2021-08-19

Associations Between Screen Time and Child Internalizing and Externalizing Behaviour Problems: A Meta-Analysis

Eirich, Rachel

UNIVERSITY OF CALGARY

Associations Between Screen Time and Child Internalizing and Externalizing Behaviour Problems: A Meta-Analysis

by

Rachel Eirich

A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE

DEGREE OF MASTER OF SCIENCE

GRADUATE PROGRAM IN CLINICAL PSYCHOLOGY

CALGARY, ALBERTA

AUGUST, 2021

Abstract

Background: Research on the effects of screen time on child outcomes has increased exponentially in response to the ubiquity of digital media. However, due to mixed findings, significant debate exists as to whether screen time is associated with problematic child outcomes, including internalizing and externalizing problems. It is important to understand the methodological differences that may be contributing to heterogeneity in findings and the possible risks and benefits of screen time to inform parents, clinicians, policy makers, and future research.

Objectives: To 1) meta-analytically determine the association between screen time (i.e., duration of use) and child externalizing and internalizing problems; 2) identify moderators that may contribute to discrepancies in the literature and point to areas for methodological improvement in future research.

Method: Electronic searches were conducted in MEDLINE, Embase, and PsycINFO in June of 2019 and 22,528 non-duplicate articles were identified and screened for inclusion. Quantity of screen time was defined as the duration of time children spend viewing screens (e.g., television, tablets, video games, and/or computers, etc.). Child behaviour problems included externalizing (e.g., aggression, hyperactivity) and/or internalizing (e.g., depression, anxiety) behavioural symptoms or clinical diagnoses.

Results: After screening all abstracts for inclusion, 434 full text articles were assessed for eligibility and a total of 64 studies (with 74 unique samples; 85,225 participants) met all inclusion criteria. Results revealed that screen time was associated with more externalizing problems ($k = 72$, $r = 0.12$; 95% CI [0.10, 0.14]). Moderator analyses suggested that effect sizes were larger for males, in older studies, in studies examining aggression (vs. hyperactivity/inattention). Effect sizes were larger when the screen time informant was the child

versus the parent. A separate meta-analysis revealed that screen time was also associated with more internalizing problems (k = 26, r = 0.07, 95% CI [0.04, 0.11]) and moderator analyses suggested that effect sizes were larger when the screen time informant was the child (vs. parent). **Conclusions:** These meta-analyses support small but significant associations between screen time and children's behaviour problems. Methodological differences across studies were one of the most common contributors to mixed findings in the literature.

Table of Contents

List of Tables

List of Figures

Associations Between Screen Use and Child Internalizing and Externalizing Behaviour Problems: A Meta-Analysis

Digital devices are now ubiquitous in the day-to-day lives of children. Approximately 98% of North American children under 8 live in a home with at least one digital device, and spend, on average, 2 hours and 19 minutes a day on screens (Rideout, 2017). With the widespread availability and accessibility to screens, duration of screen viewing has also increased significantly, nearly doubling for children under 2 since 1997 (Chen & Adler, 2019). Because screen use may displace activities that foster healthy child development, such as social exchanges, learning, and physical activities (Christakis et al., 2009), the rise of screen use in childhood has engendered concern about the consequences of screen use on children's developmental health. However, significant debate exists among scholars and the public as to whether these concerns are warranted (Browne et al., 2020; Orben, 2020).

In 2016, the American Academy of Pediatrics released recommendations that families limit children's screen use and prioritize high quality, age-appropriate programming and co-viewing that provides context over solitary screen use (Radesky et al., 2016). However, recent studies show that approximately 79% and 95% of 2 and 3-year-olds, respectively, are exceeding screen use guidelines (Madigan, Racine, et al., 2020) and co-viewing is reported by only 28-47% of parent-child dyads (Çelen Yoldaş & Özmert, 2021; John et al., 2021; Zimmerman et al., 2007). One often cited barrier to uptake of screen use guidelines noted by parents is that the associated risks of screen use are not clear (He et al., 2005). There has also been criticism in the academic literature that current screen use guidelines are not sufficiently empirically founded (Elson et al., 2019; Ferguson & Beresin, 2017) and that more robust evidence is needed to understand the true risks associated with screen time. While recent meta-analyses and

longitudinal studies have shown that screen time is associated with poorer language skills in children (Madigan, McArthur, et al., 2020), sleep problems (Hale & Guan, 2015), and poor achievement of developmental milestones (Madigan et al., 2019; Pagani et al., 2013), the empirical literature on screen use and behavioural problems remains mixed.

Elson et al. (2019) argue that the public may assume that policy statements and guidelines on screen use "reflect objective conclusions, but their actual fidelity in representing science remains largely untested" (p.12) and that these guidelines "often ignore conflicting research results" (p.12). Given that evidence of a link between screen use and children's behavioural problems is mixed, a meta-analysis is warranted to resolve debate surrounding conflicting findings across the literature. The primary objective of the current study is therefore to clarify, through meta-analysis, whether there is a positive association between screen time and child behaviour problems. A second objective was to examine whether pooled associations vary as a function of demographic (i.e., child age, sex) and methodological (i.e., informant, type of behaviour problem, study design) factors. Given that the early years of childhood are crucial for developing a strong foundation of emotional and mental health (Center on the Developing Child, 2007) and screen use habits that develop in early childhood are typically sustained throughout development (Certain & Kahn, 2002; Trinh et al., 2019), the current study focuses on children years 12 and under. This focus on childhood carries an overarching goal of informing early intervention to offset adverse developmental trajectories before they become entrenched.

Internalizing and Externalizing Behaviour Problems

Childhood behaviour problems, which can be broadly categorized into internalizing and externalizing behaviour problems (Achenbach, 1966; Cicchetti & Natsuaki, 2014), has long been a focus of developmental researchers. Internalizing problems refer to anxiety, depression, and

somatization, while externalizing problems are comprised of attention-deficit/hyperactivity problems, aggression, and delinquent behaviour. Internalizing and externalizing problems in childhood are not uncommon (American Psychiatric Association [APA], 2013; (Egger & Angold, 2006; Merikangas et al., 2009) and confer risk for psychopathology across the lifespan. Several longitudinal studies have demonstrated continuity of symptoms of psychopathology from childhood to later emotional problems and pathology (Bufferd et al., 2012; Costello et al., 2006; Lavigne et al., 1998; Luby et al., 2014); although symptom stability over the lifespan is not inevitable.

The development of behaviour problems in childhood is multidetermined, consistent with the notion of multifinality (Cicchetti & Rogosch, 1996), and several putative environmental risks exist. One relatively modern and frequently cited risk is screen use. However, research is mixed as to how screen use contributes to the development and continuity of internalizing and externalizing problems, with some studies showing moderate associations (Allen & Vella, 2015; Tamana et al., 2019; Yousef et al., 2014), some showing weak or no associations (Comer et al., 2008; Parkes et al., 2013) and others finding that the pattern of associations changes over early and middle childhood (Neville et al., 2021). Therefore, understanding the association between screen use and child behaviour problems across the literature is a crucial step towards establishing whether there is evidence for screen use being a possible modifiable risk factor for behaviour problems in childhood.

Screen Use and Externalizing Problems

Externalizing symptoms in childhood are one of the primary reasons parents seek help from mental health professionals for their children (Shanley et al., 2008). The two categories of externalizing problems often discussed include those related to attention-deficit hyperactivity

disorder (ADHD; e.g., inattention, hyperactivity, and impulsivity), and those related to oppositional defiant disorder (ODD) or conduct disorder (CD) (e.g., aggression, rule-breaking, and disruptive behaviour; Lahey et al., 2008). Symptoms under the umbrella of ADHD have been linked with poorer academic achievement, problems in peer relationships, and increased risk for injury (Nigg, 2013). Symptoms associated with ODD and CD have significant adverse consequences such as increased criminal offenses, comorbid conditions, inter-partner violence, and lower educational and employment attainment (Fergusson et al., 2005).

While engaging in screen use, children may be exposed to inappropriate content, aggression, and violence (Matos, Ferreira, & Haase, 2012; Strasburger, 2011). Consistent with social learning theory (Bandura, 1977), it has been hypothesized that children may become desensitized to violence or aggression after repeated exposures to inappropriate screen media and model the observed aggressive or violent content towards others (Huesmann, 2007; Nikkelen et al., 2014). It has also been theorized that screen media may impede self-regulation strategies and executive functioning and increase arousal levels due to the fast-paced and intense audiovisual effects of screen media, which may contribute to attentional issues and externalizing problems (Linebarger et al., 2014; Lissak, 2018; Nikkelen et al., 2014).

Individual studies examining the association between screen use and externalizing problems vary considerably in their effect size estimates. For example, in a sample of 99 toddlers, Tomopoulos et al. (2007) found small to medium associations between increased screen use duration at 21 and 33 months and externalizing behaviour at 33 months. By contrast, in a population-based sample of 3,913 children, the duration and content of screen use at 24 months did not predict externalizing problems at 34 months (Verlinden et al., 2012) and another prospective study using a nationally representative sample in Ireland found no association

between screen time and subsequent externalizing problems across childhood (Neville et al., 2021). Furthermore, a systematic review by Mitrofan et al. (2009) on the association between television and/or video game use and child aggression found no consensus across the literature. The authors highlighted several methodological issues that may explain between-study differences in effect sizes, such as study design and low statistical power. Thus, study findings are mixed likely due to variability in methodology, and, to my knowledge, no meta-analysis exists to resolve and explain between-study discrepancies.

Screen Use and Internalizing Problems

Approximately 33% of children experience some form of internalizing problems such as anxiety, somatization, or depression during the developmental span of childhood or adolescence (Costello et al., 2006). Anxiety, somatization, and depression are frequently comorbid with one another (Cummings et al., 2014; Lieb et al., 2007), can result in significant functional impairment and reduced quality of life (American Psychiatric Association, 2013; Ramsawh & Chavira, 2016), and are associated with social and academic difficulties (Hughes et al., 2008; Ooi et al., 2017). Theoretically, children who have high levels of screen use may spend less time interacting with friends and family, which may, in turn, result in feelings of isolation or limit opportunities to "face their fears" and master anxiety-provoking situations. Indeed, social isolation and withdrawal in childhood has historically been linked to depression and anxiety (Rubin et al., 2009; Rubin et al., 1991) and avoidance plays an important role in the development and maintenance of anxiety disorders (Berman et al., 2010). It has also been theorized that the content of screen media, such as violence in television, movies, or video games, may lead to feelings of fear or anxiety in children (Christakis, 2019). Finally, screen use may disrupt sleep

duration (Hale & Guan, 2015), which is an established predictor of internalizing problems (Alfano et al., 2009; Quach et al., 2018).

Despite concerns surrounding the effects of screen use on child internalizing problems, current research lags behind the proliferation new forms of digital media in the lives of today's children. Much of the meta-analytic and review literature to-date has focused on associations between screen use and internalizing problems in adolescents (Hoare et al., 2016; McCrae et al., 2017). For example, one recent meta-analysis by Liu et al. (2016) found support for a dose-response relationship between screen use and depression in children and adolescents; however, all but two studies included in their analyses examined this relationship in adolescents and none included children under the age of 10. To my knowledge, there are no other meta-analyses examining the association between screen use and internalizing or externalizing problems in children, representing a window of opportunity to shed light on the ongoing debate as to whether screen use is a risk factor for internalizing problems earlier in life.

Meta-Analytic Approaches for Resolving Literature Discrepancies

To help provide clarity to the debate as to whether screen use has implications for behavioural problems in childhood, it is timely to synthesize studies amassed to date on this topic. While individual studies may lack statistical power, a meta-analysis can result in greater statistical precision by pooling the results from multiple studies (Cohn & Becker, 2003). Moreover, meta-analyses serve to resolve discrepancies in the literature by identifying between-study differences in effect size via the testing of methodological, sample, or study-level moderators that may either amplify or attenuate associations. Methodological variation in screen time research is likely a primary contributor to conflicting findings and fuelling debate. Specifically, the type of statistical analysis conducted (McBee et al., 2021), the way in which

screen time and behaviour problems are measured (Stiglic & Viner, 2019), and whether data are cross-sectional versus longitudinal (Kaye et al., 2020) are important considerations when evaluating the screen time literature.

Potential Moderators of Associations

Screen Time Measurement. Issues with using retrospective self-reports or daily diaries to assess screen use have been identified (Christakis, 2019), particularly because these methods may not give a full picture of exactly how much and what type of screen use a child is engaging in, in a given day. Indeed, many contemporary digital devices are portable (e.g., smartphones, tablets), and may not be able to be easily monitored by parents. Given the challenging nature of accurately capturing the number of hours per day the child spends on screens from parent or child report, I will examine whether the method (e.g., activity log, questionnaire, etc.) and informant (e.g., child, parent) for measuring screen use moderates the association between screen use and behaviour problems.

Child Behaviour Problems Measurement. There has been much discussion surrounding the measurement of behaviour problems in children, particularly with regards to who the informant for the measure is (e.g., parent, child, teacher). Studies have found consistent issues with agreement between informants for children's behaviour (De Los Reyes & Kazdin, 2005) and these discrepancies may hold important information regarding the contexts and ways in which behaviour problems are perceived by the child and others (De Los Reyes, 2011). Therefore, the current study will examine whether the type of informant moderates the potential association between screen use and child behaviour problems. In the same way there are differences in informant types for behaviour problems, the different tools used to assess them (i.e., questionnaire, interview, diagnosis) have individual strengths and drawbacks. Behaviour

checklists and questionnaires (e.g., the CBCL, Behavior Assessment System for Children [BASC]) may miss capturing low base rate behaviours (Carter et al., 2004), the context in which behaviour is being assessed (e.g., a questionnaire about behaviour at home vs. observational coding in the classroom) may influence the behaviour that is reported, and correspondence between the different tools tends to vary considerably (De Los Reyes & Makol, 2021). The tool used to assess behaviour problems is therefore an important potential moderator to examine.

Sex Differences. There are mixed findings in the literature with regards to whether screen use differs between the sexes, with some studies finding no differences in screen use (Hinkley et al., 2012) and others finding that boys have higher screen use than girls (de Jong et al., 2013; Hoyos Cillero & Jago, 2011). Despite these mixed results, there are well-established sex differences in the prevalence and continuity of behaviour problems in childhood (APA, 2014), with elevated trajectories of internalizing problems across childhood being more prevalent in girls (Sterba et al., 2007) and externalizing problems being particularly prevalent among boys (Zahn-Waxler et al., 2008). Due to these disparities in screen use and behaviour problems in boys and girls, the current study will examine sex as a moderator.

Child Age. A review of the psychological effects of screen use on children by Domingues-Montanari (2017) identified age as an important variable to consider when examining the association between screen use and behaviour problems in children. Specifically, it was concluded that, as children age, the effects of screen use accumulate, and symptomatology becomes more apparent. This may be due to older children having higher levels of screen use than younger children (Marshall et al., 2006) and prevalence rates of behaviour problems increasing with age (Costello et al., 2011; Costello et al., 2006). Additionally, younger children engage in more social interactions with family members while viewing screens than older

children (Schmitt et al., 2006), which may buffer them from adverse outcomes. It is also possible that, as children age, interacting with friends and developing social skills becomes particularly important for healthy development and screen use may undermine children's ability to practice these skills or see friends. Therefore, age will be examined as a possible moderator.

Family Socioeconomic Status. Children coming from disadvantaged backgrounds, such as low socioeconomic status (SES) may be particularly at risk for the adverse effects of screen use (Domingues-Montanari, 2017). That is, although screen use and behaviour problems transcend discrete groups of individuals, the screen time and the behaviour problems have been shown to be higher in children from low income households and/or with less educated parents (Carson et al., 2010; LeBlanc et al., 2015; Wadsworth et al., 2016; Weitzman et al., 2014). However, findings across the literature of the role of SES on screen use has not been consistent (Anderson et al., 2008). Based on these findings, family socioeconomic status (i.e., low income, low parental education, and/or having an adolescent parent) will be examined as a potential moderator in analyses.

