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University of Southampton

Faculty of Environmental and Life Sciences

School of Psychology

**Examining the Relationship Between Children's Screen Use and Externalising
Behaviours**

by

Chloe Dickel BSc (Hons) MSc

Thesis for the degree of Doctorate in Clinical Psychology

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Abstract

Children's screen use and its relationship with young people's mental health has received significant attention in recent years. The research conducted in this area is often cross-sectional in design and therefore unable to explore the bi-directional relationship between these two constructs.

The first chapter is a meta-analysis of existing screen time literature and its relationship with externalising behaviours in children aged 4 – 18 years. Child age, screen type, type of measure and reporter of measure were included as moderators. The meta-analysis included 17 studies including a total of 15,448 young people. The overall association between children's screen use and externalising behaviours was significant but small, $Z = 0.117$ (95% Confidence Interval [CI] = 0.061 – 0.173, $p < .001$). Screen type, type of measure were significant moderators of this relationship. The current meta-analysis suggests that there is a relationship between children's screen use and externalising behaviours which is moderated by screen type, reporter of externalising measure and type of externalising measure. The review highlights a number of methodological limitations of the studies included and suggests further research is conducted before screen use guidelines for children over five are implemented.

The second chapter is an empirical study on pre-schoolers' screen use and externalising behaviours during the Covid-19 pandemic in England. The study aimed to overcome some of the methodological limitations of previous studies by employing a longitudinal design and using cross-lagged analysis to explore the bi-directional association between pre-schoolers screen use and externalising behaviours. Types of screen use, active and passive, were also explored separately. The study was conducted using data from the Co-Spyce dataset. The results showed one cross-lagged effect; increases in active screen use at baseline significantly predicted externalising behaviours at one month follow-up ($\beta = 0.25$, $p = .013$). This relationship was not bi-directional. There was no over-time relationship between passive screen use and externalising behaviours but there was a within-time relationship. Active screen use significantly predicts externalising behaviour overtime whilst passive screen use does not. The strength of this relationship is weak but suggests that the mechanisms underlying the relationship between active and passive screen use and externalising behaviour differs.

Keywords: pre-schoolers, children, screen use, externalising behaviours

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Research Thesis: Declaration of Authorship

Print name: Chloe Dickel

Title of thesis: Examining The Relationship Between Children's Screen Use and Externalising Behaviours

I declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;
2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;
3. Where I have consulted the published work of others, this is always clearly attributed;
4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;
5. I have acknowledged all main sources of help;
6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;
7. None of this work has been published before submission.

Signature:

Date: 5th June 2021

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Definitions and Abbreviations

CBCL	Child Behaviour Checklist
CI.....	Confidence Interval
Co-Spyce.....	Covid-19: Supporting Parents and Young Children during Epidemics
M.....	Mean
NHS.....	National Health Service
R.....	Statistical Software
SD.....	Standard Deviation
SDQ.....	Strengths and Difficulties Questionnaire
WHO	World Health Organisation
Z	Fisher's Z Transformation

Chapter 1 Screen Time and Externalising Problems in Primary Aged Children: A Meta-Analysis

The following paper has been prepared in line with author guidelines for the Journal of Child Psychiatry and Psychology.

Abstract

Background;

Young people's screen use and its link with their mental health is a topical subject and cause of concern amongst parents and politicians. Screen use guidelines recommend restricting the use of screens in children under five, however, there are not any suggestions for older children.

Methods;

We conducted a meta-analysis of studies exploring the relationship between screen use and externalising behaviours as measured by the Strengths and Difficulties Questionnaire or the Child Behaviour Checklist in children between 4 and 18 years. Child age, screen type, type of measure and reporter of measure were included as moderators.

Results;

We included 17 studies with a total of 15,448 young people. The overall association between children's screen use and externalising behaviours was significant but small, $Z = 0.117$ (95% Confidence Interval [CI] = 0.061 – 0.173, $p < .001$). Screen type and type of measure were significant moderators of this relationship.

Conclusions;

The current meta-analysis suggests that there is a relationship between children's screen use and externalising behaviours which is moderated by screen type, reporter of externalising measure and type of externalising measure. The review highlights a number of methodological limitations of the studies included and suggests further research is conducted before screen use guidelines for children over five are implemented.

