Studies

The primary goal of the first study was to develop a parent report measure of children's addictive use of screen media, the Problematic Media Use Measure (PMUM). To do so, we use the DSM-5 criteria for IGD (see Method for full description of measure development). A critique of the prior development of measures of device or media addiction is the proliferation of measures that differ from each other, but purport to measure the same construct (e.g., inconsistently using substance use disorder criteria and/or pathological gambling criteria; Lemmens et al., 2015; Petry et al., 2014; van den Eijnden et al., 2016). With the expert consensus on IGD criteria, it has been emphasized that researchers use common methodology to assess IGD (Petry et al., 2014) and other screen-based behavioral addictions like social media disorder (van den Eijnden et al., 2016). As such, we use all nine IGD criteria to measure screen media addiction in young children. A second aim of this study was to test the reliability and validity of the PMUM in a sample of mothers of children ages 4 through 11 years old. To test convergent validity, we examined correlations between PMUM scores and other measures that have been previously associated with other types of

addictive media use (i.e., screen time and psychosocial difficulties) or should theoretically associate with addiction (i.e., mothers' reported concern about their child's media use). To examine incremental validity, we tested whether PMUM scores uniquely predict child psychosocial functioning, over and above screen time.

In Study 2, our aim was to confirm the factor structure of the PMUM that emerged in Study 1, and to test for factor and structural invariance by gender. Finally, an additional examination of the PMUM's convergent validity was conducted in this independent sample.

Study 1

Method

Participants and Procedure—The IRB of the authors' institution reviewed this study and determined that this research was exempt. In December 2015, participants were recruited through Amazon Mechanical Turk (MTurk). MTurk has been found to be a reliable and inexpensive way to recruit participants (Buhrmester, Kwang, & Gosling, 2011; Casler, Bickel, & Hackett, 2013; Shapiro, Chandler, & Mueller, 2013). For example, Mturk respondents have been found to be more representative of the United States (US) population than convenience samples recruited for in-person data collection (Berinsky, Huber, & Lenz, 2012), and has been successfully used to study family processes and youth psychosocial functioning (Schleider & Weisz, 2015). MTurk workers who resided in the US and who had been qualified as "master" workers by Amazon Mturk were able to view the recruitment posting. Participants were compensated $0.40.

The participant had to be the mother of a child within the ages of 4 years through 11 years. We chose to include only mothers because prior research has indicated that mothers are more likely than fathers to engage in certain media parenting practices (e.g., restrict TV and explain TV content (Valkenburg, Krcmar, Peeters, & Marseille, 1999). Demographic questions screened out ineligible responders. Participants were unable to go back to the demographic questions in order to prevent response changes to the eligibility questions.

Participants who answered one or more of the validation checks incorrectly were not included in analyses ($n = 5$). Participants who demonstrated incoherent response patterns (e.g., answering 1's or 2's for all items and not altering their responses for reverse-scored questions; $n = 2$) were also excluded from analyses, reducing the sample size from 298 to 291 participants. See Table 1 for descriptive statistics.

Additional Measures

Demographics—Mother's age, race/ethnicity, highest level of education, relationship to child (e.g., biological mother, adoptive mother, other), and family income were assessed. Mothers also reported on their child's sex, age, race/ethnicity, and type of school or child-care setting.

Screen media use—Mothers reported on their child's average weekday and weekend screen time for the following types of screen media: (1) television (TV) shows (broadcast or streaming), DVDs, or videotapes on a TV set; (2) video games on a handheld game player or

game system; (3) mobile devices, such as smartphones and tablets, not including time required for school assignments or homework; and (4) desktop computer or laptop use. Response options ranged from *None* to *More than 4 hours per day*. Categorical responses were classified on a scale from 0 to 6 to be used in the regression analyses.

To calculate average daily screen time, responses to the weekday items were multiplied by 5 and responses to the weekend items were multiplied by 2. These products were added together and divided by 7 to calculate total screen time across all devices.

Mothers were asked (from Rideout, 2013): "What age did your child first get his/her OWN mobile device, such as a smartphone or tablet (e.g., iPad, Kindle Fire)?", and "What type of screen media does your child use the most (not including screen media used for school or homework)?" with the following options: TV, video games, mobile phone, tablet, handheld video game device, and computer/laptop.