Study Characteristics. Given that the accessibility and use of screens has been increasing over time (Chen & Adler, 2019), study year will be examined as a potential moderator. Furthermore, study design (i.e., cross-sectional vs. longitudinal) will be examined as a moderator, as it is likely that effect sizes wane over time in longitudinal studies due to the temporal distance between measures. Finally, I will assess whether study quality influences any associations between screen use and behaviour problems. Study quality assessment has been identified as an essential component of meta-analytic studies (Appelbaum et al., 2018; Protogerou & Hagger, 2019) and is used to evaluate whether the quality of studies and their presumed error variance influence the strength of effects.

Current Study

In sum, there are two primary objectives of this meta-analysis. First, to address discrepancies and inform the ongoing debate surrounding whether screen use poses a risk for the development of child internalizing and externalizing problems via meta-analysis. Internalizing and externalizing disorders are broad, heterogeneous constructs, with individual disorders and symptoms falling under each category. Because screen use may be differentially associated with specific internalizing or externalizing symptomatology (Tomopoulos et al., 2007), the association between screen use and internalizing and externalizing behaviour was examined in two independent meta-analyses.

The second objective is to explain between-study variability in the associations between screen use and internalizing and externalizing problems via moderator analyses. Specifically, to identify whether the associations between screen use and behaviour problems vary as a function of: (1) study methodology, such as the informant or type of measures used to assess screen use and behaviour problems; (2) demographic characteristics, including child sex, age, and SES; and (3) study characteristics, such as year of publication, publication status, study design, and study quality.

Methods

Definition of Constructs

Screen use. *Quantity* of screen use is defined as the amount of time spent watching television, movies, or DVDs, or streaming videos on any type of device, as well as background television, videogaming on any device (e.g., gaming console, tablet, smartphone apps, computer), computer use, smartphone use, and tablet use, typically reported in hours per day.

Child Behaviour Problems. Child behaviour problems were split into two general categories: internalizing problems, which encompass symptoms of anxiety, depression, and somatization; and externalizing problems, which include symptoms of inattention, hyperactivity, aggression, and delinquency or conduct problems. Measures of internalizing and externalizing symptoms or disorders reported via parent-, teacher-, or child-report questionnaires (e.g., the Child Behavior Checklist [CBCL], Achenbach & Edelbrook, 1983), structured interviews (e.g., the Schedule for Affective Disorders and Schizophrenia for School-Age Children [K-SADS], Kaufman et al., 1997), or observational coding were included in analyses to capture the constructs of internalizing and externalizing symptoms.

Search Strategy

Searches were conducted in MEDLINE, Embase, and PsycINFO in June of 2019 by a health sciences librarian. The concepts of "screen use", "internalizing and externalizing behaviour" and "children" were captured by searching database specific subject headings and text word fields. Synonymous terms were first combined with the Boolean "OR". These three concepts were then combined with the Boolean "AND". The concept of children (<12 years of age) was searched using both the "Age Limits" function in the databases, and with a text word search. In all databases, truncation symbols were used in text word searches when applicable, to capture variations in phrasing and spelling. In MEDLINE and PsycINFO, a publication date limit from 1960 – June 2019 was included in the search strategy. In Embase, no date restriction was applied, as it only goes back as far as 1974. No language limits were applied. References of included studies, as well as review articles, were manually searched for further studies for inclusion. The search strategy revealed 22,528 non-duplicate abstracts to be reviewed for determination of meeting inclusion criteria.

Study Inclusion and Exclusion Criteria

Inclusion Criteria. Studies were included if they met the following criteria: (1) measured screen use; (2) measured behaviour problems (i.e., internalizing, externalizing); (3) an observational study or experimental study with baseline data; (4) statistical data that could be extracted and transformed into an effect size; and (5) full-text article available in English. If effect sizes could not be extracted from the study, the corresponding author was contacted.

Exclusion Criteria. Studies were excluded if they: (1) were qualitative; (2) included children older than 12 years old; (3) measured parent, but not child screen use; (4) were experimental and without baseline measures; (5) used screens as an experimental condition (e.g., examined child behaviour after viewing a short video in a lab setting); (6) had a sample that was not typically developing (e.g., autism spectrum disorder or intellectual disability); (7) were in a language other than English. All studies were assessed for inclusion by two coders and any study meeting inclusion criteria by at least one coder was pulled for full text review.

Data Extraction

A standard data extraction document was created to code effect sizes, moderator variables (see Table 1 for the moderator coding system), and study quality.

Screen measurement. Screen time measurement method was coded as: (1) questionnaire or interview; (2) daily diary; (3) observation or device tracking; or (4) combination of reporters 1-3. Screen time informant was coded as: (1) parent; (2) child; (3) observer or device; or (4) combination of reporters 1-3.

Child Behaviour Problems Measurement. Externalizing problems were coded under four categories: (1) general externalizing symptoms; (2) attention/hyperactivity symptoms; (3) aggression; and (4) conduct/delinquent behaviour. Internalizing problems were coded as

belonging to one of four categories: (1) general internalizing symptoms; (2) anxiety symptoms specifically (e.g., separation anxiety, general anxiety, social anxiety, phobias); (3) depression symptoms specifically (e.g., withdrawal, depressed mood); and (4) somatization symptoms (e.g., pain). Behaviour problems informant was coded as one of the following: (1) parent; (2) child; (3) teacher; (4) classmates/peers; (5) clinician or coder; (6) a combination of any of the other categories. Behaviour problems measurement method was recorded as one of the following: (1) questionnaire; (2) structured interview/diagnosis; (3) observer report; (4) a combination of 1-3.

Child Sex. Sex was coded based on the percentage of males in the study sample. In the event a study did not indicate the proportion of male and female children in their sample, the sample was coded as being 50% male.

Child Age. The mean child age at the time of measuring screen use and behaviour problems was coded in months. If mean age was not provided, it was estimated based on sample information (e.g., child grade).

Socioeconomic Status. SES factors were coded based on explicit quantitative classifications outlined in studies (e.g., mean family income; study classification of 80% or more of the sample as low, middle, or high SES), or through indirect methods (e.g., study classification of 80% or more of the sample with parent education levels above vs. below high school, or adolescent parenthood). Based on this information, SES for each study sample was coded categorically as “low”, “mid/high”, or “mixed”.

Study Design. The timeframe of data collection for screen use and behaviour problem variables was coded as either: (1) cross-sectional; or (2) longitudinal.

Publication Year. The year the study was published was coded as a proxy for approximate year of data collection.

Study Quality Assessment

Each study underwent an appraisal of quality based on a 15-item quality assessment tool adapted for this study from the National Institutes of Health Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies (National Institutes of Health, 2014; see Table 2). Each study was assessed for quality by two independent coders, and each item was coded as 0 ("No") or 1 ("Yes") with a total possible score of 16 points.

Data Synthesis

In the case of multiple studies conducting analyses on the same sample, the study with the largest sample size and most comprehensive data collection information was selected for inclusion. When both adjusted and unadjusted statistics are provided, the adjusted statistic was selected. Separate meta-analyses were conducted on both internalizing and externalizing symptoms; therefore, when single studies provided an effect size for both types of behaviour problems, both effect sizes were extracted and entered into the separate analyses. When more than one measure of internalizing or externalizing symptoms was presented (e.g., depression, anxiety, and general internalizing symptoms), the most global measure was selected. If, within a single study, screen use and/or behaviour problems were measured across multiple timepoints, the effect sizes with the largest temporal distance between the measure of screen use and the measure of behaviour problems was selected. As per Rosenthal (1995), when studies reported non-significant findings without any corresponding statistic or *p* value, a *p* value of .50 was entered. Finally, if a study provided effect sizes from multiple discrete samples, these samples were entered into the meta-analysis separately.

Data Analysis

Pooled effect size estimates and moderator analyses were conducted using Comprehensive Meta-Analysis 3.0 (CMA; Borenstein, Hedges, Higgins, & Rothstein, 2005). All effect sizes were transformed into correlations (*r*) with 95% confidence intervals (CIs) using random effects modelling via the DerSimonian and Laird estimator (Dersimonian & Laird, 1986), which assumes that all studies represent unique population parameters. Correlations were evaluated as small (.1), medium (.2) or large (.3) as suggested by Funder and Ozer (2019).

To assess for between-study heterogeneity of effects, the *Q* and I^2 statistics were computed. When significant, the *Q* statistic indicates that study variability is greater than sampling error, indicating that moderator variables should be explored. The I^2 statistic measures the amount of inconsistency among included studies and indicates the percent of variation across studies due to heterogeneity as opposed to chance (Higgins et al., 2003). I^2 values greater than 50% indicate moderate heterogeneity and suggest that moderator variables should be explored (Higgins et al., 2003). Random-effect meta-regressions and subgroup comparisons were conducted to assess continuous and categorical moderators, respectively. Subgroup comparisons were conducted when specific categories had at least 3 cells (i.e., samples) for each comparison (Borenstein et al., 2013). Due to the number of moderator analyses conducted, a conservative alpha of .01 was used to determine significance (Borenstein et al., 2009).

Publication bias is a threat to the validity of meta-analyses and the conclusions drawn from them (Rothstein et al., 2005). Inspection of funnel plots, Duval and Tweedie's trim and fill procedure, and Egger's test (Egger et al., 1997), was used to estimate and adjust for publication bias. When publication bias is not present, funnel plots are triangular in shape, with smaller studies scattered around the bottom of the plot and studies clustering more tightly as their sample

sizes increase and they approach the top of the plot (Sterne & Harbord, 2004). When publication bias is present, funnel plots may be asymmetrical. The Duval and Tweedie trim and fill method estimates number and potential effect of studies that may be missing from meta-analyses and adjusts the funnel plot to account for the impact of missing studies (Rothstein et al., 2005). Egger's linear regression method (Egger et al., 1997) tests the linear association between the effect of included studies and their standard errors. When publication bias is not present, the regression intercept should be equal to zero.

Results

Figure 1 depicts the PRISMA diagram outlining the search strategy and the included and excluded studies. The search strategy revealed 22,528 non-duplicate abstracts to be reviewed for determination of meeting inclusion criteria. After abstract review, 434 full text articles were assessed for eligibility and 64 studies (with 74 unique samples) were included in the meta-analyses.

Study Characteristics

A detailed description of study and sample characteristics can be found in Table 3. Sample sizes across studies ranged from 15 to 15,291 (M = 1151.69). The mean age of children when screen time and behaviour problems were measured was 6.21 years old (SD = 2.62; range = 1.07 – 11 years), and 7.20 years old (SD = 2.57; range = 1.5–12 years), respectively. On average, 51.36% of participants were male. Thirty-six samples (48.7%) were from North America, 16 (21.6%) from Europe/UK, 1 (1.4%) from Africa, 10 (13.5%) from Asia, 5 (6.8%) from Australia/New Zealand, 4 (5.4%) from the Middle East, and 2 (2.7%) from South America.

Screen Time and Externalizing Problems

Pooled Effect Sizes. The effect size for the association between child screen time and externalizing problems across 72 samples (82,335 children) was small but statistically significant (r = .12, 95% CI [.10, .14]; see Figure 2 for forest plot), indicating that increases in duration of screen time were associated with more externalizing problems. The Egger's test was significant ($p < .001$), and the funnel plot showed asymmetry (see Figure 3), indicating the possibility of publication bias and/or small-study effects. There was evidence of significant between-study heterogeneity (Q = 659.38, $p < .001$, I^2 = 89.23); therefore, moderators were explored (see Table 4).

Moderator Analyses. Meta-regression analyses suggested that child sex was a significant moderator, with the association between screen time and externalizing problems increasing as the percent of males in studies increased (k = 72, b = .01, $p < .001$). Effect sizes also varied as a function of the publication year (k = 72, b = -0.003, p = .001) such that the association between screen time and externalizing problems decreased as publication year increased. Additionally, effect sizes varied as a function of study quality (k = 72, b = -0.01, p = .003); as study quality increased, effect sizes decreased.

A planned sub-group analysis revealed that the type of externalizing problems assessed moderated associations (Q = 8.35, p = .004). Specifically, associations between screen time and externalizing problems were higher in studies examining aggression (k = 20, r = .17, 95% CI [.13, .20]) relative to those that measure attention/hyperactivity (k = 18, r = .09, 95% CI [.06, .13]). The associations between screen time and externalizing problems varied depending on the externalizing problem informant (Q = 20.24, p = .001). Studies that used peers to assess externalizing problems had higher associations (k = 8, r = .20, 95% CI [.14, .26]) compared to

child self-report (k = 3, r = .10, 95% CI = .01 - .18) parent-report (k = 43, r = .10, 95% CI [.08 - .43]), and a combination of informants (k = .8, r = .09, 95% CI [.04, .14]), as did studies that used a clinician/coder to assess externalizing problems (k = 4, r = .29, 95% CI [.18, .39]). Finally, associations between screen time and externalizing problems were higher in studies with children as screen time informants (k = 17, r = .17, 95% CI [.13, .21]) relative to those that had parents as screen time informants (k = 53, r = .10, 95% CI [.09, .12]; Q = 9.61, p = .002).

Screen Time and Internalizing Problems

Pooled Effect Sizes. Across 26 samples (36,530 children), the association between child screen time and internalizing problems was small but significant, (r = .07, 95% CI [.04, .11]; see Figure 4 for forest plot). As duration of screen time increased, internalizing problems increased as well. The Egger's test was not significant (p = .20) and the funnel plot did not show asymmetry (see Figure 4). The Q statistic was significant (Q = 110.27, p < .001, I^2 = 77.33) and moderator analyses were conducted to explain between-study heterogeneity (see Table 5). Significant moderators are discussed below.

Moderator Analyses. A planned subgroup analysis revealed that the associations between screen time and internalizing problems varied depending on screen time informant (Q = 7.71, p = .006). Studies using children as screen time informants had significantly higher associations between screen time and internalizing problems (k = 3, r = .17, 95% CI [.10 - .23]) than those with parents as informants (k = 22, r = .06, 95% CI [.04, .09]). Several moderators (i.e., specific internalizing problem type, screen time measurement method, internalizing problems measurement method, internalizing problems informant) were not analyzed due to insufficient cells for comparison. For example, only one study used activity logs to measure screen time and

only two used a diagnosis or structured interview to assess for internalizing problems. No other moderators emerged as significant.

Discussion

Current screen use guidelines issued by global health officials have been put in place to limit the amount of time young children spend on screens with the aim to improve wellbeing and development; however, there is little agreement as to whether screen use confers risk for child internalizing and externalizing symptoms. The lack of clarity in the literature has led to criticism that current screen use guidelines lack an evidence base. Indeed, to-date, no study has meta-analytically evaluated the association between screen use and behaviour problems in children. The current study suggests small but significant positive associations between screen time and children's internalizing and externalizing behaviour problems. The magnitude of these associations is similar to those derived in other meta-analyses on screen time and child language (Madigan et al., 2020), ADHD-related behaviours (Nikkelen et al., 2014), and academic outcomes (Adelantado-Renau et al., 2019). At a population level, the size of these associations is considered meaningful. Crucially, the results suggest that the heterogeneity across studies to date on screen time and behaviour problems may be the result of significant methodological variability (Kaye et al., 2020).

Christakis (2009) proposed that the content and context of screen use are important mechanisms that help to explain why screen time and behavioural problems may be associated. In terms of content, screen time may be associated with behavioural problems through the types of digital media being used. For example, elevated screen time may be associated with externalizing problems through violent programing. In terms of context, the risk of screen time on child outcomes may operate through solitary viewing of digital media (versus co-viewing or

interactive viewing). That is, when children view screens alone, they miss out on social scaffolding and social connectedness, which are integral to healthy development. Children who watch screens alone may be more likely to actively, passively, or unknowingly view programing inappropriate for their developmental age (Madigan et al., 2018), which can result in behavioural problems. Taken together, the formal elements of screen time that may not be optimal for development (e.g., inappropriate content) and decreases in social interaction that go hand-in-hand with heavy screen time use, could give rise to the development of behaviour problems.