Keywords; screen use, children, young people, externalising behaviour

Introduction

Children and young people's screen use is a topical subject and a cause of concern particularly in relation to their mental health (Davies, Atherton, Calderwood & McBride, 2019). In a recent survey, over two thirds of parents of children aged 11 years and younger expressed concern that their child may spend too much time in front of screens (Auxier, Anderson, Perrin & Turner, 2020). Leisure time use of screens, thus not accounting for school or homework, amongst 8 – 12 year olds has been reported to exceed 4.5 hours each day whilst for 13-18 year it is almost 7.5 hours (Rideout & Robb, 2019). It is not only the amount of time young people are exposed to screens that is causing concern. As children grow, so too does the diversity of screens and content they witness. Three decades ago, it would have been common place to have one television in the familial home which was shared in a communal area. Now, by the time a child reaches the age of 6 years they are likely to have access to a TV, tablet and computer within the family home and own their own smart phone by the age of 12 (Ibbetson, 2020).

Inflammatory media headlines appear to contribute to the commonly held belief that screen use can have a negative impact on children and young people causing concern amongst parents, educators and politicians (Ofcom, 2019). Consequently, the ostensible risk of excessive screen time has been researched considerably. Whilst the theoretical underpinnings of the link between childhood screen time and psychopathology remain ambiguous, there is evidence emerging which implicates brain structure. Paulus and colleagues (2019) tested the maturational coupling hypothesis (i.e. the concept that synchronised patterns of structural changes to the brain correspond with certain behaviours) and its association with psychopathology in 4277 adolescents. They found that some regions of the brain are associated with screen media activity and that some of these are linked to increased externalising difficulties amongst youth. This finding is novel and promising in developing our understanding of the link between screen time and psychopathology.

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In an attempt to protect children's health, including mental health and wellbeing, guidelines recommending restrictions on the use of screens have been developed. The World Health Organisation (WHO; 2019) state that screen time is not recommended for children under two years whilst those between two and four years should not be exposed to more than an hour each day. In the UK, the Royal College of Paediatrics and Child Health (RCPCH, 2019) guidelines for screen time do not stipulate specific screen time cut-offs, due to the limited robustness of the evidence. Instead, they advocate for screen time being controlled within the household and ensuring that screen time does not interfere with other family activities or sleep. Consequently, current guidelines are limited by their predominant focus on those under the age of 5 years. Furthermore, research by Martin-Biggers et al. (2015) prior to the publication of the WHO and RCPCH guidelines, found that despite parental worries around screen time previous guidelines had largely been ignored. In their study, 133 parents of pre-school children cited the following reasons for non-adherence to screen time guidelines: few affordable alternative entertainment options, parental fatigue, the need to prioritise house-hold chores and adverse weather.

Polanczyk, Salum, Sugaya, Caye, & Rohde (2015) conducted a meta-analysis of prevalence estimates of mental health disorders amongst children and young people, which included 41 studies from 27 countries of origin. They established that the worldwide prevalence of mental health disorders in children and young people was 13.4%, anxiety disorders being most prevalent (6.5%). Research in the UK highlights that prevalence estimates appear to be increasing over time. In 1999, the number of 5-15 year olds with a mental health disorder was reported at 9.7% and this figure increased to 10.1% in 2004, 11.2% in 2017 and 16% in 2020 (NHS Digital, 2017; NHS Digital, 2020). These reports also suggest that emotional disorders are more common in girls whilst behavioural and hyperactivity disorders are more common in boys. The research exploring the link between children's screen use and mental health outcomes has predominantly been cross-sectional

and those which have used a longitudinal design have only focussed on a uni-directional relationship (Dickson et al., 2018) and shown inconclusive findings.