Child psychosocial functioning—Mothers completed the 25-item Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997), a widely-used instrument (Stone, Otten, Engels, Vermulst, & Janssens, 2010) which assesses five domains of child functioning (e.g., emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behaviors) and provides a total difficulty score (sum of all subscales except prosocial behaviors). These subscales of the SDQ reflect constructs that have been used to test the validity of measures of IGD and Social Media Disorder (e.g., Lemmens et al., 2015 and van den Eijnden et al., 2016). Mothers received the version of the SDQ (parent-report for 4–10 year olds or for mothers of 11 year olds, the 11–17 year old version) appropriate for the age of the child. Response options for both SDQ versions are: *Not True* (= 0), *Somewhat True* (= 1), and *Certainly True* (= 2). Current Cronbach's alphas for the total difficulties score (20 items) were .86 and .91 for the 4–10 year old version and 11–17 year old versions, respectively (see Table 2 for descriptive statistics for SDQ subscales).

Concern about child media use—We used one item to assess mothers' concern about their child's screen media use: "How often do you worry about your child's screen media use (TV, computer, video games, or mobile device)?" Response options ranged from *Never* (1) to *Always* (5).

Problematic Media Use Measure (PMUM) Development

PMUM items were generated based on criteria suggested for IGD in the DSM-5 (APA, 2013). With slight modifications to account for parents reporting on their child's media use compared to youth reporting on their own use, we created items reflecting the following IGD criteria items (APA, 2013): (1) preoccupation (5 items), (2) withdrawal (11 items), (3) tolerance (4 items), (4) unsuccessful attempts by parent to control use (10 items), (5) loss of interest in previous hobbies and entertainment (7 items), (6) deceived others about use (5 items), (7) use to escape or relieve a negative mood (4 items), (8) jeopardized/lost a relationship or had compromised functioning in school due to use (4 items), and (9) continued use despite psychosocial problems (10 items). Content used to generate items that correspond to the DSM criteria were drawn from literature on problematic media use in adolescents, clinical experience, and interviews with mothers of children between the ages

of 4–8 years old that had been collected in a separate study (Author removed for peer review).

The resulting pool of 60 items was sent to five experts on addiction, internet gaming disorder, internet addiction, and children's media use. Experts represented a variety of disciplines, including pediatrics, developmental psychology, clinical psychology, communications, and adolescent medicine. Experts provided feedback on measure instructions, item content and wording, and indicated whether criteria were not included or adequately captured. Revisions to the measure instructions and items were made based on expert feedback.

The 60-item measure, instructed participants to respond to questions based on any type of screen media their child used (see online supplemental material for instructions) and to "select the option that is true for your child in the past month." We chose the more general term "screen media" instead of specifying screen media format in order to identify problematic use of any screen media. We did so for two reasons. First, given the multiple formats of screen media used by children, problems could arise for more than one media format (e.g., video game console and tablet) and/or problems could arise for different formats in different contexts. For example, a parent may report problems with his/her child wanting to use the computer at home, but persistent requests to use mobile devices primarily outside the home. Second, we chose the term screen media instead of a specific format (e.g., internet games, Youtube videos), as parents may be unable to reliably report on the specific programs their child uses. For example, parents may not be able to distinguish whether their child has problems due to wanting to play internet games on his Ipad versus stream TV programs (or both). Thus, the term "screen media" was chosen to be broad enough to capture a variety of media formats and to facilitate parent report of general problems due to use, and with an eye to the fact that media formats will change over time. We chose "past month" for parents to report on their child's problematic media use, instead of one year (as used for IGD; APA, 2013), as we believed that accurately characterizing a young child's media use over one year would be challenging for parents. Responses were based on a 5-point Likert scale, ranging from *Never* (1) to *Always* (5).

Data Analytic Plan

In Study 1, data reduction analyses were conducted to decrease the number of items on the PMUM for a full scale and short form version. Inter-item correlations were first examined to identify items that were poorly correlated with the other items in the scale. Next, exploratory factor analyses (EFAs) were conducted to aid in item reduction and finalize the scale content. Then, analyses on the final PMUM scale and PMUM Short Form (PMUM-SF) were conducted to establish the convergent validity by examining correlations between the PMUM and PMUM-SF and children's screen time and correlations between the PMUM and PMUM-SF and mothers' reported concern about their child's screen media use. We tested incremental validity of the PMUM and PMUM-SF via multiple regression analyses to determine whether the PMUM and PMUM-SF accounted for significant variance in child functioning (i.e., subscales of the SDQ), over and above screen time.