Moderators of the Associations Between Screen Time and Behaviour Problems

A significant moderator in the current study for the association between screen time and externalizing problems was child sex. Specifically, it was found that boys may be particularly at risk for the effects of screen time on externalizing problems. This finding is consistent with previous research showing that that boys have higher screen use than girls (de Jong et al., 2013; Hoyos Cillero & Jago, 2011) and have higher prevalence rates of externalizing problems (Zahn-Waxler et al., 2008). Externalizing behaviour such as aggression may be more accepted for boys relative to girls through sex stereotypic socialization (Mesman et al., 2001), and boys tend to play more violent videogames than girls (Polman et al., 2008); however, the link between violent content and externalizing problems is still an area of significant debate (Mathur & VanderWeele, 2019).

For associations between screen time and both internalizing and externalizing problems, studies that used children as informants of their own screen time showed higher overall associations than those that used parents as informants. One possible reason for this is that children are more accurate reporters of their own screen use (van der Voort & Vooijs, 1990), as contemporary digital devices are often portable (e.g., smartphones, tablets) and difficult for

parents to monitor (Anderson et al., 1985; Barr et al., 2020). While this is a likely possible explanation, it should be noted that no studies measured screen time using device report (e.g., via apps or sensors) and this method would likely be the least biased estimate of screen time.

This meta-analysis revealed that when studies used more objective reporters (e.g., clinicians/coders or peers) of child externalizing problems, larger associations were found compared to those using child-, parent-, or teacher-reports, respectively. Inconsistency between informants for children's behaviour problems is common (De Los Reyes & Kazdin, 2005), but this inconsistency may shed light on the settings and ways in which behaviour problems occur and are identified (De Los Reyes, 2011). Children who have high levels of screen time may have parents who also have high levels of screen time (Madigan, Racine, et al., 2020) that includes more violent and faced-paced content. Consequently, due to desensitization (Carnagey et al., 2007), these parents might have a higher threshold for what they consider externalizing behaviour in their children.

We found that studies that measured aggression had stronger effect sizes than those that measured hyperactivity/inattention. While viewing screen media, children may be exposed to inappropriate content, aggression, and violence (Funk et al., 2004; Huesmann, 2007; Tomopoulos et al., 2007). Consistent with social learning theory (Bandura, 1977), children may become desensitized after repeated exposures and model the observed aggressive or violent content towards others (Funk et al., 2004; Huesmann, 2007; Nikkelen et al., 2014). Given that some children may model aggressive behaviour, parents should monitor screen time, ensure that the content their children are viewing is age-appropriate, limit exposure to violent content, and talk to their children about the content they are viewing.

Finally, in terms of publication characteristics that moderated the association between screen time and externalizing problems, publication year and study quality were also significant. Specifically, newer studies yielded smaller associations and associations decreased as study quality increased. The former finding is consistent with the decline effect (i.e., diminishing effect sizes over time) (Schooler, 2011) and temporal associations between screen time and behaviour problems are often unstable (Neville et al., 2021). In addition, the accessibility and use of screens has increased over time (Chen & Adler, 2019); therefore, it is possible that as screens become the norm in childhood and contemporary culture, the risks associated with their use becomes less consequential for externalizing problems. It may also be the case that newer screen time guidelines, such as those from the AAP, have left parents more informed about and better at monitoring their child's screen time.

Future Research

Methodological variability is a dominant contributor to the heterogeneity across studies examining screen time and behaviour problems. Subsequently, suggestions can be made for future research. First, when possible, future research should utilize multi-informant (e.g., peers and child) and multi-method (e.g., passive sensing apps and questionnaires) approaches to measuring screen time. Second, externalizing behaviour problems are typically examined as an overarching broad spectrum of concerns such as aggression, oppositional behaviour, conduct problems, and hyperactivity (Achenbach, 1966; Achenbach & Edelbrock, 1978); however, the finding that screen time was more strongly associated with aggression relative to other externalizing problems suggests that this broad externalizing spectrum may not capture the nuances in the association between screen time and behaviour problems. Thus, future research should consider examining individual types of externalizing behaviours (e.g., aggression,

hyperactivity/inattention, conduct problems) and their associations with screen time. Third, as child sex was an important moderator of associations, raw correlations should be provided for males and females separately. Fourth and finally, not all screen time is created equal, as the subject matter (e.g., educational, violent, etc.) and formal features of some screen time may be differentially associated with developmental outcomes (Christakis, 2014) and more research is needed to address this possibility.

While the current study focused on unidirectional effects from screen time to behavioural problems, bidirectional or transactional effect are also possible, although rarely tested (e.g., Neville et al., 2021). For externalizing problems, children who view violent or inappropriate content may model aggression and, subsequently, be placed in front of screens in order to manage and/or modulate this behaviour, which heightens their risk for further externalizing behaviour. Similarly, when viewing screens, children may miss out on opportunities to interact with others and/or face potentially anxiety-provoking situations, which may contribute to internalizing problems and these children, subsequently, use screens as a withdrawal or coping strategy. In future research, it will be important to disentangle these bi-directional and/or transactional effects further using sophisticated modelling techniques such as Random-Intercept Cross Lagged Panel modelling (RI-CLPM; Hamaker et al., 2015), which can be used to estimate the longitudinal bidirectional associations between two variables, thereby providing firmer conclusions regarding the directionality of associations.

Clinical Implications

The current study has important implications for clinicians, parents, researchers, and policy makers seeking to manage screen use in a rapidly evolving digital landscape. The positive associations between screen use and internalizing and externalizing problems found in this meta-

analysis, as well as the negative associations between screen use and language development (Madigan, McArthur, et al., 2020), sleep (Hale & Guan, 2015), and academic achievement (Adelantado-Renau et al., 2019), provide evidence-based support for guidelines to moderate screen use during childhood. As parent screen use strongly predicts child screen use (Madigan et al., 2020), it is important to take a 'whole family' approach when discussing the digital media ecology. Specifically, parents should be encouraged to model healthy device habits, such as prioritizing device-free family time, not using screens 1 hour before bed (Dube et al., 2017), and limiting screen time in general. Families can be support by developing family media plans that determine where, when, for how long, and with whom screens are used (Korioth, 2016).

Associations between screen time and externalizing problems were larger for aggression, in particular, and boys. Parents and clinicians can use this information to guide their screen time decisions and recommendations. For example, if high levels of aggression are observed, reducing screen time (especially violent or inappropriate content) may be one strategy to manage this behaviour. Importantly, as associations were small, limiting screen time should not be relied on as the only means to address behavioural concerns; however, device-free interactions go hand-in-hand with other evidence-based strategies to foster healthy development, such as encouraging physical activity (Wu et al., 2018), adequate sleep, play-based learning (Wong et al., 2021), and reading together (Lee et al., 2017).

Limitations

Due to the limited literature, potential important moderators such as sleep disruption (Guerrero et al., 2019) and parent-child interactions could not be examined. Therefore, more research is needed to understand the potential mechanisms behind the associations found in this meta-analysis. Additionally, the effect sizes found are very small to small and are correlational in

nature; thus, causality and directionality could not be determined. Indeed, some studies have found that, at different timepoints in childhood, internalizing and externalizing problems may themselves predict screen time (Neville et al., 2021). While it is possible that screens lead to increased behaviour problems, it is also possible that screens are used to placate children or as a tool to negotiate with difficult child behaviour (Shah et al., 2019; Tang et al., 2018). Thus, future research should continue to disentangle the directionality of associations between screen use and children's behavioural problems.

With rapid shifts in technology, generational cohorts may not use devices in comparable ways over time (Kaye et al., 2020). For example, originally, cell phones were used primarily for calling and few children had their own; now, smartphones can be used to access webpages, stream videos, and socialize (e.g., call, text, social media), and 69% of American children have their own digital device by age 12 (Rideout & Robb, 2019). In this meta-analysis, newer studies showed smaller effects for the association between screen time and externalizing problems, but new technology is outpacing the speed of research. Future studies should ensure that screen time is not necessarily measured as a single construct across multiple devices and instead focus on the function of screen use (e.g., entertainment, socializing, education) to untangle the various ways screens are used without being device specific. The search strategy for the current study was conducted in 2019 and given the rapid rate of device use and accessibility in children, an updated meta-analysis is warranted. Finally, findings from this study only apply to screen time in terms of duration but more nuanced aspects of screen time such as context (e.g., co-viewing vs. passive viewing) and quality (e.g., educational vs. entertainment) should be examined in the future.

Conclusions

The association between screen time and children's mental health has garnered significant attention from academic, professional, and public sectors. While acknowledging that children's mental health is multidetermined, findings from this study suggest that screen time is one of the many socio-environmental factors associated with child behaviour problems. These meta-analyses identified several important methodological moderators for the association between screen time and behaviour problems, such as the informants and measures used, that highlight the lack of unity in the screen time literature. Overall, the associations were small but significant and varied as a function of child demographics and methodological rigor. It is essential for the field of screen time to work towards unity in methodological approaches, and to further explore facets of screen use (i.e., content and context) as they relate to children's mental health. Now that screens are a pervasive part of family life, researchers, policy makers, and clinicians should go beyond the individual child to the wider family media ecology to understand the effects of screen time on child development and provide practical guidance on how to limit screen time (Barr, 2019).

References

Achenbach, T. M. (1966). The classification of children's psychiatric symptoms: a factor-analytic study. *Psychological Monogrraphs*, *80*(7), 1-37. https://doi.org/10.1037/h0093906

Achenbach, T. M., & Edelbrock, C. S. (1978). The classification of child psychopathology: A review and analysis of empirical efforts. *Psychological Bulletin*, *85*(6), 1275-1301. https://doi.org/10.1037/0033-2909.85.6.1275

Achenbach, T. M., & Edelbrock, C. S. (1983). Manual for the child behavior checklist and revised child behavior profile.

Adelantado-Renau, M., Moliner-Urdiales, D., Cavero-Redondo, I., Beltran-Valls, M. R., Martínez-Vizcaíno, V., & Álvarez-Bueno, C. (2019). Association Between Screen Media Use and Academic Performance Among Children and Adolescents: A Systematic Review and Meta-analysis. *JAMA Pediatrics*, *173*(11), 1058-1067. https://doi.org/10.1001/jamapediatrics.2019.3176

Al-Ali, N. M., Yaghy, H. S., Shattnawi, K. K., & Al-Shdayfat, N. M. (2018). Parents' Knowledge and Beliefs about the Impact of Exposure to Media Violence on Children's Aggression. *Issues in Mental Health Nursing*, *39*(7), 592-599. https://doi.org/10.1080/01612840.2017.1422201

Alfano, C. A., Zakem, A. H., Costa, N. M., Taylor, L. K., & Weems, C. F. (2009). Sleep problems and their relation to cognitive factors, anxiety, and depressive symptoms in children and adolescents. *Depression and Anxiety*, *26*(6), 503-512. https://doi.org/10.1002/da.20443

Allen, M. S., & Vella, S. A. (2015). Screen-based sedentary behaviour and psychosocial well-being in childhood: Cross-sectional and longitudinal associations. *Mental Health and Physical Activity*, *9*, 41-47. https://doi.org/10.1016/j.mhpa.2015.10.002

Amawi, S. O., Subki, A. H., Khatib, H. A., Alkhateeb, O. S., Fida, R. H., Saggaf, O. M., & Jan, M. M. (2018). Use of Electronic Entertainment and Communication Devices Among a Saudi Pediatric Population: Cross-Sectional Study [Original Paper]. *Interact J Med Res*, *7*(2), e13. https://doi.org/10.2196/ijmr.9103

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders : DSM-5*. American Psychiatric Association.

Anderson, D. R., Field, D. E., Collins, P. A., Lorch, E. P., & Nathan, J. G. (1985). Estimates of Young Children's Time with Television: A Methodological Comparison of Parent Reports with Time-Lapse Video Home Observation. *Child Development*, *56*(5), 1345-1357. https://doi.org/10.2307/1130249

Anderson, S. E., Economos, C. D., & Must, A. (2008). Active play and screen time in US children aged 4 to 11 years in relation to sociodemographic and weight status characteristics: a nationally representative cross-sectional analysis. *Bmc Public Health*, *8*, 366. https://doi.org/10.1186/1471-2458-8-366

Appelbaum, M., Cooper, H., Kline, R. B., Mayo-Wilson, E., Nezu, A. M., & Rao, S. M. (2018). Journal Article Reporting Standards for Quantitative Research in Psychology: The APA Publications and Communications Board Task Force Report. *American Psychologist*, *73*(1), 3-25. https://doi.org/10.1037/amp0000191

Bandura, A. (1977). *Social learning theory*. Prentice-Hall.

Barlett, N. D., Gentile, D. A., Barlett, C. P., Eisenmann, J. C., & Walsh, D. A. (2012). Sleep as a Mediator of Screen Time Effects on US Children's Health Outcomes. *Journal of Children and Media*, *6*(1), 37-50. https://doi.org/10.1080/17482798.2011.633404

Barr, R. (2019). Growing Up in the Digital Age: Early Learning and Family Media Ecology. *Current Directions in Psychological Science*, *28*(4), 341-346. https://doi.org/10.1177/0963721419838245

Barr, R., Kirkorian, H., Radesky, J., Coyne, S., Nichols, D., Blanchfield, O., Rusnak, S., Stockdale, L., Ribner, A., Durnez, J., Epstein, M., Heimann, M., Koch, F.-S., Sundqvist, A., Birberg-Thornberg, U., Konrad, C., Slussareff, M., Bus, A., Bellagamba, F., & Fitzpatrick, C. (2020). Beyond Screen Time: A Synergistic Approach to a More Comprehensive Assessment of Family Media Exposure During Early Childhood. *Frontiers in Psychology*, *11*, 1283-1283. https://doi.org/10.3389/fpsyg.2020.01283

Berman, N. C., Wheaton, M. G., McGrath, P., & Abramowitz, J. S. (2010). Predicting anxiety: The role of experiential avoidance and anxiety sensitivity. *Journal of Anxiety Disorders*, *24*(1), 109-113. https://doi.org/https://doi.org/10.1016/j.janxdis.2009.09.005

Borenstein, M., Hedges, L., Higgins, J. P. T., & Rothstein, H. R. (2013). *Comprehensive Meta-Analysis Version 3*. Biostat.

Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (2009). *Introduction to Meta-Analysis*. https://doi.org/10.1002/9780470743386

Browne, D., Thompson, D. A., & Madigan, S. (2020). Digital Media Use in Children: Clinical versus Scientific Responsibilities. *JAMA Pediatrics*, *174*(2), 111. https://doi.org/10.1001/jamapediatrics.2019.4559

Bufferd, S. J., Dougherty, L. R., Carlson, G. A., Rose, S., & Klein, D. N. (2012). Psychiatric Disorders in Preschoolers: Continuity From Ages 3 to 6. *American Journal of Psychiatry*, *169*(11), 1157-1164. https://doi.org/10.1176/appi.ajp.2012.12020268

Byun, Y.-H., Ha, M., Kwon, H.-J., Hong, Y.-C., Leem, J.-H., Sakong, J., Kim, S. Y., Lee, C. G., Kang, D., Choi, H.-D., & Kim, N. (2013). Mobile Phone Use, Blood Lead Levels, and Attention Deficit Hyperactivity Symptoms in Children: A Longitudinal Study. *PloS one*, *8*(3), e59742. https://doi.org/10.1371/journal.pone.0059742

Cao, H., Yan, S., Gu, C., Wang, S., Ni, L., Tao, H., Shao, T., Xu, Y., & Tao, F. (2018). Prevalence of attention-deficit/hyperactivity disorder symptoms and their associations with sleep schedules and sleep-related problems among preschoolers in mainland China. *BMC Pediatrics*, *18*(1), 70. https://doi.org/10.1186/s12887-018-1022-1

Carnagey, N. L., Anderson, C. A., & Bushman, B. J. (2007). The effect of video game violence on physiological desensitization to real-life violence. *Journal of Experimental Social Psychology*, *43*(3), 489-496. https://doi.org/https://doi.org/10.1016/j.jesp.2006.05.003

Carson, V., Spence, J. C., Cutumisu, N., & Cargill, L. (2010). Association between neighborhood socioeconomic status and screen time among pre-school children: a cross-sectional study. *Bmc Public Health*, *10*. https://doi.org/Artn 367

10.1186/1471-2458-10-367

Carter, A. S., Briggs-Gowan, M. J., & Davis, N. O. (2004). Assessment of young children's social-emotional development and psychopathology: recent advances and recommendations for practice. *Journal of Child Psychology and Psychiatry*, *45*(1), 109-134. https://doi.org/10.1046/j.0021-9630.2003.00316.x

Çelen Yoldaş, T., & Özmert, E. N. (2021). Communicative Environmental Factors Including Maternal Depression and Media Usage Patterns on Early Language Development. *Maternal and Child Health Journal*, *25*(6), 900-908. https://doi.org/10.1007/s10995-021-03125-3

Center on the Developing Child. (2007). *The Science of Early Childhood Development (InBrief)*. www.developingchild.harvard.edu

Certain, L. K., & Kahn, R. S. (2002). Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics*, *109*(4), 634-642. https://doi.org/10.1542/peds.109.4.634

Chen, W. W., & Adler, J. L. (2019). Assessment of Screen Exposure in Young Children, 1997 to 2014. *JAMA Pediatrics*, *173*(4), 391-393. https://doi.org/10.1001/jamapediatrics.2018.5546

Chonchaiya, W., Sirachairat, C., Vijakkhana, N., Wilaisakditipakorn, T., & Pruksananonda, C. (2015). Elevated background TV exposure over time increases behavioural scores of 18-month-old toddlers. *Acta Paediatrica*, *104*(10), 1039-1046. https://doi.org/https://doi.org/10.1111/apa.13067

Christakis, D. A. (2009). The effects of infant media usage: what do we know and what should we learn? *Acta Paediatrica*, *98*(1), 8-16. https://doi.org/https://doi.org/10.1111/j.1651-2227.2008.01027.x

Christakis, D. A. (2014). Interactive Media Use at Younger Than the Age of 2 Years: Time to Rethink the American Academy of Pediatrics Guideline? *JAMA Pediatrics*, *168*(5), 399-400. https://doi.org/10.1001/jamapediatrics.2013.5081

Christakis, D. A., Gilkerson, J., Richards, J. A., Zimmerman, F. J., Garrison, M. M., Xu, D., Gray, S., & Yapanel, U. (2009). Audible television and decreased adult words, infant vocalizations, and conversational turns: a population-based study. *Archives of Pediatrics & Adolescent Medicine*, *163*(6), 554-558. https://doi.org/10.1001/archpediatrics.2009.61

Christakis, D. A., Zimmerman, F. J., DiGiuseppe, D. L., & McCarty, C. A. (2004). Early Television Exposure and Subsequent Attentional Problems in Children. *Pediatrics*, *113*(4), 708-713. https://doi.org/10.1542/peds.113.4.708

Cicchetti, D., & Natsuaki, M. N. (2014). Multilevel developmental perspectives toward understanding internalizing psychopathology: Current research and future directions. *Development and Psychopathology*, *26*(4), 1189-1190. https://doi.org/10.1017/S0954579414000959

Cicchetti, D., & Rogosch, F. A. (1996). Equifinality and multifinality in developmental psychopathology. *Development and Psychopathology*, *8*(4), 597-600. https://doi.org/10.1017/S0954579400007318

Cohn, L. D., & Becker, B. J. (2003). How meta-analysis increases statistical power. *Psychological Methods*, *8*(3), 243-253. https://doi.org/10.1037/1082-989x.8.3.243

Coker, T. R., Elliott, M. N., Schwebel, D. C., Windle, M., Toomey, S. L., Tortolero, S. R., Hertz, M. F., Peskin, M. F., & Schuster, M. A. (2015). Media Violence Exposure and Physical Aggression in Fifth-Grade Children. *Academic Pediatrics*, *15*(1), 82-88. https://doi.org/https://doi.org/10.1016/j.acap.2014.09.008

Comer, J. S., Furr, J. M., Beidas, R. S., Babyar, H. M., & Kendall, P. C. (2008). Media use and children's perceptions of societal threat and personal vulnerability. *Journal of Clinical*

Child and Adolescent Psychology, *37*(3), 622-630. https://doi.org/10.1080/15374410802148145

Cooper, N. S. (2004). *The identification of psychological and social correlates of Internet use in children and teenagers* [Ph.D., Alliant International University, Los Angeles]. ProQuest Dissertations & Theses Global. Ann Arbor.

Costello, E. J., Copeland, W., & Angold, A. (2011). Trends in psychopathology across the adolescent years: what changes when children become adolescents, and when adolescents become adults? *Journal of Child Psychology and Psychiatry*, *52*(10), 1015-1025. https://doi.org/10.1111/j.1469-7610.2011.02446.x

Costello, E. J., Foley, D. L., & Angold, A. (2006). 10-year research update review: The epidemiology of child and adolescent psychiatric disorders: II. Developmental epidemiology. *Journal of the American Academy of Child and Adolescent Psychiatry*, *45*(1), 8-25. https://doi.org/10.1097/01.chi.0000184929.41423.c0

Cummings, C. M., Caporino, N. E., & Kendall, P. C. (2014). Comorbidity of Anxiety and Depression in Children and Adolescents: 20 Years After. *Psychological Bulletin*, *140*(3), 816-845. https://doi.org/10.1037/a0034733

Davison, L. L. (2004). *Media viewing and the neurological development of ADHD: Voluntary and involuntary processing* [Ph.D., The Claremont Graduate University]. ProQuest Dissertations & Theses Global. Ann Arbor.

de Jong, E., Visscher, T. L. S., HiraSing, R. A., Heymans, M. W., Seidell, J. C., & Renders, C. M. (2013). Association between TV viewing, computer use and overweight, determinants and competing activities of screen time in 4-to 13-year-old children. *International Journal of Obesity*, *37*(1), 47-53. https://doi.org/10.1038/ijo.2011.244

De Los Reyes, A. (2011). Introduction to the Special Section: More Than Measurement Error: Discovering Meaning Behind Informant Discrepancies in Clinical Assessments of Children and Adolescents. *Journal of Clinical Child & Adolescent Psychology*, *40*(1), 1-9. https://doi.org/10.1080/15374416.2011.533405

De Los Reyes, A., & Kazdin, A. E. (2005). Informant discrepancies in the assessment of childhood psychopathology: A critical review, theoretical framework, and recommendations for further study. *Psychological Bulletin*, *131*(4), 483-509. https://doi.org/10.1037/0033-2909.131.4.483

De Los Reyes, A., & Makol, B. A. (2021). Interpreting convergences and divergences in multiinformant, multi-method assessment. In J. Mihura (Ed.), *The Oxford handbook of personality and psychopathology assessment* (2nd ed.).

Dersimonian, R., & Laird, N. (1986). Meta-analysis in Clinical-Trials. *Controlled Clinical Trials*, *7*(3), 177-188. https://doi.org/Doi 10.1016/0197-2456(86)90046-2

Domingues-Montanari, S. (2017). Clinical and psychological effects of excessive screen time on children. *Journal of Paediatrics and Child Health*, *53*(4), 333-338. https://doi.org/10.1111/jpc.13462

Dube, N., Khan, K., Loehr, S., Chu, Y., & Veugelers, P. (2017). The use of entertainment and communication technologies before sleep could affect sleep and weight status: a population-based study among children. *International Journal of Behavioral Nutrition and Physical Activity*, *14*(1), 97. https://doi.org/10.1186/s12966-017-0547-2

Ebenegger, V., Marques-Vidal, P.-M., Munsch, S., Quartier, V., Nydegger, A., Barral, J., Hartmann, T., Dubnov-Raz, G., Kriemler, S., & Puder, J. J. (2011). Relationship of Hyperactivity/Inattention With Adiposity and Lifestyle Characteristics in Preschool

Children. *Journal of Child Neurology*, *27*(7), 852-858. https://doi.org/10.1177/0883073811428009

Egger, H. L., & Angold, A. (2006). Common emotional and behavioral disorders in preschool children: presentation, nosology, and epidemiology. *Journal of Child Psychology and Psychiatry*, *47*(3-4), 313-337. https://doi.org/10.1111/j.1469-7610.2006.01618.x

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *Bmj-British Medical Journal*, *315*(7109), 629-634. https://doi.org/DOI 10.1136/bmj.315.7109.629

Elson, M., Ferguson, C. J., Gregerson, M., Hogg, J. L., Ivory, J., Klisanin, D., Markey, P. M., Nichols, D., Siddiqui, S., & Wilson, J. (2019). Do Policy Statements on Media Effects Faithfully Represent the Science? *Advances in Methods and Practices in Psychological Science*, *2*(1), 12-25. https://doi.org/10.1177/2515245918811301

Erdogan, A., Kiran, S., Aydogan, G., Boettjet, N. K., Yurtseven, E., Can, G., Konuk, N., Atik, L., & Atasoy, N. (2006). Behavioral correlates of television viewing time in a Turkish sample of preschool children [Article]. *Neurology Psychiatry and Brain Research*, *13*(4), 225-230. <Go to ISI>://WOS:000249575500013

Ferguson, C. J., & Beresin, E. (2017). Social science's curious war with pop culture and how it was lost: The media violence debate and the risks it holds for social science. *Preventive Medicine*, *99*, 69-76. https://doi.org/10.1016/j.ypmed.2017.02.009

Fergusson, D. M., John Horwood, L., & Ridder, E. M. (2005). Show me the child at seven: the consequences of conduct problems in childhood for psychosocial functioning in adulthood. *Journal of Child Psychology and Psychiatry*, *46*(8), 837-849. https://doi.org/10.1111/j.1469-7610.2004.00387.x

Froiland, J. M., & Davison, M. L. (2016). Home literacy, television viewing, fidgeting and ADHD in young children. *Educational Psychology*, *36*(8), 1337-1353. https://doi.org/10.1080/01443410.2014.963031

Funder, D. C., & Ozer, D. J. (2019). Evaluating Effect Size in Psychological Research: Sense and Nonsense. *Advances in Methods and Practices in Psychological Science*, *2*(2), 156-168. https://doi.org/10.1177/2515245919847202

Funk, J. B., Baldacci, H. B., Pasold, T., & Baumgardner, J. (2004). Violence exposure in real-life, video games, television, movies, and the internet: is there desensitization? *Journal of Adolescence*, *27*(1), 23-39. https://doi.org/https://doi.org/10.1016/j.adolescence.2003.10.005

Gentile, D. A., Berch, O. N., Choo, H., Khoo, A., & Walsh, D. A. (2017). Bedroom media: One risk factor for development. *Developmental Psychology*, *53*(12), 2340-2355. https://doi.org/10.1037/dev0000399

Guerrero, M. D., Barnes, J. D., Chaput, J.-P., & Tremblay, M. S. (2019). Screen time and problem behaviors in children: exploring the mediating role of sleep duration. *International Journal of Behavioral Nutrition and Physical Activity*, *16*(1), 105. https://doi.org/10.1186/s12966-019-0862-x

Guxens, M., Vermeulen, R., Steenkamer, I., Beekhuizen, J., Vrijkotte, T. G. M., Kromhout, H., & Huss, A. (2019). Radiofrequency electromagnetic fields, screen time, and emotional and behavioural problems in 5-year-old children. *International Journal of Hygiene and Environmental Health*, *222*(2), 188-194. https://doi.org/https://doi.org/10.1016/j.ijheh.2018.09.006

Hale, L., & Guan, S. (2015). Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Medicine Reviews, 21*, 50-58. https://doi.org/10.1016/j.smrv.2014.07.007

Hamaker, E. L., Kuiper, R. M., & Grasman, R. P. P. P. (2015). A critique of the cross-lagged panel model. *Psychological Methods*, *20*(1), 102-116. https://doi.org/10.1037/a0038889

Hastings, E. C., Karas, T. L., Winsler, A., Way, E., Madigan, A., & Tyler, S. (2009). Young Children's Video/Computer Game Use: Relations with School Performance and Behavior. *Issues in Mental Health Nursing*, *30*(10), 638-649. https://doi.org/10.1080/01612840903050414

He, M., Irwin, J. D., Sangster Bouck, L. M., Tucker, P., & Pollett, G. L. (2005). Screen-Viewing Behaviors Among Preschoolers: Parents' Perceptions. *American Journal of Preventive Medicine*, *29*(2), 120-125. https://doi.org/https://doi.org/10.1016/j.amepre.2005.04.004

Hefner, H. L. (2013). *Risks of Television Viewing Among Children With and Without the ADHD Diagnosis* [Ph.D., Walden University]. ProQuest Dissertations & Theses Global. Ann Arbor.

Higgins, J. P. T., Thompson, S. G., Deeks, J. J., & Altman, D. G. (2003). Measuring inconsistency in meta-analyses. *British Medical Journal*, *327*(7414), 557-560. https://doi.org/DOI 10.1136/bmj.327.7414.557

Hinkley, T., Salmon, J., Okely, A. D., Crawford, D., & Hesketh, K. (2012). Preschoolers' Physical Activity, Screen Time, and Compliance with Recommendations. *Medicine and Science in Sports and Exercise*, *44*(3), 458-465. https://doi.org/10.1249/MSS.0b013e318233763b

Hoare, E., Milton, K., Foster, C., & Allender, S. (2016). The associations between sedentary behaviour and mental health among adolescents: a systematic review. *International Journal of Behavioral Nutrition and Physical Activity*, *13*. https://doi.org/ARTN 108 10.1186/s12966-016-0432-4

Holton, K. F., & Nigg, J. T. (2016). The Association of Lifestyle Factors and ADHD in Children. *Journal of Attention Disorders*, *24*(11), 1511-1520. https://doi.org/10.1177/1087054716646452

Hosokawa, R., & Katsura, T. (2018). Association between mobile technology use and child adjustment in early elementary school age. *PloS one*, *13*(7), e0199959. https://doi.org/10.1371/journal.pone.0199959

Hoyos Cillero, I., & Jago, R. (2011). Sociodemographic and home environment predictors of screen viewing among Spanish school children. *Journal of Public Health*, *33*(3), 392-402. https://doi.org/10.1093/pubmed/fdq087

Huesmann, L. R. (2007). The impact of electronic media violence: scientific theory and research. *Journal of Adolescent Health*, *41*(6 Suppl 1), S6-13. https://doi.org/10.1016/j.jadohealth.2007.09.005

Huesmann, L. R., & Eron, L. D. (1984). Cognitive processes and the persistence of aggressive behavior. *Aggressive Behavior*, *10*(3), 243-251. https://doi.org/https://doi.org/10.1002/1098-2337(1984)10:3<243::AID-AB2480100308>3.0.CO;2-6

Hughes, A. A., Lourea-Waddell, B., & Kendall, P. C. (2008). Somatic complaints in children with anxiety disorders and their unique prediction of poorer academic performance. *Child*

Psychiatry & Human Development, *39*(2), 211-220. https://doi.org/10.1007/s10578-007-0082-5

Jia, S., Wang, L., Shi, Y., & Li, P. (2016). Family Risk Factors Associated With Aggressive Behavior in Chinese Preschool Children. *Journal of Pediatric Nursing*, *31*(6), e367-e374. https://doi.org/https://doi.org/10.1016/j.pedn.2016.08.001

John, J. J., Joseph, R., David, A., Bejoy, A., George, K. V., & George, L. (2021). Association of screen time with parent-reported cognitive delay in preschool children of Kerala, India. *BMC Pediatrics*, *21*(1), 73. https://doi.org/10.1186/s12887-021-02545-y

Kaufman, J., Birmaher, B., Brent, D., Rao, U., Flynn, C., Moreci, P., Williamson, D., & Ryan, N. (1997). Schedule for Affective Disorders and Schizophrenia for School-Age Children Present and Lifetime version (K-SADS-PL): Initial reliability and validity data. *Journal of the American Academy of Child and Adolescent Psychiatry*, *36*(7), 980-988. https://doi.org/Doi 10.1097/00004583-199707000-00021