Research examining the role of screen time in children's externalising behaviours is often of limited quality. Media portrayal of young people's screen time is frequently misconstrued as it implies causation which cannot be inferred from the correlational research that informs the reports. Small effect sizes tend to be misinterpreted and statistically significant results rather than meaningful effects are focussed upon (Kardefelt-Winther, 2019). Screen time literature is also impacted by the reliance on self-reported measures which are prone to social desirability effects and the reliability of participant memory (Abeele, Beullens & Roe, 2013; Grondin, 2010). Finally, studies typically fail to distinguish between types (e.g. active vs passive) and content (e.g. violent, prosocial, educational) of screen use (Kaye, Orben, Ellis, Hunter, & Houghton, 2020). As a result, conclusions are drawn and generalised to all types of screen use. However, evidence suggests, for example, that educational TV content has a positive impact on children's behaviour, literacy and cognition (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001) and socially interactive content can ameliorate a child's ability to acquire new words compared to passively watching the word on a screen (Roseberry, Hirsh-Pasek & Golinkoff, 2013). It is important, therefore, to distinguish between the type and content of screen use as generalisation of findings universally is not warranted. Ultimately, current scientific research is too inconclusive to underpin evidence-based guidelines on children's screen use (Gottschalk, 2019).

A review of the literature on the relationship between children's screen use and externalising behaviours is necessary to establish whether existing literature demonstrates a strong and significant relationship between these two constructs. A review will also aid our understanding around the types and content of screen use that are related to externalising behaviours and how consistently these are being assessed. The current review aims to

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synthesise the literature on the relationship between children's screen time and externalising behaviours. It is intended to add to existing literature by including the type of screen (e.g. TV, computer, mobile device) and type of media as moderators where the studies under review have included this information. The review includes other moderators of interest including child age, reporter of screen use, reporter of externalising measure and scale of externalising behaviour.

Method

Protocol

This review was pre-registered with the International Prospective Register of Systematic Reviews (PROSPERO; Registration ID. CRD42020193674) and was guided and reported by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA, n.d.). We modified the original protocol to account for the narrower scope of this review. The focus of the current review is on the relationship between screen time and externalising behaviour. Those studies which met the criteria in our registered protocol but focussed on behaviour more broadly and/or cognition, but not externalising behaviour, will be reported independently.

Eligibility Criteria

Eligible studies included children between the ages of four and 11 years, published in peer reviewed journals and written in English. Studies were required to include either a retrospective or tracking measure of screen use (i.e. television, computer, video games, smart phones) reported by the child, parent/guardian or teacher as well as a validated measure of externalising behaviour (i.e. Strengths and Difficulties Questionnaire [SDQ; Goodman, 1997] or Child Behaviour Checklist [CBCL; Achenbach & Edelbrock, 1983]). Other measures of externalising behaviour were included in the screening phase, however, we excluded them due to concerns over validity and their relatively infrequent use. Studies

which reported solely qualitative data, review papers and studies in which screen use was an intervention were excluded from analysis.

Information Sources and Search Terms

After conducting scoping searches, the following four databases were searched for relevant literature published between 1980 and November 2020; PsycINFO and Medline (EBSCO platform), Embase (Ovid platform) and Web of Science. Search terms were adapted from those used by Poitras et al. (2017) and were checked by a research librarian specialising in systematic reviews. Appendix A contains the search syntax used for each database.

Outcome Measures

The primary outcome of the current review was externalising behaviour measured by one of two validated questionnaires; SDQ or CBCL. Externalising behaviour, operationalised by these measures, includes; conduct, delinquency, aggression and hyperactivity/inattention.

Study Selection

Two reviewers (the candidate and an undergraduate Psychology student) independently conducted title and abstract screening. Full text papers considered eligible by either reviewer at title and abstract screening were obtained where possible. Disagreements regarding eligibility at full text screen were discussed with a third reviewer (one of the candidate's supervisors). There was 81% agreement between raters. Disagreements predominantly centred on the age group included in the studies and agreements were reached following discussion between the three reviewers.

Study Quality Assessment

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We used the Standard Quality Assessment Criteria for Evaluating Primary Research Papers from a Variety of Fields (Kmet, Lee & Cook, 2004) as it is appropriate for assessing research quality across an array of study designs. This tool includes 14 criteria by which to rate each study. Three criteria were not applicable to the studies used in our analysis because they focus on experimental designs and were excluded. Each criterion is rated on a three-point Likert scale; 0 (not met), 1 (partially met) and 2 (met). A total summary score, between 0 and 1, for each study was derived from the sum of scores for each item and divided by the total achievable score. The quality ratings for included studies are presented in Appendix B. Quality ratings for all 17 studies was high ranging from 0.73 to 1.00.