Results

Factor Structure and Reliability—After eliminating four items based on low inter-item correlations, the final set of 56 items was then entered into an EFA with Oblimin rotation. Evaluation of the scree plot indicated a one-factor solution, with all items loading > .40 on the factor. To further reduce the items, in order to decrease redundancy among items measuring the same symptom, we retained the three highest loading items from each IGD symptom for the PMUM full scale, and the highest loading item for the PMUM-SF (based on prior measure development utilizing three items to assess each symptom; Lemmens et al., 2015; van den Eijnden et al., 2016). The EFA for the final set of PMUM items is presented in Table 3 and the EFA for the PMUM-SF is presented in Table 4. Internal reliability for the final PMUM and PMUM-SF were strong (Cronbach α = .97 and α = .93, respectively). The PMUM Full Scale and PMUM-SF correlated highly with each other (r = .98, p < .01).

Convergent and Incremental Validity—Correlations between the PMUM Full Scale and total daily screen time and the one-item "worry about child's media use" were significant (p < .01) and moderate in size (r = .49 and r = .59, respectively), supporting convergent validity of the scale. Similar correlations (p < .01) were found between the PMUM-SF and total daily screen time (r = .47) and the one-item "worry about child's media use" (r = .58).

Incremental validity was examined by using multiple regression to test whether the PMUM and PMUM-SF predicted child psychosocial functioning over and above screen time. Age and total screen time were entered in the first step and PMUM total score (or PMUM-SF score) was entered in the second step (see Tables 5 and 6). Total screen time and child age predicted child psychosocial functioning difficulties (B = .37 and B = −.17, respectively, p < .01), explaining 13% of the variance. In the second step, the PMUM explained an additional 24% of the variance in child psychosocial functioning difficulties (see Table 5), and screen time was no longer significantly associated with child functioning difficulties (B = .09, p = .12). Similar results were found for the SDQ subscales: Hyperactivity and Inattention and Prosocial Behaviors, which are also presented in Table 5. Screen time remained significantly associated with the Peer Relationship Problems, Conduct Problems, and Emotional Symptoms subscales in Step 2, albeit with a lower standardized Beta value (see Table 5). Similar findings were found for the PMUM-SF (see Table 6).

Results from Study 1 support the reliability and convergent and incremental validity of the PMUM Full Scale and PMUM-SF. Best practices in scale development include confirmation of the factor structure in a separate, independent sample (Worthington & Whittaker, 2006), which we pursue in Study 2. Given that the PMUM-SF demonstrated similar psychometric properties, was highly correlated with the PMUM Full Scale, similarly predicted child psychosocial difficulties, and was shorter (i.e., less burdensome to participants), we chose to confirm the validation of the PMUM-SF in Study 2.

Study 2

Method

Participants and Procedure—Study 2 participants were recruited through Qualtrics; the data presented for Study 2 are drawn from a larger study on parent and child media use. Eligible participants had to be the primary caregiver (mother or father) of a child between the ages of 4 years and 14 years. Demographic questions screened out ineligible responders ($n = 154$). Data was screened for implausible scores or if two or more participants had the same IP address (indicating that the same parent reported on more than one child or if two parents reported on the same child; $n = 2$). See Table 7 for descriptive statistics for the final sample ($N = 632$).

Measures—In addition to the PMUM-SF and demographic questions, items related to parental conflict with child over screen media use were administered. These items consisted of the stem, "How often do you have a conflict with your child because your child has to turn off" and included the following types of media: television, computer, tablet, smartphone, and video games. Parents responded on a scale from "once a year or never" to "many times a day."

Data Analytic Plan

To confirm the factor structure of the PMUM-SF in this new sample, we conducted a Confirmatory Factor Analysis (CFA) using maximum likelihood estimation via Mplus (Muthén & Muthén, 2012). Model fit was assessed using cut-off values suggested by Hu and Bentler (1999): root mean square error of approximation (RMSEA) less than or equal to 0.06 and standardized root mean square residual (SRMR) less than or equal to 0.08 indicates good fit. Model fit was also assessed using CFI (above .90), squared mean residuals above .1, and significant factor loadings. Another aim of this study was to determine if there was measurement invariance of the PMUM-SF by gender. To determine equivalence, we examined change in CFI and RMSEA values between measurement models (as recommended by Cheung & Rensvold, 2002 and Timmons, 2010). Finally, as a test of convergent validity, we examined the association between PMUM-SF scores and parent-child conflict over screen media use, using bivariate correlation analysis.