Kaye, L., Orben, A., Ellis, D., Hunter, S., & Houghton, S. (2020). The Conceptual and Methodological Mayhem of "Screen Time". *International Journal of Environmental Research and Public Health*, *17*(10), 3661. https://www.mdpi.com/1660-4601/17/10/3661

Korioth, T. (2016). Family Media Plan helps parents set boundaries for kids. *American Academy of Pediatrics News*. https://www.aappublications.org/news/2016/10/21/mediaparents102116

Lahey, B. B., Rathouz, P. J., Van Hulle, C., Urbano, R. C., Krueger, R. F., Applegate, B., Garriock, H. A., Chapman, D. A., & Waldman, I. D. (2008). Testing structural models of DSM-IV symptoms of common forms of child and adolescent psychopathology. *Journal*

of Abnormal Child Psychology, *36*(2), 187-206. https://doi.org/10.1007/s10802-007-9169-5

Lavigne, J. V., Arend, R., Rosenbaum, D., Binns, H. J., Christoffel, K. K., & Gibbons, R. D. (1998). Psychiatric disorders with onset in the preschool years: I. Stability of diagnoses. *Journal of the American Academy of Child and Adolescent Psychiatry*, *37*(12), 1246-1254. https://doi.org/Doi 10.1097/00004583-199812000-00007

LeBlanc, A. G., Katzmarzyk, P. T., Barreira, T. V., Broyles, S. T., Chaput, J. P., Church, T. S., Fogelholm, M., Harrington, D. M., Hu, G., Kuriyan, R., Kurpad, A., Lambert, E. V., Maher, C., Maia, J., Matsudo, V., Olds, T., Onywera, V., Sarmiento, O. L., Standage, M., Tudor-Locke, C., Zhao, P., Tremblay, M. S., & Grp, I. R. (2015). Correlates of Total Sedentary Time and Screen Time in 9-11 Year-Old Children around the World: The International Study of Childhood Obesity, Lifestyle and the Environment. *PloS one*, *10*(6). https://doi.org/UNSP e0129622

10.1371/journal.pone.0129622

Lee, E.-Y., Spence, J. C., & Carson, V. (2017). Television viewing, reading, physical activity and brain development among young South Korean children. *Journal of Science and Medicine in Sport*, *20*(7), 672-677. https://doi.org/https://doi.org/10.1016/j.jsams.2016.11.014

Lieb, R., Meinlschmidt, G., & Araya, R. (2007). Epidemiology of the association between somatoform disorders and anxiety and depressive disorders: An update. *Psychosomatic Medicine*, *69*(9), 860-863. https://doi.org/10.1097/PSY.0b013e31815b0103

Linebarger, D. L. (2015). Contextualizing video game play: The moderating effects of cumulative risk and parenting styles on the relations among video game exposure and

problem behaviors. *Psychology of Popular Media Culture*, *4*(4), 375-396. https://doi.org/10.1037/ppm0000069

Linebarger, D. L., Barr, R., Lapierre, M. A., & Piotrowski, J. T. (2014). Associations Between Parenting, Media Use, Cumulative Risk, and Children's Executive Functioning. *Journal of Developmental & Behavioral Pediatrics*, *35*(6). https://journals.lww.com/jrnldbp/Fulltext/2014/07000/Associations_Between_Parenting,_Media_Use,.3.aspx

Lissak, G. (2018). Adverse physiological and psychological effects of screen time on children and adolescents: Literature review and case study. *Environmental Research*, *164*, 149-157. https://doi.org/10.1016/j.envres.2018.01.015

Liu, M. L., Wu, L., & Yao, S. Q. (2016). Dose-response association of screen time-based sedentary behaviour in children and adolescents and depression: a meta-analysis of observational studies. *British Journal of Sports Medicine*, *50*(20), 1252-+. https://doi.org/10.1136/bjsports-2015-095084

Lobel, A., Engels, R. C. M. E., Stone, L. L., Burk, W. J., & Granic, I. (2017). Video Gaming and Children's Psychosocial Wellbeing: A Longitudinal Study. *Journal of Youth and Adolescence*, *46*(4), 884-897. https://doi.org/10.1007/s10964-017-0646-z

Luby, J. L., Gaffrey, M. S., Tillman, R., April, L. M., & Belden, A. C. (2014). Trajectories of Preschool Disorders to Full DSM Depression at School Age and Early Adolescence: Continuity of Preschool Depression. *American Journal of Psychiatry*, *171*(7), 768-776. https://doi.org/10.1176/appi.ajp.2014.13091198

Madigan, S., Browne, D., Racine, N., Mori, C., & Tough, S. (2019). Association Between Screen Time and Children's Performance on a Developmental Screening Test. *JAMA Pediatrics*, *173*(3), 244-250. https://doi.org/10.1001/jamapediatrics.2018.5056

Madigan, S., McArthur, B. A., Anhorn, C., Eirich, R., & Christakis, D. A. (2020). Associations Between Screen Use and Child Language Skills: A Systematic Review and Meta-analysis. *JAMA Pediatrics*. https://doi.org/10.1001/jamapediatrics.2020.0327

Madigan, S., Racine, N., & Tough, S. (2020). Prevalence of Preschoolers Meeting vs Exceeding Screen Time Guidelines. *Jama Pediatrics*, *174*(1), 93-95. https://doi.org/10.1001/jamapediatrics.2019.4495

Madigan, S., Villani, V., Azzopardi, C., Laut, D., Smith, T., Temple, J. R., Browne, D., & Dimitropoulos, G. (2018). The Prevalence of Unwanted Online Sexual Exposure and Solicitation Among Youth: A Meta-Analysis. *Journal of Adolescent Health*, *63*(2), 133-141. https://doi.org/https://doi.org/10.1016/j.jadohealth.2018.03.012

Manganello, J. A., & Taylor, C. A. (2009). Television Exposure as a Risk Factor for Aggressive Behavior Among 3-Year-Old Children. *Archives of Pediatrics & Adolescent Medicine*, *163*(11), 1037-1045. https://doi.org/10.1001/archpediatrics.2009.193

Marshall, S. J., Gorely, T., & Biddle, S. J. (2006). A descriptive epidemiology of screen-based media use in youth: a review and critique. *Journal of Adolescence*, *29*(3), 333-349. https://doi.org/10.1016/j.adolescence.2005.08.016

Martin, A., Razza, R. A., & Brooks-Gunn, J. (2012). Specifying the links between household chaos and preschool children's development. *Early Child Development and Care*, *182*(10), 1247-1263. https://doi.org/10.1080/03004430.2011.605522

Martins, N., & Wilson, B. J. (2012). Social Aggression on Television and Its Relationship to Children's Aggression in the Classroom. *Human Communication Research*, *38*(1), 48-71. https://doi.org/10.1111/j.1468-2958.2011.01417.x

Mathur, M. B., & VanderWeele, T. J. (2019). Finding Common Ground in Meta-Analysis "Wars" on Violent Video Games. *Perspectives on Psychological Science*, *14*(4), 705-708. https://doi.org/10.1177/1745691619850104

McBee, M. T., Brand, R. J., & Dixon, W. E. (2021). Challenging the Link Between Early Childhood Television Exposure and Later Attention Problems: A Multiverse Approach. *Psychological Science*, *32*(4), 496-518. https://doi.org/10.1177/0956797620971650

McCrae, N., Gettings, S., & Purssell, E. (2017). Social Media and Depressive Symptoms in Childhood and Adolescence: A Systematic Review. *Adolescent Research Review*, *2*(4), 315-330. https://doi.org/10.1007/s40894-017-0053-4

McNeill, J., Howard, S. J., Vella, S. A., & Cliff, D. P. (2019). Longitudinal Associations of Electronic Application Use and Media Program Viewing with Cognitive and Psychosocial Development in Preschoolers. *Academic Pediatrics*, *19*(5), 520-528. https://doi.org/https://doi.org/10.1016/j.acap.2019.02.010

Merikangas, K. R., Nakamura, E. F., & Kessler, R. C. (2009). Epidemiology of mental disorders in children and adolescents. *Dialogues in Clinical Neuroscience*, *11*(1), 7-20. https://www.ncbi.nlm.nih.gov/pubmed/19432384

Mesman, J., Bongers, I. L., & Koot, H. M. (2001). Preschool developmental pathways to preadolescent internalizing and externalizing problems. *Journal of Child Psychology and Psychiatry*, *42*(5), 679-689. https://www.ncbi.nlm.nih.gov/pubmed/11464972

Miller, C. J., Marks, D. J., Miller, S. R., Berwid, O. G., Kera, E. C., Santra, A., & Halperin, J. M. (2006). Brief Report: Television Viewing and Risk for Attention Problems in Preschool Children. *Journal of Pediatric Psychology*, *32*(4), 448-452. https://doi.org/10.1093/jpepsy/jsl035

Miller, L. E., Grabell, A., Thomas, A., Bermann, E., & Graham-Bermann, S. A. (2012). The associations between community violence, television violence, intimate partner violence, parent–child aggression, and aggression in sibling relationships of a sample of preschoolers. *Psychology of Violence*, *2*(2), 165-178. https://doi.org/10.1037/a0027254

Mistry, K. B., Minkovitz, C. S., Strobino, D. M., & Borzekowski, D. L. G. (2007). Children's Television Exposure and Behavioral and Social Outcomes at 5.5 Years: Does Timing of Exposure Matter? *Pediatrics*, *120*(4), 762-769. https://doi.org/10.1542/peds.2006-3573

Mitrofan, O., Paul, M., & Spencer, N. (2009). Is aggression in children with behavioural and emotional difficulties associated with television viewing and video game playing? A systematic review. *Child Care Health and Development*, *35*(1), 5-15. https://doi.org/10.1111/j.1365-2214.2008.00912.x

Moyer, V. S. (2008). *The Role of User Motivations in Moderating the Relation Between Video Game Playing and Children's Adjustment* Bowling Green State University]. http://rave.ohiolink.edu/etdc/view?acc_num=bgsu1210548781

Mundy, L. K., Canterford, L., Olds, T., Allen, N. B., & Patton, G. C. (2017). The Association Between Electronic Media and Emotional and Behavioral Problems in Late Childhood. *Academic Pediatrics*, *17*(6), 620-624. https://doi.org/https://doi.org/10.1016/j.acap.2016.12.014

National Institutes of Health. (2014). *Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies*. http:// www.nhlbi.nih.gov/health-pro/guidelines/in-develop/cardiovascular-riskreduction/tools/cohort.

Neville, R. D., McArthur, B. A., Eirich, R., Lakes, K. D., & Madigan, S. (2021). Bidirectional associations between screen time and children's externalizing and internalizing behaviors. *Journal of Child Psychology and Psychiatry*. https://doi.org/10.1111/jcpp.13425

Nigg, J. T. (2013). Attention-deficit/hyperactivity disorder and adverse health outcomes. *Clinical Psychology Review*, *33*(2), 215-228. https://doi.org/10.1016/j.cpr.2012.11.005

Nikkelen, S. W., Valkenburg, P. M., Huizinga, M., & Bushman, B. J. (2014). Media use and ADHD-related behaviors in children and adolescents: A meta-analysis. *Developmental Psychology*, *50*(9), 2228-2241. https://doi.org/10.1037/a0037318

Nikkelen, S. W. C., Vossen, H. G. M., & Valkenburg, P. M. (2015). Children's Television Viewing and ADHD-related Behaviors: Evidence from the Netherlands. *Journal of Children and Media*, *9*(4), 399-418. https://doi.org/10.1080/17482798.2015.1088872

Obel, C., Henriksen, T. B., Dalsgaard, S., Linnet, K. M., Skajaa, E., Thomsen, P. H., & Olsen, J. (2004). Does Children's Watching of Television Cause Attention Problems? Retesting the Hypothesis in a Danish Cohort. *Pediatrics*, *114*(5), 1372-1373. https://doi.org/10.1542/peds.2004-0954

Ooi, L. L., Nocita, G., Coplan, R. J., Zhu, J. J., & Rose-Krasnor, L. (2017). Beyond bashful: Examining links between social anxiety and young children's socio-emotional and school adjustment. *Early Childhood Research Quarterly*, *41*, 74-83. https://doi.org/10.1016/j.ecresq.2017.06.003

Orben, A. (2020). Teenagers, screens and social media: a narrative review of reviews and key studies. *Social Psychiatry and Psychiatric Epidemiology*, *55*(4), 407-414. https://doi.org/10.1007/s00127-019-01825-4

Özmert, E., Toyran, M., & Yurdakök, K. (2002). Behavioral Correlates of Television Viewing in Primary School Children Evaluated by the Child Behavior Checklist. *Archives of Pediatrics & Adolescent Medicine*, *156*(9), 910-914. https://doi.org/10.1001/archpedi.156.9.910

Pagani, L. S., Fitzpatrick, C., & Barnett, T. A. (2013). Early childhood television viewing and kindergarten entry readiness. *Pediatric Research*, *74*(3), 350-355. https://doi.org/10.1038/pr.2013.105

Parkes, A., Sweeting, H., Wight, D., & Henderson, M. (2013). Do television and electronic games predict children's psychosocial adjustment? Longitudinal research using the UK Millennium Cohort Study. *Archives of Disease in Childhood*, *98*(5), 341-348. https://doi.org/10.1136/archdischild-2011-301508

Paulus, F. W., Sinzig, J., Mayer, H., Weber, M., & von Gontard, A. (2018). Computer Gaming Disorder and ADHD in Young Children—a Population-Based Study. *International Journal of Mental Health and Addiction*, *16*(5), 1193-1207. https://doi.org/10.1007/s11469-017-9841-0

Peralta, G. P., Forns, J., García de la Hera, M., González, L., Guxens, M., López-Vicente, M., Sunyer, J., & Garcia-Aymerich, J. (2018). Sleeping, TV, Cognitively Stimulating Activities, Physical Activity, and Attention-Deficit Hyperactivity Disorder Symptom Incidence in Children: A Prospective Study. *Journal of Developmental & Behavioral Pediatrics*, *39*(3), 192-199. https://doi.org/10.1097/dbp.0000000000000539

Polman, H., de Castro, B. O., & van Aken, M. A. (2008). Experimental study of the differential effects of playing versus watching violent video games on children's aggressive behavior. *Aggressive Behavior*, *34*(3), 256-264. https://doi.org/10.1002/ab.20245

Poulain, T., Vogel, M., Neef, M., Abicht, F., Hilbert, A., Genuneit, J., Körner, A., & Kiess, W. (2018). Reciprocal Associations between Electronic Media Use and Behavioral Difficulties in Preschoolers. *International Journal of Environmental Research and Public Health*, *15*(4), 814. https://www.mdpi.com/1660-4601/15/4/814

Protogerou, C., & Hagger, M. S. (2019). A Case For a Study Quality Appraisal in Survey Studies in Psychology. *Frontiers in Psychology*, *9*. https://doi.org/ARTN 2788

10.3389/fpsyg.2018.02788

Quach, J. L., Nguyen, C. D., Williams, K. E., & Sciberras, E. (2018). Bidirectional Associations Between Child Sleep Problems and Internalizing and Externalizing Difficulties From Preschool to Early Adolescence. *JAMA Pediatrics*, *172*(2), e174363. https://doi.org/10.1001/jamapediatrics.2017.4363

Radesky, J., Christakis, D., Hill, D., Ameenuddin, N., Chassiakos, Y. R., Cross, C., Radesky, J., Hutchinson, J., Boyd, R., Mendelson, R., Moreno, M. A., Smith, J., Swanson, W. S., & Media, C. C. (2016). Media and Young Minds. *Pediatrics*, *138*(5). https://doi.org/ARTN e20162591

10.1542/peds.2016-2591

Ramsawh, H. J., & Chavira, D. A. (2016). Association of Childhood Anxiety Disorders and Quality of Life in a Primary Care Sample. *Journal of Developmental and Behavioral Pediatrics*, *37*(4), 269-276. https://doi.org/10.1097/Dbp.0000000000000296

Reynolds, J. E. (1978). An assessment of variables associated with television viewing and their influence on aggressive behavior of third grade children. In: ProQuest Dissertations Publishing.