Data Extraction and Statistical Analysis

Appendix C details the extracted data including outcomes and relevant participant and study characteristics. The primary researcher wrote to 49 authors of 49 studies to request additional information and received three responses. Given our aim to understand the relationship between screen use and externalising behaviours, we opted to use zero-order Pearson's correlation co-efficient (r) as our effect size. Borenstein, Hedges, Higgins & Rothstein (2009) recommend standardising the correlation coefficient r to generate summary effects, confidence intervals and variance. Thus, for papers which reported either odds ratios or d as their effect size, we converted these to r using equations recommended by Borenstein et al. (2009) and inputted these values into the 'Practical Meta-Analysis Effect Size Calculator' (Wilson, n.d.) to obtain confidence intervals and variance.

RStudio (RStudio Team, 2021) was used to conduct statistical analysis. The following packages were employed; 'metafor' for meta-analysis and 'robumeta' for meta-analyses of dependent effect sizes (Fisher & Tipton, 2015). The t^2 and I^2 statistics were used as an estimate of between-study heterogeneity. More than one effect size (e.g. hyperactivity/inattention and conduct) was reported in 14 studies, which were therefore a

violation of the independence assumption in meta-analysis. Robust variance estimation was used to address dependency by modifying standard errors to account for associations between effects within studies (Hedges, Tipton, & Johnson, 2010).

Publication Bias

We used Egger's test (Egger, Smith, Schneider, & Minder, 1997) and a funnel plot (Viechtbauer, 2010) to measure publication bias.

Results

Included Studies

A total of 54 studies met our inclusion criteria (Figure 1 illustrates the PRISMA flowchart of included studies). We obtained data from five studies and e-mailed 49 authors to request additional data. Three authors responded to our request, all of whom gave the