Results

Confirmatory Factor Analysis—A confirmatory factor analysis (CFA) was conducted to test the factor structure of the PMUM-SF. The one-factor model demonstrated an acceptable fit to the data (RMSEA = .085; CFI = .961; SRMR = .024; see Table 8). The 9 items loaded significantly on the factor (above .70, $p < .001$; see Figure 1) and squared mean residuals were above .1. To test for measurement invariance between boys and girls, we conducted a multiple-group analysis in Mplus. The fit for the configural invariance model did not significantly change from the overall model (see Table 8), indicating that the factor structure of the PMUM-SF is the same for boys and girls. Successive tests of model fit were also conducted to test for other indicators of measurement invariance (Table 8). Utilizing the CFI and RMSEA tests (i.e., CFI and RMSEA < .01 indicates a non-significant difference in fit), support was found for metric, scalar, and strict invariance. In other words,

factor loadings, intercepts, and residuals were equivalent across groups. Finally, factor-level invariance was also demonstrated in that the factor variance and factor mean were equivalent for boys and girls. In sum, strong evidence was found for measurement invariance of the PMUM-SF.

Convergent Validity—Bivariate correlations between the parent-child conflict over screen media use and PMUM-SF scores were conducted. Across each type of media, greater parent-child conflict associated with higher PMUM-SF scores, ranging from .41 to .50 ($p <$. 01; see Table 9), further supporting the convergent validity of the PMUM-SF.

Discussion

The purpose of this study was to develop and test the reliability and validity of a measure of screen media "addiction" in a sample of children between the ages of 4 and 11 years old. We found, in Study 1, that the PMUM Full Scale and its shorter version, the PMUM-SF, evidenced strong psychometric properties, with good internal consistency and convergent validity. Incremental validity was demonstrated as well, with the PMUM and PMUM-SF independently predicting children's total difficulties in functioning, over and above hours of screen time. In Study 2, with a separate, larger sample, we confirmed the factor structure, reliability, and convergent validity of the PMUM-SF; we also found that the PMUM-SF works well for both girls and boys via multiple group analyses. These studies support the use of the PMUM-SF as a measure of problematic media use in children under age 12 years.

The PMUM assesses a unidimensional construct of problematic media use, consisting of 27 items that reflect all nine criteria proposed for Internet Gaming Disorder (APA, 2013). The PMUM-SF uses 9 items corresponding to these criteria. To our knowledge, this is the first parent-report measure of problematic media use in children ages 4–11 years old. Certain qualities of this measure make it highly suitable for use by clinicians and researchers alike. The PMUM-SF is short enough to be completed during intake appointments with psychologists. With its strong psychometrics and face validity, the PMUM-SF could also be used by researchers seeking to identify children with problematic media use who may be too young to self-report on their symptoms. Another promising feature of the PMUM-SF is its use of the term "screen media" instead of specifying certain devices. Given how quickly new mobile media devices are developed, and the diversity of media platforms used by children today, it was important to create a screening tool that was broad enough to capture any screen media. As is done with other clinical measures, the clinician can assess for *what* media (e.g., video games, online gaming) is of most concern to the parents, after administering this screener. The PMUM-SF can be completed by parents whose child is having problems related to video game use, tablet use, and/or other mobile device use (or heretofore unknown platforms). By not focusing on a specific device, the PMUM-SF can be used to capture any problematic media use. We recommend that researchers and/or clinicians ask parents about the type of media their child uses the most to complement the PMUM-SF total score.

There were limitations of this study that should be addressed in the future. First, in this cross-sectional study, we could not test whether problematic media use preceded problems

in psychosocial functioning or vice versa. This relationship may also be bidirectional (Gentile, Swing, Lim, & Khoo, 2012). Future research using multiple time points is needed in order to understand the development of problematic media use in children. A limitation, that should be addressed in the future, regarded our method for assessing screen time. Although future studies should use Time Use Diaries or passive sensing technology, we were limited to parent report given that it was a one-time online study. Another limitation is the racial/ethnic diversity of the sample was fairly homogenous; thus, the findings may not generalize to all parent populations. Finally, there are multiple strategies that can be taken to reduce the items, each of which carries assumptions such as whether IGD is a singular unifactor disorder or a complex issue that may present heterogeneous sets of symptoms across patients. Future research should consider the whether certain approaches are more valid for clinical diagnosis in different populations.

Another limitation of this measure is that it is focused on "addictive" screen media use; other aspects of problematic media use have been articulated (see a Pathway Model of Problematic Mobile Phone Use: Billieux, 2012; Billieux, Maurage, Lopez-Fernandez, Kuss, & Griffiths, 2015), that this measure does not assess. Thus, future research should consider other aspects of problematic media use (e.g., antisocial and risky patterns of use; Billieux et al., 2015) as appropriate to the developmental stage of the child.