Rideout, V. (2017). *The Common Sense census: Media use by kids age zero to eight*. https://www.commonsensemedia.org/research/the-common-sense-census-media-use-by-kids-age-zero-to-eight-2017

Rideout, V., & Robb, M. B. (2019). *The Common Sense census: Media use by tweens and teens*. https://www.commonsensemedia.org/sites/default/files/uploads/research/2019-census-8-to-18-key-findings-updated.pdf

Rosen, L. D., Lim, A. F., Felt, J., Carrier, L. M., Cheever, N. A., Lara-Ruiz, J. M., Mendoza, J. S., & Rokkum, J. (2014). Media and technology use predicts ill-being among children, preteens and teenagers independent of the negative health impacts of exercise and eating habits. *Computers in Human Behavior*, *35*, 364-375. https://doi.org/https://doi.org/10.1016/j.chb.2014.01.036

Rosenthal, R. (1995). Writing Meta-analytic Reviews. *Psychological Bulletin*, *118*(2), 183-192. https://doi.org/10.1037/0033-2909.118.2.183

Rothstein, H. R., Sutton, A. J., & Borenstein, M. (2005). *Publication Bias in Meta-Analysis*. John Wiley & Sons Ltd.

Rubin, K. H., Coplan, R. J., & Bowker, J. C. (2009). Social withdrawal in childhood. *Annual Review of Psychology*, *60*, 141-171. https://doi.org/10.1146/annurev.psych.60.110707.163642

Rubin, K. H., Hymel, S., Mills, R. S. L., & Rose-Krasnor, L. (1991). Conceptualizing Different Developmental Pathways to and from Social Isolation in Childhood. In D. Cicchetti & S.

L. Toth (Eds.), *Internalizing and Externalizing Expressions of Dysfunction*. Lawrence Erlbaum Associates Inc.

Sanders, W., Parent, J., Forehand, R., Sullivan, A. D. W., & Jones, D. J. (2016). Parental perceptions of technology and technology-focused parenting: Associations with youth screen time. *Journal of Applied Developmental Psychology*, *44*, 28-38. https://doi.org/https://doi.org/10.1016/j.appdev.2016.02.005

Schaefer, W. G. (1991). *The effects of television viewing on the academic performance of elementary school children with Attention Deficit Disorder* [Ed.D., Western Michigan University]. ProQuest Dissertations & Theses Global. Ann Arbor.

Schmiedeler, S., Niklas, F., & Schneider, W. (2014). Symptoms of attention-deficit hyperactivity disorder (ADHD) and home learning environment (HLE): findings from a longitudinal study. *European Journal of Psychology of Education*, *29*(3), 467-482. https://doi.org/10.1007/s10212-013-0208-z

Schmitt, K. L., Woolf, K. D., & Anderson, D. R. (2006). Viewing the Viewers: Viewing Behaviors by Children and Adults During Television Programs and Commercials. *Journal of Communication*, *53*(2), 265-281. https://doi.org/10.1111/j.1460-2466.2003.tb02590.x

Schooler, J. (2011). Unpublished results hide the decline effect. *Nature*, *470*(7335), 437-437. https://doi.org/10.1038/470437a

Séguin, D., & Klimek, V. (2016). Just five more minutes please: electronic media use, sleep and behaviour in young children. *Early Child Development and Care*, *186*(6), 981-1000. https://doi.org/10.1080/03004430.2015.1071528

Shah, R. R., Fahey, N. M., Soni, A. V., Phatak, A. G., & Nimbalkar, S. M. (2019). Screen time usage among preschoolers aged 2-6 in rural Western India: A cross-sectional study. *Journal of family medicine and primary care*, *8*(6), 1999-2002. https://doi.org/10.4103/jfmpc.jfmpc_206_19

Shanley, D. C., Reid, G. J., & Evans, B. (2008). How parents seek help for children with mental health problems. *Administration and Policy in Mental Health and Mental Health Services Research*, *35*(3), 135-146. https://doi.org/10.1007/s10488-006-0107-6

Sheehan, P. W. (1983). Age Trends And The Correlates Of Children's Television Viewing. *Australian Journal of Psychology*, *35*(3), 417-431. https://doi.org/https://doi.org/10.1080/00049538308258753

Shmukler, D. (1981). A Descriptive Analysis of Television Viewing in South African Preschoolers and its Relationship to their Spontaneous Play. *South African Journal of Psychology*, *11*(3), 106-110. https://doi.org/10.1177/008124638101100303

Sterba, S. K., Prinstein, M. J., & Cox, M. J. (2007). Trajectories of internalizing problems across childhood: Heterogeneity, external validity, and gender differences. *Development and Psychopathology*, *19*(2), 345-366. https://doi.org/10.1017/S0954579407070174

Sterne, J. A. C., & Harbord, R. M. (2004). Funnel plots in meta-analysis. *Stata Journal*, *4*(2), 127-141. https://doi.org/Doi 10.1177/1536867x0400400204

Stevens, T., & Mulsow, M. (2006). There Is No Meaningful Relationship Between Television Exposure and Symptoms of Attention-Deficit/Hyperactivity Disorder. *Pediatrics*, *117*(3), 665-672. https://doi.org/10.1542/peds.2005-0863

Stiglic, N., & Viner, R. M. (2019). Effects of screentime on the health and well-being of children and adolescents: a systematic review of reviews. *Bmj Open*, *9*(1), e023191. https://doi.org/10.1136/bmjopen-2018-023191

Sugawara, M., Matsumoto, S., Murohashi, H., Sakai, A., & Isshiki, N. (2015). Trajectories of Early Television Contact in Japan: Relationship with Preschoolers' Externalizing Problems. *Journal of Children and Media*, *9*(4), 453-471. https://doi.org/10.1080/17482798.2015.1089298

Swing, E. L., Gentile, D. A., Anderson, C. A., & Walsh, D. A. (2010). Television and Video Game Exposure and the Development of Attention Problems. *Pediatrics*, *126*(2), 214-221. https://doi.org/10.1542/peds.2009-1508

Tamana, S. K., Ezeugwu, V., Chikuma, J., Lefebvre, D. L., Azad, M. B., Moraes, T. J., Subbarao, P., Becker, A. B., Turvey, S. E., Sears, M. R., Dick, B. D., Carson, V., Rasmussen, C., Pei, J., Mandhane, P. J., & Investigators, C. S. (2019). Screen-time is associated with inattention problems in preschoolers: Results from the CHILD birth cohort study. *PloS one*, *14*(4). https://doi.org/ARTN e0213995

10.1371/journal.pone.0213995

Tang, L., Darlington, G., Ma, D. W. L., Haines, J., & on behalf of the Guelph Family Health, S. (2018). Mothers' and fathers' media parenting practices associated with young children's screen-time: a cross-sectional study. *BMC Obesity*, *5*(1), 37. https://doi.org/10.1186/s40608-018-0214-4

Tansriratanawong, S., Louthrenoo, O., Chonchaiya, W., & Charnsil, C. (2017). Screen viewing time and externalising problems in pre-school children in Northern Thailand. *Journal of*

Child and Adolescent Mental Health, *29*(3), 245-252. https://doi.org/10.2989/17280583.2017.1409226

Teramoto, S., Soeda, A., Hayashi, Y., Saito, K., & Urashima, M. (2005). Problematic behaviours of 3-year-old children in Japan: Relationship with socioeconomic and family backgrounds. *Early Human Development*, *81*(6), 563-569. https://doi.org/https://doi.org/10.1016/j.earlhumdev.2004.12.011

Tomopoulos, S., Dreyer, B. P., Valdez, P., Flynn, V., Foley, G., Berkule, S. B., & Mendelsohn, A. L. (2007). Media content and externalizing behaviors in Latino toddlers. *Ambulatory Pediatrics*, *7*(3), 232-238. https://doi.org/10.1016/j.ambp.2007.02.004

Trinh, M. H., Sundaram, R., Robinson, S. L., Lin, T. C., Bell, E. M., Ghassabian, A., & Yeung, E. H. (2019). Association of Trajectory and Covariates of Children's Screen Media Time. *JAMA Pediatrics*. https://doi.org/10.1001/jamapediatrics.2019.4488

van der Voort, T. H. A., & Vooijs, M. W. (1990). Validity of children's direct estimates of time spent television viewing. *Journal of Broadcasting & Electronic Media*, *34*(1), 93-99. https://doi.org/10.1080/08838159009386729

Verlinden, M., Tiemeier, H., Hudziak, J. J., Jaddoe, V. W. V., Raat, H., Guxens, M., Hofman, A., Verhulst, F. C., & Jansen, P. W. (2012). Television Viewing and Externalizing Problems in Preschool Children The Generation R Study. *Archives of Pediatrics & Adolescent Medicine*, *166*(10), 919-925. https://doi.org/10.1001/archpediatrics.2012.653

Viemerö, V., & Paajanen, S. (1992). The role of fantasies and dreams in the TV viewing—aggression relationship. *Aggressive Behavior*, *18*(2), 109-116. https://doi.org/https://doi.org/10.1002/1098-2337(1992)18:2<109::AID-AB2480180204>3.0.CO;2-1

Wadsworth, M. E., Evans, G. W., Grant, K., Carter, J. S., & Duffy, S. (2016). Poverty and the Development of Psychopathology. *Developmental Psychopathology*, 1-44. https://doi.org/doi:10.1002/9781119125556.devpsy404

10.1002/9781119125556.devpsy404 (Major Reference Works)

Weitzman, C., Edmonds, D., Davagnino, J., & Briggs-Gowan, M. J. (2014). Young Child Socioemotional/Behavioral Problems and Cumulative Psychosocial Risk. *Infant Mental Health Journal*, *35*(1), 1-9. https://doi.org/10.1002/imhj.21421

Wimbarti, S. (2002). *Children's aggression in Indonesia: The effects of culture, familial factors, peers, TV violence viewing, and temperament* [Ph.D., University of Southern California]. ProQuest Dissertations & Theses Global. Ann Arbor.

Wong, R. S., Tung, K. T. S., Rao, N., Ho, F. K. W., Chan, K. L., Fu, K. W., Tso, W. W. Y., Jiang, F., Yam, J. C. S., Coghill, D., Wong, I. C. K., & Ip, P. (2021). A longitudinal study of the relation between childhood activities and psychosocial adjustment in early adolescence. *International Journal of Environmental Research and Public Health*, *18*(10), Article 5299. https://doi.org/http://dx.doi.org/10.3390/ijerph18105299

Woodfield, D. L. (1987). Mass media viewing habits and toleration of real-life aggression. In: ProQuest Dissertations Publishing.

Wu, X., Bastian, K., Ohinmaa, A., & Veugelers, P. (2018). Influence of physical activity, sedentary behavior, and diet quality in childhood on the incidence of internalizing and externalizing disorders during adolescence: a population-based cohort study. *Annals of Epidemiology*, *28*(2), 86-94. https://doi.org/https://doi.org/10.1016/j.annepidem.2017.12.002

Wu, X., Kirk, S. F. L., Ohinmaa, A., & Veugelers, P. (2016). Health behaviours, body weight and self-esteem among grade five students in Canada. *SpringerPlus*, *5*(1), 1099. https://doi.org/10.1186/s40064-016-2744-x

Wu, X., Tao, S., Rutayisire, E., Chen, Y., Huang, K., & Tao, F. (2017). The relationship between screen time, nighttime sleep duration, and behavioural problems in preschool children in China. *European Child & Adolescent Psychiatry*, *26*(5), 541-548. https://doi.org/10.1007/s00787-016-0912-8

Yousef, S., Eapen, V., Zoubeidi, T. K., & Mabrouk, A. (2014). Behavioral correlation with television watching and videogame playing among children in the United Arab Emirates. *International Journal of Psychiatry in Clinical Practice*, *18*(3), 203-207. https://doi.org/10.3109/13651501.2013.874442

Zahn-Waxler, C., Shirtcliff, E. A., & Marceau, K. (2008). Disorders of childhood and adolescence: Gender and psychopathology. *Annual Review of Clinical Psychology*, *4*, 275-303. https://doi.org/10.1146/annurev.clinpsy.3.022806.091358

Zimmerman, F. J., Christakis, D. A., & Meltzoff, A. N. (2007). Associations between media viewing and language development in children under age 2 years. *Journal of Pediatrics*, *151*(4), 364-368. https://doi.org/10.1016/j.jpeds.2007.04.071

Zimmerman, F. J., Glew, G. M., Christakis, D. A., & Katon, W. (2005). Early Cognitive Stimulation, Emotional Support, and Television Watching as Predictors of Subsequent Bullying Among Grade-School Children. *Archives of Pediatrics & Adolescent Medicine*, *159*(4), 384-388. https://doi.org/10.1001/archpedi.159.4.384

Table 1

Coding System of Study Variables

Variable	Coding
Screen Method	1 = Questionnaire/Interview
	2 = Daily diary
	3 = Observer/device tracking
	4 = Combination
Screen Informant	1 = Parent
	2 = Child
	3 = Observer/device
	4 = Combination
Externalizing Problems Type	1 = Externalizing problems
	2 = Hyperactivity/Inattention
	3 = Aggression
	4 = Conduct/delinquent behavior
Internalizing Problems Type	1 = General internalizing problems
	2 = Anxiety
	3 = Depression
	4 = Somatization
Behaviour Problems Informant	1 = Parent
	2 = Child
	3 = Teacher
	4 = Classmates/peers
	5 = Clinician/observer
	6 = Combination
Child Sex	% Male

Child Age	Continuous (age in months)
Socioeconomic Status	1 = Low SES 2 = Mid/High SES 3 = Mixed SES
Study Design	0 = Cross-sectional 1 = Longitudinal
Publication Year	Continuous (Year)

Table 2

Study Quality Evaluation Coding Criteria[a]

1.	Research question	Was the research question, objective, or goal clearly stated?	0 = No 1 = Yes
2.	Defined sample	Did the study clearly specify and define their sample, including demographics, time period, and location of recruitment and assessment?	0 = No 1 = Yes
3.	Participation rate	Was the participation rate of eligible persons in the study 50% or greater?	0 = No 1 = Yes
4.	Inclusion/Exclusion	Did the study provide inclusion and exclusion criteria for selection of their study population **AND** was the criteria applied consistently to all potential participants **AND** were subjects recruited from similar populations (i.e., recruited at the same time and similar place)?	0 = No 1 = Yes
5.	Sample size	Did the study provide justification for their sample size, such as a power analysis? If the study was an observational cohort study that was exploratory in nature, indicate "No".	0 = No 1 = Yes
6.	Exposure assessment	Was screen use assessed prior to assessing behaviour problems? If the study was a prospective cohort study that examined a cohort identified by exposure to screen use and compared them to a cohort with no screen use exposure, following them in time to assess for behaviour problems, code as "Yes".	0 = No 1 = Yes
7.	Timeframe	Was the timeframe between the assessment of screen use and the assessment of behaviour problems sufficient enough to expect an association should it exist? If cross-sectional, indicate "No".	0 = No 1 = Yes
8.	Levels of screen use	Did the study examine different levels of screen use as related to behaviour problems? (i.e. multiple categories of exposure or continuous measure of screen use).	0 = No 1 = Yes

9. Valid screen use measure	Was the measure of screen use clearly defined **AND** did the study provide reliability information about the measure **AND** was screen use measured consistently across participants?	0 = No 1 = Yes
10. Longitudinal	Was screen use assessed more than once?	0 = No 1 = Yes
11. Valid measure of behaviour problems	Did the study use a validated measure of child behaviour problems (e.g., CBCL, BSID, IBQ-R) **AND** were child behaviour problems measured consistently across participants?	0 = No 1 = Yes
12. Objectivity of screen use measure	Does the study use different reporters or multiple methods to measure child screen use? Multiple methods = at least 2 of the following: daily diary, questionnaire/survey, monitoring device. Multiple reporters = at least 2 of the following: child report, parent report, observer report, device report.	0 = Single reporter **AND** single method 1 = Multiple reporters **OR** multiple methods
13. Objectivity of behaviour problems measure	Does the study use different reporters or multiple methods to measure child behaviour problems? Multiple methods = at least 2 of the following: structured interview, questionnaire/survey, time sampling/observational assessment.	0 = Single reporter **AND** single method 1 = Multiple reporters **OR** multiple methods
14. Attrition	Was the attrition rate after recruitment ≤ 20%?	0 = No 1 = Yes
15. Confounds	Were potential confounding variables measured and taken into account in the analysis (i.e. adjusted for)?	0 = No 1 = Yes
16. Publication status	Was the study published in a peer-reviewed journal?	0 = No 1 = Yes

Note. CBCL = Child Behaviour Checklist; BSID = Bayley Scales of Infant Development; IBQ-R = Infant Behaviour Questionnaire-Revised.