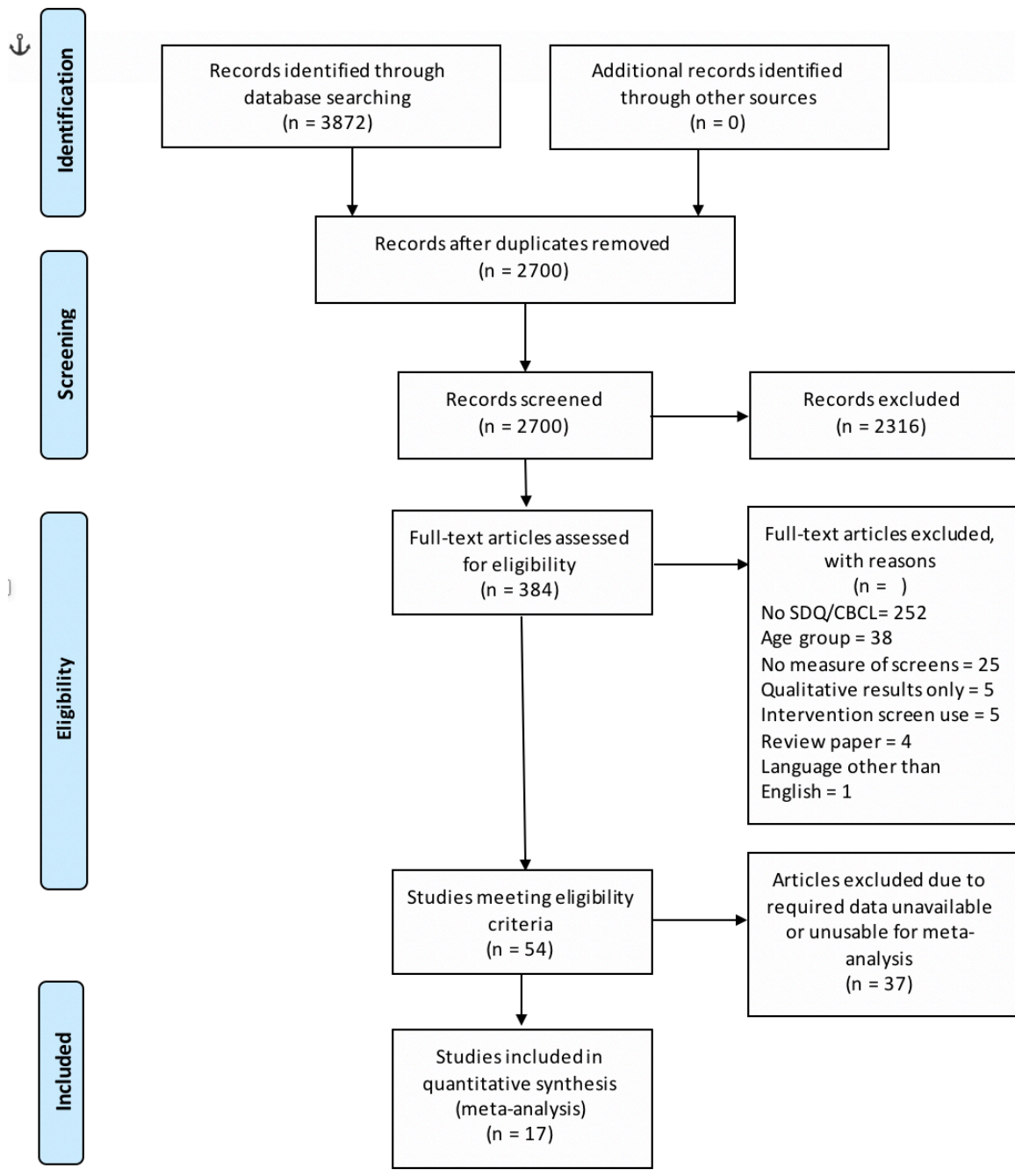


Figure 1. PRISMA Flowchart.

data we requested. We were able to transform data from an additional nine papers using an effect size calculator. Consequently, we had data for 17 studies including 45 effect sizes with a total of 15,448 participants available for meta-analysis.

Sensitivity Analysis

Sensitivity analyses were executed and indicated that the effect sizes and Tau^2 did not differ according to the size of rho.

Main Analysis

Initially, the robust variance meta-analysis examined the overall association between children's screen use and externalising problems and gave a small significant association. The overall intercept model showed a point estimate of $Z = 0.117$ (95% Confidence Interval [CI] = 0.061 – 0.173, $p < .001$). Heterogeneity was high: $I^2 = 89.12\%$. A visual representation of the analysis is available by means of forest plot (Figure 2).

Moderation Analyses

Further analysis was undertaken to establish whether the relationship between child screen use and externalising behaviours was moderated by other variables.