These studies presents a first attempt to measure problematic media use in children. Future studies are encouraged in order to validate the PMUM-SF in more diverse samples. Future research can test whether the PMUM Full Scale or PMUM-SF associates with other indices of child adjustment. Validating the PMUM in clinical samples is an important next step, as well as establishing clinical cut-off scores. Pending further validation, the PMUM has the potential to identify children at greater risk for later screen media dependence and problems associated with excessive screen media use.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Public Significance Statement

Children's screen time and mobile device use has grown markedly. Concerns have been raised about whether children are "addicted" to screen media; however, no measures have been developed to assess screen media addiction in younger children. This manuscript describes the development and validation of a parent-report measure of screen media addiction in children under age 12 years.
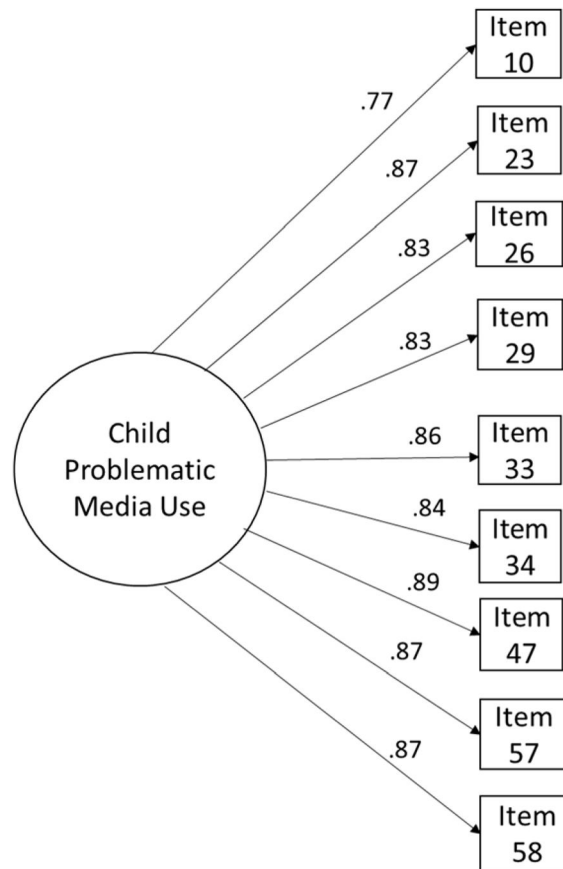
Figure 1.

Confirmatory Factor Analysis of PMUM-SF (*N* = 632)

Note. Standardized estimates displayed above arrows. All loadings are significant at *p* < .01.

Model fit: RMSEA = .085, SRMR = .024, and CFI = .961.

Table 1

Study 1: Demographic Characteristics of Participants (n = 291)

Demographic variable	Mean (SD) or % (*n*)
Child age (years)	7 (2)
Child sex (female)	50.0% (145)
Child race and ethnicity	
White	76.8% (222)
Black	9.0% (26)
Biracial	8.9% (26)
Asian or Pacific Islander	4.2% (12)
Other	1.0% (3)
Hispanic or Latino/a (any race)	11.0% (32)
Mother race and ethnicity	
White	80.8% (235)
Black	9.6% (28)
Biracial	3.8% (11)
Asian or Pacific Islander	4.1% (12)
Other	1.7% (5)
Hispanic or Latina (any race)	7.6% (22)
Past Year Family Income	
$0–$20,000	16.6% (48)
$20,001–$40,000	26.5% (77)
$40,001–$60,000	19.3% (56)
$60,001–$80,000	17.9% (52)
$80,000–$100,000	10.7% (31)
Greater than $100,000	9.0% (26)
Mother education level	
Did not graduate high school	0.3% (1)
High school diploma or GED only	13.8% (40)
Some college courses	30.9% (90)
2-year college degree	12.0% (35)
4-year college degree	30.2% (88)
More than a 4-year college degree	12.7% (37)
Most Commonly Used Screen Media by the Child	
Tablet	32.4% (94)
Television	31.0% (90)
Video games	13.8% (40)
Computer/laptop	11.0% (32)
Mobile phone	8.6% (25)
Handheld video game device	2.7% (8)

Demographic variable	Mean (SD) or % (*n*)
Child has his/her own mobile device (yes)	69.3% (201)
Age when child received his/her own mobile device (years)	7 (2)
Daily Screen Time[a]	
Television	3.18 (1.29)
Mobile device	2.22 (1.60)
Video game	1.69 (1.47)
Computer/laptop	1.20 (1.46)
Total Daily Screen Time	8.24 (3.91)[b]

Note. Frequencies may not add up to *n* = 291 due to missing values.