[a] Adapted from the National Institutes of Health (NIH) Assessment Tool for Observational Cohort and Cross-Sectional Studies

Table 3

Study and Sample Characteristics

First author (Year)	*N*	Geog	Male (%)	SES	Age (screen)	Age (bhvr)	Bhvr measure	Screen type	Inform (screen)	Inform (bhvr)	Bhvr type	Study Design	Study Quality
Al-Ali (2018)	262	ME	50.0	Mixed	7.2	7.2	Qtn	VG	Parent	Parent	Ext	Cross	9
Allen (2015)													
Cohort 1	2747	SA	51.5	Mixed	6.0	8.0	Qtn	Mix	Parent	Parent	Int, Ext	Long	13
Cohort 2	2504	SA	51.1	Mixed	10.0	12.0	Qtn	Mix	Parent	Parent	Int, Ext	Long	13
Amawi (2018)	190	ME	50.0	Mixed	7.3	7.3	Qtn	Mix	Parent	Parent	Ext	Cross	9
Barlett (2012)	1029	NA	47.0	-	9.6	10.7	Qtn	Mix	Child	Teacher	Ext	Cross	12
Byun (2013)	1757	Asia	51.0	Mixed	8.9	10.6	Qtn	VG	Parent	Parent	Ext	Long	12
Cao (2018)	15291	Asia	53.7	Mixed	4.9	4.9	Qtn	TV	Parent	Parent	Ext	Cross	9
Chonchaiya (2015)	194	Asia	50.5	Mid/Hi	1.5	1.5	Qtn	TV	Parent	Parent	Int, Ext	Long	13
Christakis (2004)	1278	NA	50.0	Mid/Hi	1.1	7.0	Qtn	TV	Parent	Parent	Ext	Long	13
Coker (2015)	5147	NA	51.0	Mixed	10.5	10.5	Struct Ax	Mix	Child	Parent	Int, Ext	Cross	9
Cooper (2004)	15	NA	50.0	Mid/Hi	10.5	10.5	Struct Ax	Comp	Child	Parent	Int	Cross	8
Davison (2004)	64	NA	40.3	-	11.0	11.0	Qtn	Mix	Child	Combo	Ext	Cross	10
Ebenegger (2012)	450	EU/UK	47.8	-	5.2	5.2	Qtn	TV	Parent	Parent	Ext	Cross	10
Erdogan (2006)	356	EU/UK	48.9	-	6.0	6.0	Qtn	TV	Parent	Parent	Int, Ext	Cross	10
Froiland (2016)	1343	NA	50.3	Mixed	3.7	3.7	Dx	TV	Parent	Parent	Ext	Cross	10
Gentile (2017)													
6-month lag	408	NA	49.0	-	9.7	10.2	Qtn	Mix	Child	Combo	Ext	Long	14
13-month lag	922	NA	47.0	-	9.6	9.6	Qtn	Mix	Child	Combo	Ext	Long	14
Guxens (2019)	2617	EU/UK	50.0	Mixed	5.0	5.0	Qtn	Mix	Parent	Teacher	Int, Ext	Cross	10
Hastings (2009)	70	NA	50.0	Mid/Hi	7.8	7.8	Qtn	VG	Parent	Parent	Ext	Cross	7
Hefner (2013)	151	NA	57.0	-	8.5	8.5	Qtn	TV	Parent	Parent	Ext	Cross	9
Holton (2016)	287	NA	58.0	-	10.3	10.3	Dx	Mix	Parent	Clin/Coder	Ext	Cross	9
Hosokawa (2018)	1642	Asia	51.2	Mixed	6.9	6.9	Qtn	Phone	Parent	Parent	Int, Ext	Cross	7
Huesmann (1984)													

Australia	300	AUS/NZ	50.0	-	7.0	10.0	Obs Rep	TV	Child	Peers	Ext	Long	9
Finland	200	EU/UK	50.0	-	7.0	10.0	Obs Rep	TV	Child	Peers	Ext	Long	9
Israel	200	ME	50.0	-	7.0	10.0	Obs Rep	TV	Child	Peers	Ext	Long	9
Poland	200	EU/UK	50.0	-	7.0	10.0	Obs Rep	TV	Child	Peers	Ext	Long	9
USA	800	NA	50.0	-	7.0	10.0	Obs Rep	TV	Child	Peers	Ext	Long	9
Jia (2016)	1382	Asia	55.1	Mixed	5.0	5.0	Qtn	TV	Parent	Parent	Ext	Cross	10
Linebarger (2015)													
Preschool age	788	NA	53.9	Mixed	3.9	3.9	Qtn	VG	Parent	Parent	Ext	Cross	10
School age	391	NA	51.5	Mixed	7.0	7.0	Qtn	VG	Parent	Parent	Ext	Cross	10
Lobel (2017)	194	EU/UK	50.5	-	9.2	9.2	Qtn	VG	Child	Parent	Int, Ext	Cross	13
Manganello (2009)	3128	NA	47.0	Low	3.0	3.0	Qtn	TV	Parent	Parent	Ext	Cross	10
Martin (2012)	842	NA	53.0	Low	2.5	5.0	Qtn	TV	Parent	Parent	Int, Ext	Long	11
Martins (2012)	525	NA	46.3	Mixed	7.8	7.8	Qtn	TV	Child	Child	Ext	Cross	10
McNeill (2019)	156	AUS/NZ	60.5	Mixed	4.2	5.2	Qtn	Mix	Parent	Teacher	Int, Ext	Long	12
Miller (2006)	170	NA	61.8	Mid/Hi	4.3	4.3	Qtn	TV	Parent	Teacher	Ext	Cross	11
Miller (2012)	150	NA	49.3	Low	3.6	3.6	Qtn	TV	Parent	Parent	Ext	Cross	10
Mistry (2007)	528	NA	45.5	Mixed	4.0	5.5	Qtn	TV	Parent	Parent	Int, Ext	Long	10
Moyer (2008)	104	NA	53.3	-	10.5	10.5	Qtn	VG	Child	Child	Ext	Cross	9
Mundy (2017)	876	AUS/NZ	45.76	Mixed	9.0	9.0	Qtn	Mix	Parent	Parent	Int, Ext	Cross	9
Nikkelen (2015)	865	EU/UK	48.0	Mixed	5.4	5.4	Qtn	TV	Parent	Parent	Ext	Cross	10
Obel (2004)	76	EU/UK	50.0	-	3.5	10.5	Qtn	TV	Parent	Combo	Ext	Long	10
Özmert (2002)	689	EU/UK	49.8	Mixed	8.0	8.0	Qtn	TV	Parent	Parent	Int, Ext	Cross	9
Parkes (2013)	1104	EU/UK	48.9	Mixed	5.0	7.0	Qtn	Mix	Parent	Parent	Int, Ext	Long	12
Paulus (2018)	1267	EU/UK	49.9	Mixed	5.8	5.8	Qtn	VG	Parent	Parent	Ext	Cross	9
Peralta (2018)	443	EU/UK	51.2	Mixed	4.4	7.0	Qtn	TV	Parent	Parent	Ext	Long	13
Poulain (2018)	537	EU/UK	52.0	Mid/Hi	3.8	4.8	Qtn	Mix	Parent	Parent	Int, Ext	Long	12
Reynolds (1978)	108	NA	49.0	Mid/Hi	8.5	8.5	Obs Rep	TV	Child	Combo	Ext	Cross	9
Rosen (2014)	676	NA	51.0	-	8.3	8.3	Qtn	Mix	Parent	Parent	Int, Ext	Cross	9
Sanders (2016)													
Older children	200	NA	55.0	Mixed	10.0	10.0	Qtn	Mix	Parent	Parent	Int, Ext	Cross	10
Younger children	210	NA	52.0	Mixed	5.0	5.0	Qtn	Mix	Parent	Parent	Int, Ext	Cross	10
Schaefer (1991)	60	NA	78.7	-	7.6	7.6	Dx	TV	Parent	Clin/Coder	Ext	Cross	8

Schmiedeler (2014)	494	EU/UK	53.0	Mixed	4.4	7.9	Qtn	TV	Parent	Combo	Ext	Long	13
Séguin (2016)	50	NA	51.9	-	3.8	3.8	Qtn	TV	Parent	Parent	Int, Ext	Cross	9
Sheehan (1983)													
Cohort 1	106	AUS/NZ	51.0	Mid/Hi	6.1	6.1	Qtn	TV	Child	Peers	Ext	Long	11
Cohort 2	120	AUS/NZ	52.5	Mid/Hi	8.2	8.2	Qtn	TV	Child	Peers	Ext	Long	11
Shmukler (1981)	81	Africa	55.5	Mid/Hi	3.8	4.3	Obs Rep	TV	Parent	Clin/Coder	Ext	Long	11
Stevens (2006)													
Cohort 1	2500	NA	50.0	-	5.0	6.0	Qtn	TV	Parent	Combo	Ext	Long	14
Cohort 2	2500	NA	50.0	-	5.0	6.0	Qtn	TV	Parent	Combo	Ext	Long	14
Sugawara (2015)	746	Asia	52.9	Mixed	2.5	5.0	Qtn	TV	Parent	Parent	Ext	Long	10
Swing (2010)	1323	NA	47.0	-	9.6	10.7	Qtn	Mix	Combo	Teacher	Ext	Long	10
Tamana (2019)	2427	NA	52.3	Mid/Hi	5.0	5.0	Qtn	Mix	Parent	Parent	Int, Ext	Cross	9
Tansriratanawong (2017)	118	Asia	51.7	Mid/Hi	4.1	4.1	Qtn	Mix	Parent	Parent	Int, Ext	Cross	9
Teramoto (2005)	670	Asia	50.0	Mixed	3.5	3.5	Qtn	TV	Parent	Parent	Int, Ext	Cross	9
Tomopoulos (2007)	75	NA	50.0	-	1.8	2.8	Qtn	Mix	Parent	Parent	Ext	Long	12
Verlinden (2012)	3309	EU/UK	48.4	Mixed	2.0	3.0	Qtn	TV	Parent	Parent	Ext	Long	11
Viemerö (1992)	391	EU/UK	46.8	-	9.5	9.5	Qtn	TV	Child	Peers	Ext	Cross	7
Wimbarti (2002)	58	Asia	56.9	Mid/Hi	5.3	5.3	Obs Rep	TV	Parent	Clin/Coder	Ext	Cross	8
Woodfield (1987)	112	NA	46.4	-	9.4	9.4	Qtn	TV	Parent	Teacher	Ext	Cross	7
Wu (2016)	2956	NA	49.2	Mixed	10.5	10.5	Qtn	Mix	Parent	Child	Int, Ext	Cross	9
Wu (2017)	8900	Asia	52.9	Mixed	4.4	4.4	Qtn	Mix	Parent	Parent	Int, Ext	Cross	8
Yousef (2014)	197	ME	66.0	Mixed	8.7	8.7	Qtn	Mix	Combo	Parent	Int, Ext	Cross	7
Zimmerman (2005)	1266	NA	51.3	Mixed	4.0	9.2	Qtn	TV	Parent	Parent	Ext	Long	11
Zimmerman (2007)	933	NA	50.0	-	3.2	8.2	Qtn	TV	Parent	Parent	Ext	Long	12

Table 4

Moderator Analyses for the Associations Between Screen Time and Externalizing Problems

Categorical Moderators	*k*	*r*	95% CI	*Q*	Contrast *p*
Externalizing Type				8.35	.004
Aggression	21	.17***	.13, .20		
Attention/Hyperactivity	19	.09***	.06, .13		
Socioeconomic Status				2.95	.229
Low	3	.13***	.05, .20		
Mid/High	12	.13***	.08, .19		
Mixed	31	.09***	.06, .11		
Study Design				1.59	.208
Cross-sectional	42	.13***	.10, .15		
Longitudinal	30	.10***	.08, .13		
Screen Time Measure Method				5.29	.071
Activity Log	8	.15***	.09, .20		
Interview	6	.18***	.11, .25		
Questionnaire	58	.11***	.09, .13		
Screen Time Informant				9.61	.002
Child	17	.17***	.13, .21		
Parent	53	.10***	.09, .12		
Externalizing Measure Method				8.56	.014
Diagnosis/Structured Interview	4	.16***	.08, .23		
Observer Report	8	.20***	.14, .26		
Questionnaire	60	.11***	.09, .13		
Externalizing Informant				20.24	.001
Child	3	.10*	.01, .18		
Clinician/Coder	4	.29***	.18 .39		
Peers	8	.20***	.14, .26		
Teacher	6	.12***	.06, .18		
Combination	8	.09**	.04, .14		
Parent	43	.10***	.08, .13		

Continuous Moderators	*k*	*b*	SE	*z* Score	*p*
% Male	72	.012	.003	4.85	<.001
Age at Screen Assessment	72	.001	.0003	2.05	.041
Age at Externalizing Assessment	72	.0003	.0003	0.94	.348
Publication Year	72	-.003	.001	-3.19	.001
Study Quality	72	-.014	.005	-2.96	.003

Table 5

Moderator Analyses for the Association Between Screen Time and Internalizing Problems

Categorical Moderators	***k***	***r***	**95% CI**	***Q***	**Contrast *p***
Study Design				1.41	.235
Cross-Sectional	18	.09***	.05, .13		
Longitudinal	8	.05	-.002, .11		
Socioeconomic Status				1.30	.255
Mid/High	5	.02	-.08, .12		
Mixed	16	.08***	.04, .12		
Screen Time Informant				7.82	.005
Child	3	.17***	.097, .23		
Parent	22	.06***	.04, .086		
Continuous Moderators	***k***	***b***	**SE**	***z* Score**	***p***
% Male	26	.008	.004	1.79	.074
Age at Screen Assessment	26	.0003	.001	0.62	.536
Age at Internalizing Assessment	26	.0001	.001	0.11	.880
Publication Year	26	-.0003	.004	-0.08	.934
Study Quality	26	-.005	.009	-0.53	.595

Note. * $p < .05$; ** $p < .01$; *** $p < .001$. Moderators with too few cells (i.e., < 3 studies for one or more categories) included specific internalizing type, screen time measurement method, internalizing measurement method, and internalizing problems informant.