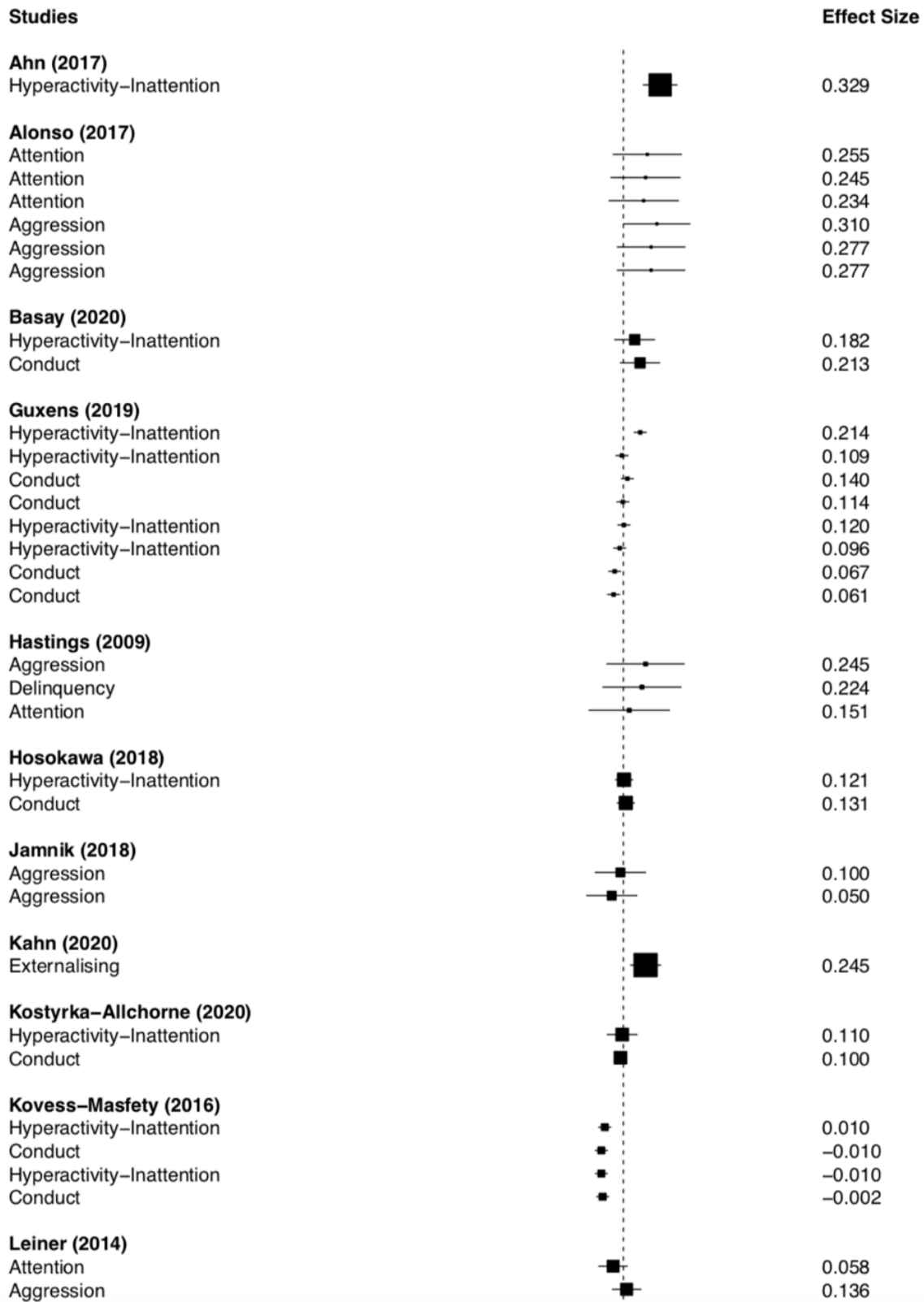
Child Age

Due to the limited number of studies available reporting solely on primary aged children (4-11 year olds), we extended our criteria to include studies which reported on those up to the age of 18 years. Overall effects did not significantly differ by child age $t(6, 5) = -0.223$, $p = .831$.

Screen Type

Next, we explored whether screen type moderated the relationship between child screen use and externalising behaviours. Six different screen types were reported which meant that moderation analyses were unreliable as degrees of freedom were below 4. To address this problem, we developed theoretically coherent categories which pooled together the data to compare 'videogame based' screen use and 'non-videogame based' screen use. The association between screen use and externalising behaviours was higher when children use 'non-video-game based screens' ($Z = 0.180$, $CI = 0.118 - 0.242$) than when they used 'videogame based' screens ($Z = -0.133$, $CI = -0.219 - -0.046$) and this difference in screen type was significant ($t(14, 7) = 6.78$, $p < .001$).