[a] Due to the use of categorical response options for screen time assessment, means reflect these transformed continuous values: 0 = 0 hours, 1 = Less than 1 hour, 2 = 1 hour, 3 = 2 hours, 4 = 3 hours, 5 = 4 hours, and 6 = More than 4 hours.

[b] This value reflects the sum of the transformed continuous scores (0–6 for each of the 4 types of media, with a possible range of 0–24, corresponding to 0 hours each day to more than 4 hours each day for each of the four types of media) and not *actual* hours.

Table 2

Descriptive Statistics of the Strengths and Difficulties Questionnaire

SDQ Scale	Range	Mean (SD)	Cronbach's alpha (items) 4– 0 year old version	Cronbach's alpha (items) 11–17 year old version
Total score	0–31	9.39 (6.48)	.86 (20)	.91 (20)
Emotional symptoms	0–9	1.88 (2.10)	.76 (5)	.80 (5)
Conduct Problems	0–8	1.47 (1.77)	.67 (5)	.82 (5)
Hyperactivity/Impulsivity	0–10	3.90 (2.47)	.75 (5)	.87 (5)
Peer Relationship Problems	0–8	2.15 (1.85)	.59 (5)	.77 (5)
Prosocial Behaviors	0–10	7.45 (2.28)	.78 (5)	.81 (5)

Note. SDQ items ranged from Not True (= 0), Somewhat True (= 1), and Certainly True (= 2). The sum of the items was calculated to generate subscale scores.

Table 3

Exploratory Factor Analysis of the Problematic Media Use Measure (PMUM) Full Scale (27 items)

PMUM Items (with original item numbers)	Factor Loading
26. It is hard for my child to stop using screen media. Unsuccessful control.	.85
56. It is increasingly difficult to pull my child away from screen media. Unsuccessful control.	.85
53. It is really difficult to get my child to stop using screen media. Unsuccessful control.	.84
47. Screen media is the only thing that seems to motivate my child. Loss of interest	.83
32. My child is always thinking about using screen media. Preoccupation	.83
23. Screen media is all that my child seems to think about. Preoccupation	.83
57. My child becomes frustrated when he/she cannot use screen media. Withdrawal	.82
58. My child's screen media use interferes with family activities.	.82
44. My child gets upset when he/she cannot use screen media. Withdrawal	.82
31. There is nothing my child enjoys as much as screen media. Loss of interest	.80
54. My child becomes angry when he/she cannot use screen media. Withdrawal	.79
33. My child's screen media use causes problems for the family.	.78
34. The amount of time my child wants to use screen media keeps increasing. Tolerance	.76
25. My child attempts to use screen media for increasing amounts of time. Tolerance	.75
52. Problems occur for our family when my child cannot use screen media.	.75
40. My child would find life boring without screen media. Loss of interest	.74
55. Life would be easier if my child was not so attached to screen media.	.74
36. The first thing my child asks to do when he/she comes home from school is to use screen media. preoccupation	.73
24. My child's screen media use negatively affects his/her friendships.	.73
7. My child uses screen media for increasing amounts of time. Tolerance	.73
6. My child loses sleep due to screen media use.	.72
10. My child sneaks using screen media. deception	.71
19. My child lies about doing chores or school work in order to use screen media. deception	.69
29. When my child has had a bad day, screen media seems to be the only thing that helps him/her feel better. escape/relieve mood	.65
20. My child feels better when he/she uses screen media. Escape/relieve mood.	.64
2. My child uses screen media to feel better. Escape/relieve mood	.62
1. My child lies in order to use screen media. deception	.60
% of Variance	57.78%

PMUM Items (with original item numbers)	Factor Loading
Eigenvalue	15.60
Cronbach alpha	.97
M (SD)	2.24 (0.83)

Note. Oblimin with Kaiser Normalization rotation method. The PMUM ranged from 1 = *Never* to 5 = *Always.*

Table 4

Exploratory Factor Analysis of the Problematic Media Use Measure (PMUM) Short Form (9 items)