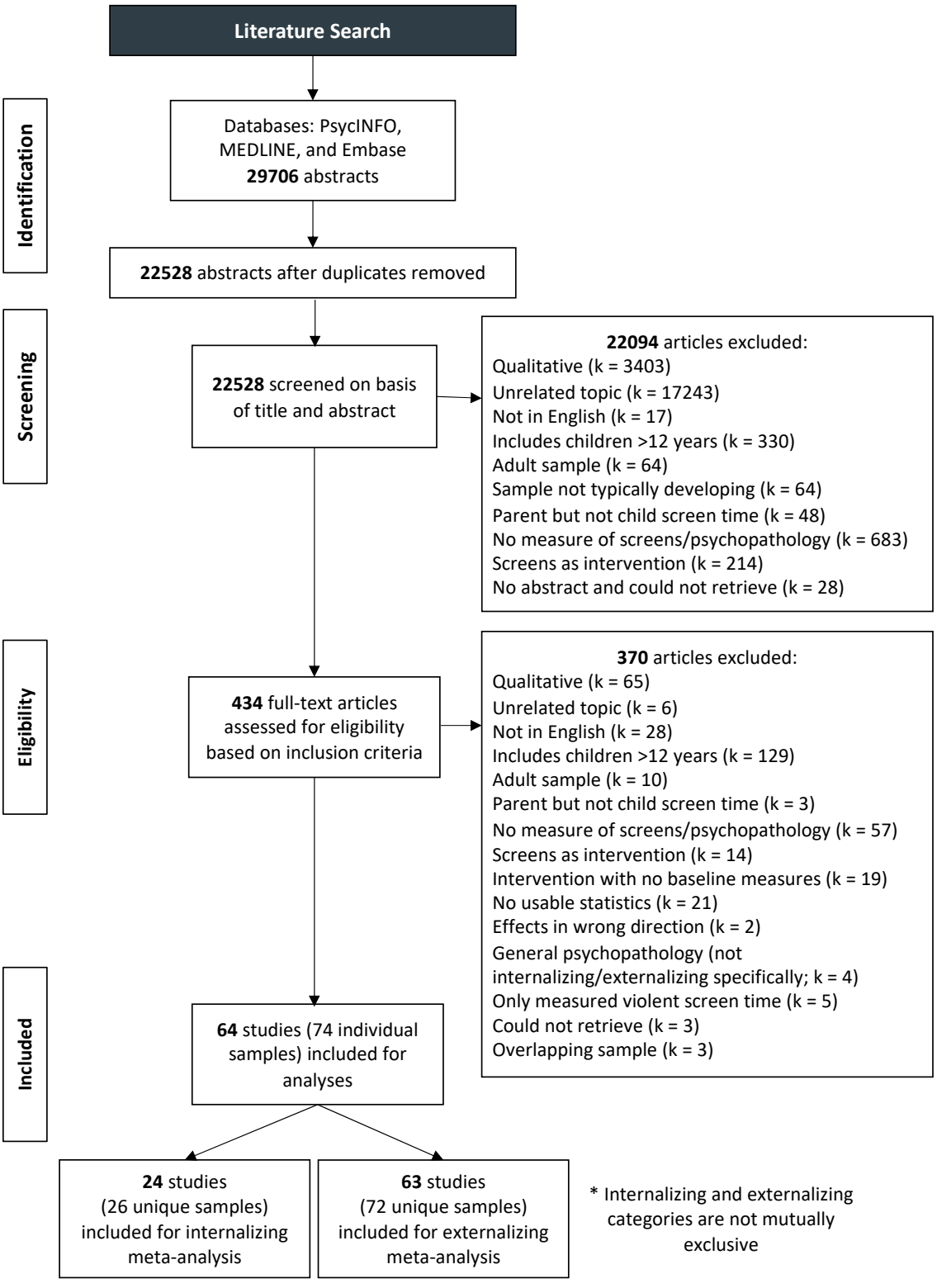

Figure 1. PRISMA flow diagram

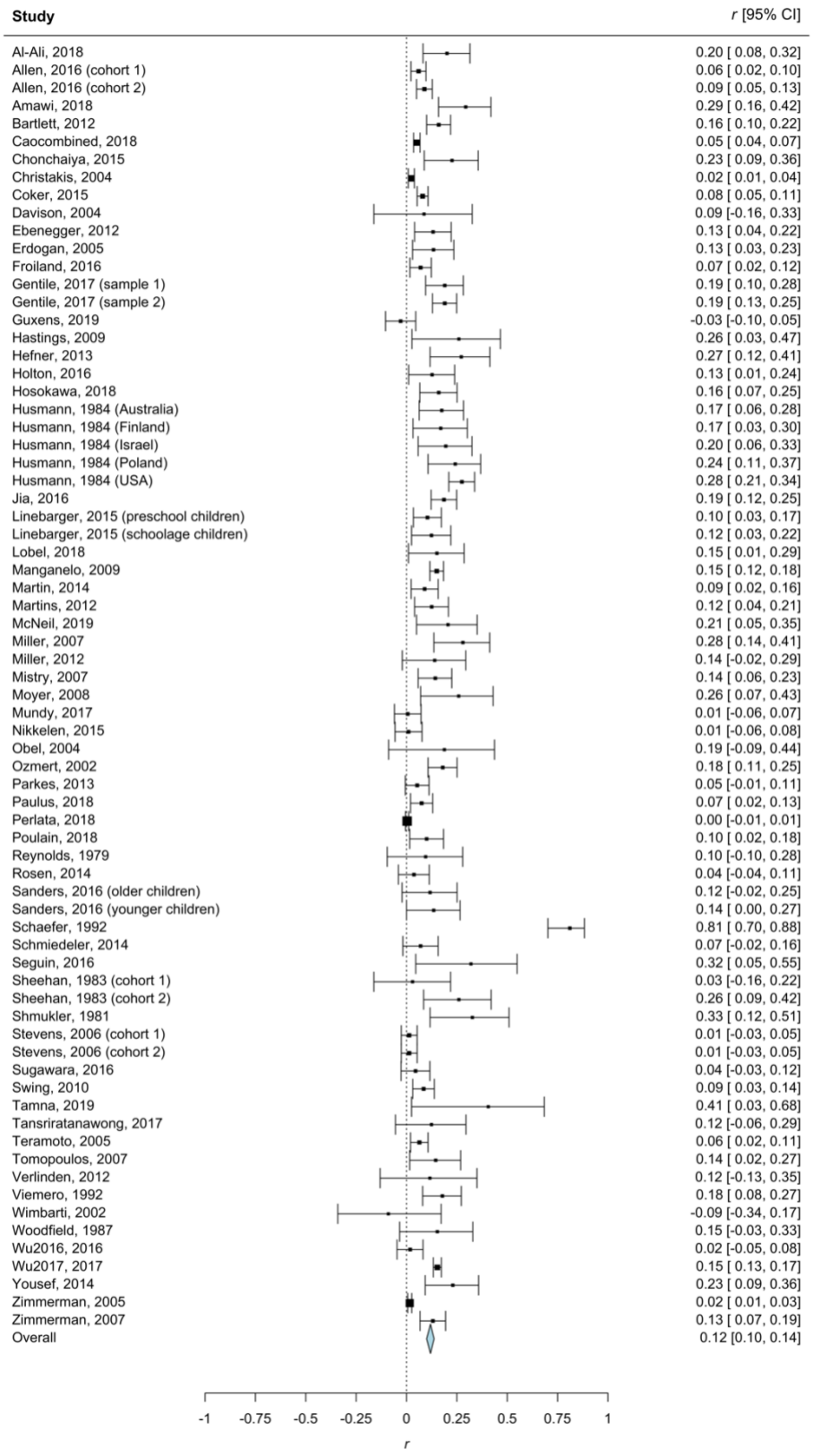

Figure 2. Screen Time and Externalizing Problems Meta-Analysis Forest Plot

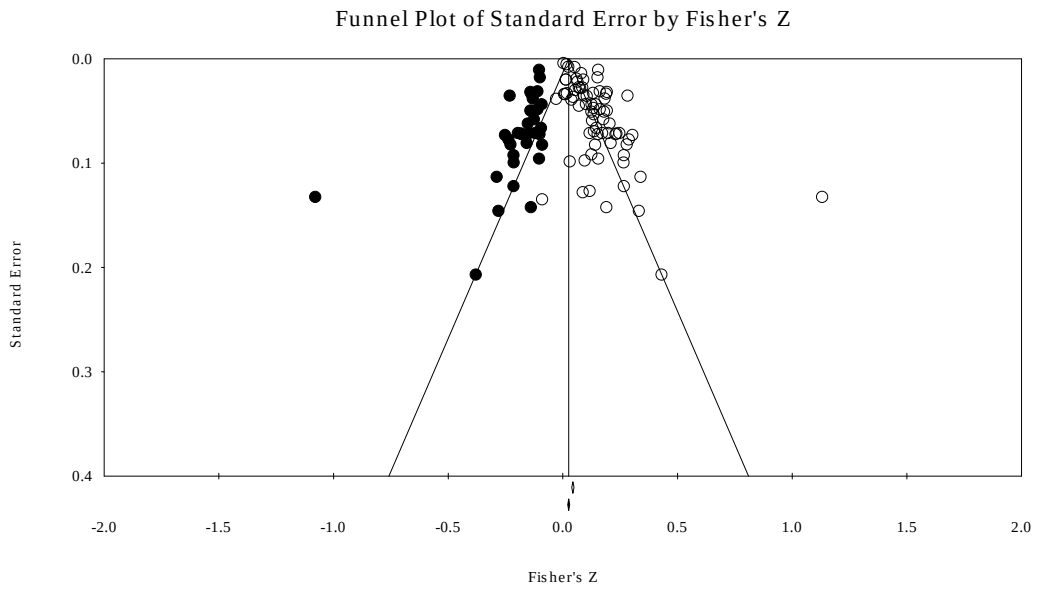

Figure 3. Funnel Plot Depicting Standard Error by Fisher's Z of Included Studies in Meta-Analysis of Screen Time and Externalizing Problems.

Legend: The funnel plot is a measure of study size (y-axis) as a function of effect size (x axis). Observed studies are indicated by white circles, while dark circles indicate their imputed counterparts when asymmetry is detected. The middle vertical line is the mean prevalence estimate, and the contour lines (to its left and right) represent the region within which 95% of observed studies should lie in the absence of publication bias. The white diamond represents the observed mean effect size, and the black diamond represents the adjusted mean effect size (in the event of asymmetry). Studies with large sample sizes appear toward the top of the graph, and tend to cluster near the mean effect size, whereas studies with smaller sample sizes appear to the bottom-middle right of the graph. Due to the tendency to have more sampling variation in effect size estimates in studies with smaller sample sizes, these studies will be dispersed across a range of values (bottom-middle right of plot).

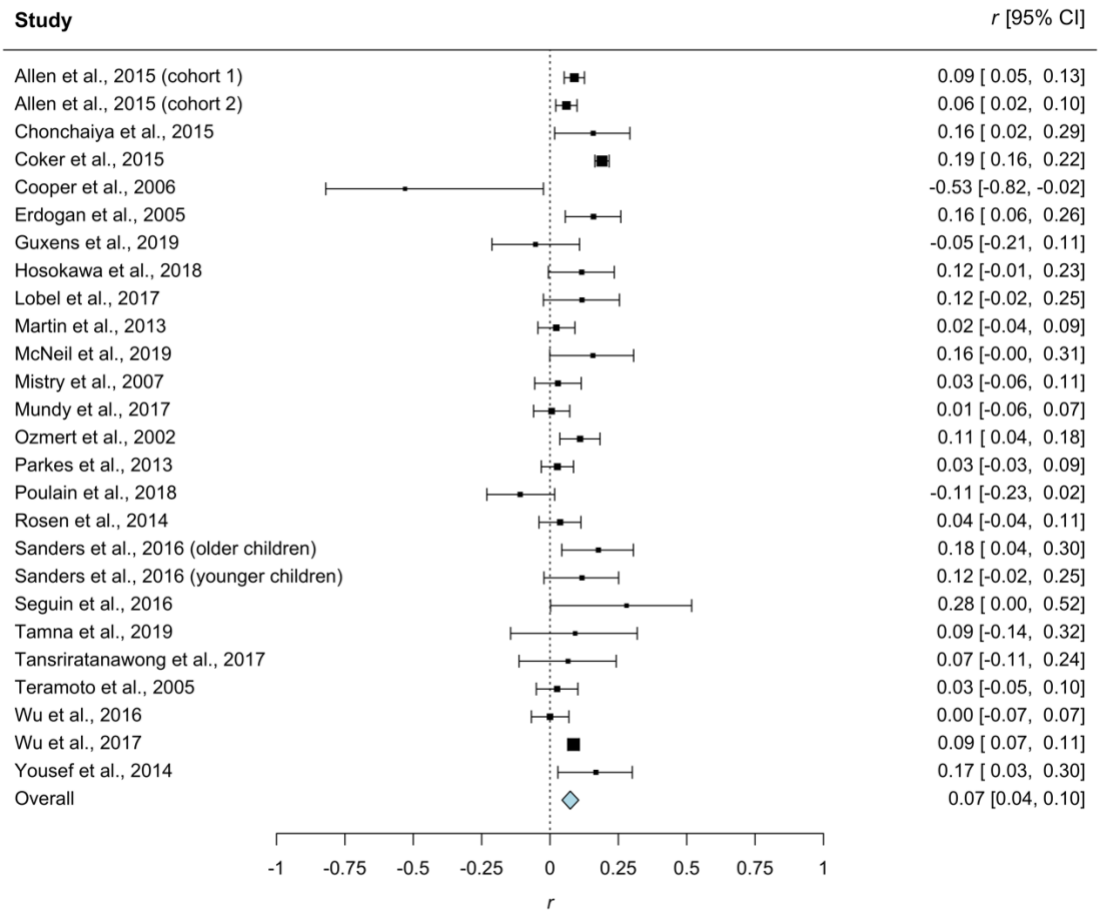

Figure 4. Screen Time and Internalizing Problems Meta-Analysis Forest Plot

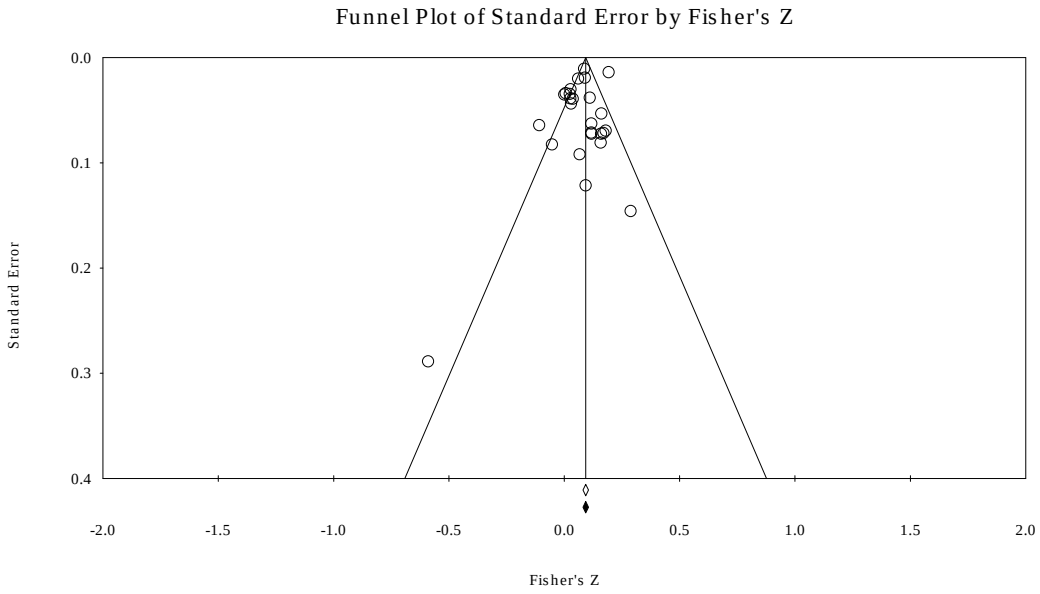

Figure 5. Funnel Plot Depicting Standard Error by Fisher's Z of Included Studies in Meta-Analysis of Screen Time and Internalizing Problems

Legend: The funnel plot is a measure of study size (y-axis) as a function of effect size (x axis). Observed studies are indicated by white circles, while dark circles indicate their imputed counterparts when asymmetry is detected. The middle vertical line is the mean prevalence estimate, and the contour lines (to its left and right) represent the region within which 95% of observed studies should lie in the absence of publication bias. The white diamond represents the observed mean effect size, and the black diamond represents the adjusted mean effect size (in the event of asymmetry). Studies with large sample sizes appear toward the top of the graph, and tend to cluster near the mean effect size, whereas studies with smaller sample sizes appear to the bottom-middle right of the graph. Due to the tendency to have more sampling variation in effect size estimates in studies with smaller sample sizes, these studies will be dispersed across a range of values (bottom-middle right of plot).