PMUM Items (with original item numbers)	Factor Loading
26. It is hard for my child to stop using screen media. (Unsuccessful control)	.86
47. Screen media is the only thing that seems to motivate my child. (Loss of interest)	.85
23. Screen media is all that my child seems to think about. (Preoccupation)	.85
58. My child's screen media use interferes with family activities. (Psychosocial consequences)	.84
33. My child's screen media use causes problems for the family. (Serious problems due to use)	.81
57. My child becomes frustrated when he/she cannot use screen media. (Withdrawal)	.81
34. The amount of time my child wants to use screen media keeps increasing. (Tolerance)	.77
10. My child sneaks using screen media. (Deception)	.72
29. When my child has had a bad day, screen media seems to be the only thing that helps him/her feel better. (Escape/relieve mood)	.68
% of Variance	64.24%
Eigenvalue	5.78
Cronbach alpha	.93
M (*SD*)	2.16 (0.87)

Note. Oblimin with Kaiser Normalization rotation method. The PMUM ranged from 1 = *Never* to 5 = *Always.*

Table 5

Incremental Validity of the PMUM-Full Scale

	SDQ Outcomes	
	SDQ Total	
	R^2	β
Step 1	.13	
Total Screen Time		.37 **
Child age		−.17 **
	$F(2, 274) = 20.97$ **	
Step 2	.24	
Total Screen Time		.09
Child age		−.15 **
PMUM Score		.56 **
	$F(3, 273) = 54.53$ **	
	SDQ Peer Relationship Problems	
Predictors	R^2	B
Step 1	.10	
Total Screen Time		.32 **
Child age		−.14 *
	$F(2, 274) = 15.09$ **	
Step 2	.09	
Total Screen Time		.16 *
Child age		−.13 *
PMUM Score		.34 **
	$F(3, 273) = 20.66$ **	
	SDQ Hyperactivity and Inattention	
Predictors	R^2	B
Step 1	.04	
Total Screen Time		.16 **
Child age		−.14 *
	$F(2, 274) = 4.97$ **	
Step 2	.19	
Total Screen Time		−.09

	SDQ Outcomes	

SDQ Total

	R^2	β
Child age		−.13[*]
PMUM Score		.50[**]
	$F(3, 273) = 26.56$[**]	

SDQ Emotional Symptoms

Predictors	R^2	B
Step 1	.11	
Total Screen Time		.35[**]
Child age		−.06
	$F(2, 274) = 17.44$[**]	
Step 2	.14	
Total Screen Time		.13[*]
Child age		−.04
PMUM Score		.43[**]
	$F(3, 273) = 31.12$[**]	

SDQ Conduct Problems

Predictors	R^2	B
Step 1	.15	
Total Screen Time		.38[**]
Child age		−.21[**]
	$F(2, 274) = 23.71$[**]	
Step 2	.19	
Total Screen Time		.13[*]
Child age		−.20[**]
PMUM Score		.50[**]
	$F(3, 273) = 45.90$[**]	

SDQ Prosocial Behaviors

Predictors	R^2	B
Step 1	.07	
Total Screen Time		−.22[**]
Child age		.23[**]

	SDQ Outcomes	
	SDQ Total	
	R^2	β
	$F(2, 274) = 10.82^{**}$	
Step 2	.10	
Total Screen Time		−.04
Child age		.22[**]
PMUM Score		−.36[**]
	$F(3, 273) = 19.06^{**}$	

*
$p < .05,$

**
$p < .01$

Table 6

Incremental Validity of the PMUM-Short Form (PMUM-SF)

	SDQ Outcomes	
	SDQ Total	
	R^2	β
Step 1	.13	
Total Screen Time		.37[**]
Child age		−.17[**]
	$F(2, 274) = 20.97$[**]	
Step 2	.24	
Total Screen Time		.10
Child age		−.15[**]
PMUM-SF		.56[**]
	$F(3, 273) = 54.74$[**]	
	SDQ Peer Relationship Problems	
Predictors	R^2	β
Step 1	.10	
Total Screen Time		.32[**]
Child age		−.14[*]
	$F(2, 274) = 15.09$[**]	
Step 2	.09	
Total Screen Time		.16[*]
Child age		−.13[*]
PMUM-SF		.34[**]
	$F(3, 273) = 21.12$[**]	
	SDQ Hyperactivity and Inattention	
Predictors	R^2	B
Step 1	.04	
Total Screen Time		.16[**]
Child age		−.14[*]
	$F(2, 274) = 4.97$[**]	
Step 2	.18	
Total Screen Time		−.07

		SDQ Outcomes
	SDQ Total	
	R^2	β
Child age		−.13[*]
PMUM-SF		.49[**]
	$F(3, 273) = 25.37$[**]	
	SDQ Emotional Symptoms	
Predictors	R^2	B
Step 1	.11	
Total Screen Time		.35[**]
Child age		−.06
	$F(2, 274) = 17.44$[**]	
Step 2	.15	
Total Screen Time		.14[*]
Child age		−.04
PMUM-SF		.43[**]
	$F(3, 273) = 31.67$[**]	
	SDQ Conduct Problems	
Predictors	R^2	B
Step 1	.15	
Total Screen Time		.38[**]
Child age		−.21[**]
	$F(2, 274) = 23.71$[**]	
Step 2	.19	
Total Screen Time		.09
Child age		−.20[**]
PMUM-SF		.50[**]
	$F(3, 273) = 46.88$[**]	
	SDQ Prosocial Behaviors	
Predictors	R^2	B
Step 1	.07	
Total Screen Time		−.22[**]
Child age		.23[**]

	SDQ Outcomes	
	SDQ Total	
	R^2	β
	$F(2, 274) = 10.81$[**]	
Step 2	.11	
Total Screen Time		−.04
Child age		.22[**]
PMUM-SF		−.38[**]
	$F(3, 273) = 20.53$[**]	

[*] $p < .05$,

[**] $p < .01$

Table 7

Study 2: Demographic Characteristics of Participants (N = 632)

Demographic variable	Mean (SD) or % (*n*)
Child age (years)	8.62 (4.12)
Child sex (female)	44.8% (336)
Child race and ethnicity	
White	84.0% (630)
Black	8.0% (60)
Asian	3.9% (29)
American Indian or Alaska Native	2.0% (15)
Native Hawaiian or other Pacific Islander	0.3% (2)
Hispanic or Latino/a (any race)	12.0% (90)
Caregiver relationship to child	
Parent	92.5% (694)
Grandparent	5.5% (41)
Aunt/Uncle	5 (0.7%)
Sibling	4 (0.5%)
Other caregiver	6 (0.8%)
Caregiver age (years)	40.36 (10.01)
Caregiver sex (female)	449 (59.9%)
Caregiver race and ethnicity	
White	82.3% (617)
Black	6.8% (51)
Asian	3.6% (27)
American Indian or Alaska Native	1.3% (10)
Native Hawaiian or other Pacific Islander	0.3% (2)
Hispanic or Latino/a (any race)	13.1% (98)
Caregiver education level	
Did not graduate high school	1.0% (7)
High school diploma or GED only	12.0% (90)
Some college (< 4 years) or technical school	29.1% (218)
College graduate (>= 4 years)	40.4% (303)
Post-graduate work (e.g., MD, MA, PhD, JD)	17.5% (131)
Screen Media Owned by Child or in Child's Bedroom	
Television	63.7% (478)
Tablet	56.0% (420)
Video game system	45.3% (340)
Smart phone or other mobile phone	42.9% (322)
Computer/laptop	42.0% (315)

Demographic variable	Mean (SD) or % (*n*)
PMUM-Short Form (Cronbach alpha = .96)	2.20 (1.12)

Table 8

Confirmatory Factor Analysis of the PMUM-SF (with Fit Indices) and Multiple Group Analysis Models

	χ^2 (df)	RMSEA	SRMR	CFI
Unifactorial Model	$\chi^2 (27) = 149.193$**	0.085	.024	.961
Multiple Group Analyses				
Configural invariance	$\chi^2 (54) = 196.778$**	0.092	.028	.954
Weak (metric) invariance	$\chi^2 (62) = 220.838$**	0.090	.060	.949
Strong (scalar) invariance	$\chi^2 (70) = 235.456$**	0.087	.059	.947
Strict invariance	$\chi^2 (79) = 252.667$**	0.083	.071	.944
Factor variance invariance	$\chi^2 (80) = 254.725$**	0.083	.082	.944
Factor mean invariance	$\chi^2 (81) = 272.893$**	0.087	.073	.938

Note. Root mean square error of approximation: RMSEA, Standardized root mean square residual: SRMR, Comparative fit index: CFI.

** $p < .01$

Table 9

Convergent Validity of the PMUM-SF: Bivariate Correlations with Parent-Child Conflict over Different Types of Screen Media

Parent-Child Conflict	PMUM-SF
Over Turning Off:	
Television	.41[**]
Computer	.45[**]
Tablet	.42[**]
Smartphone	.49[**]
Video games	.50[**]

[**]
$p < .01$