Forest Plot



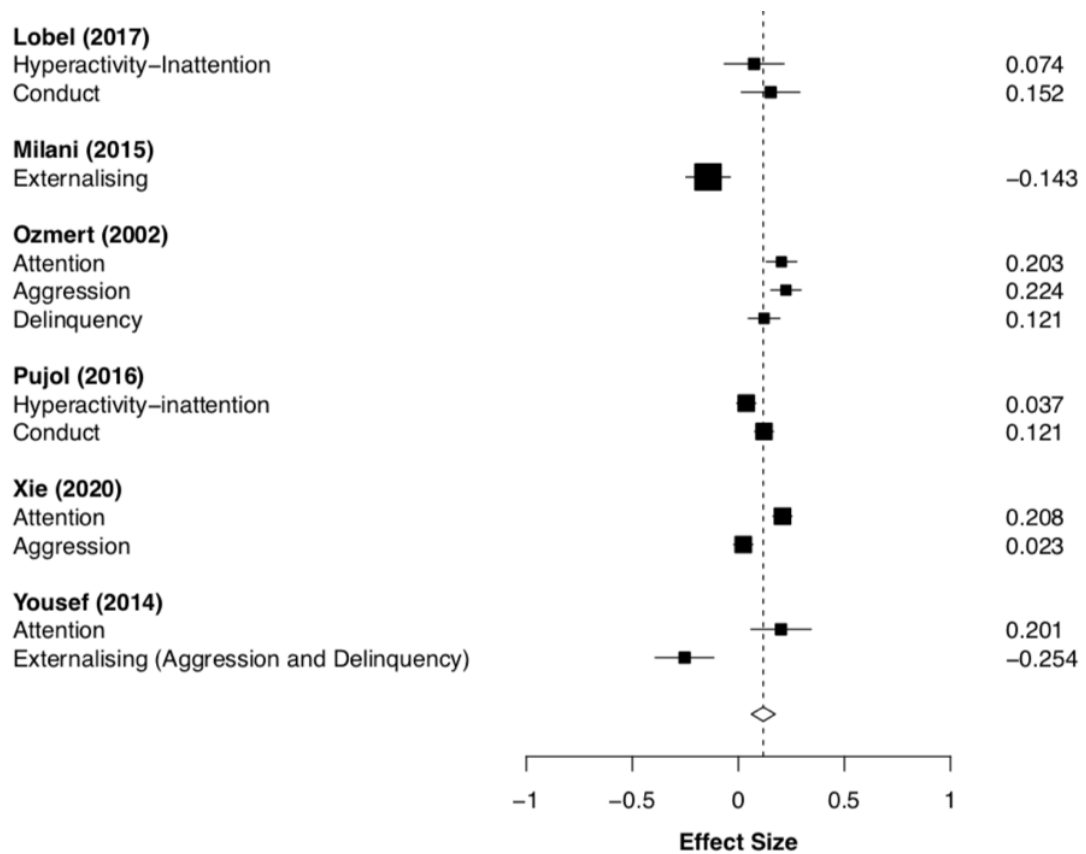


Figure 2. Forest Plot illustrating the effect size (Z) between screen use and externalising behaviour from 45 effect sizes from 17 studies.

Note. The position of the black square indicates the effect size, with horizontal lines marking the 95% confidence interval. The size of the black square indicates its weight in the meta-analysis. The name in bold is the first author of the published study along with the publication year. The type of externalising outcome is listed under each study. The upper and lower 95% confidence intervals are shown in the two columns on the right-hand side. The white diamond with black outline represents the point estimate and 95% confidence interval.

Reporter of Screen Use

Overall effects did not significantly differ according to the reporter of screen use (i.e. child or parent), $t(9, 5) = 1.14$, $p = .283$.

Reporter of Externalising Measure

The association between child screen use and externalising behaviour was higher when externalising behaviour was reported by parents ($Z = 0.123$, 95% CI = 0.065 – 0.181) than by teachers ($Z = -0.083$, 95% CI = -0.545 – 0.379), however, this difference was not statistically significant.

Scale of Externalising Measure

Finally, we examined whether the measure of externalising behaviours moderated the relationship between child screen use and externalising behaviours. Initially, we ran the analysis using the scales of the SDQ and CBCL. There were seven different scales used which again resulted in unreliable results as degrees of freedom were below 4 so we grouped together the relevant SDQ sub-scales (hyperactivity/inattention, conduct and SDQ externalising full scale) and the relevant CBCL sub-scales (attention, conduct, delinquency and CBCL externalising full scale) to form two categories. The association between child screen use and externalising behaviour was greater when measured using the SDQ ($Z = 0.140$, 95% CI = 0.065 – 0.216) than when it was measured by the CBCL ($Z = -0.053$, 95% CI = -0.172 – 0.066), although again, this difference was not statistically significant.

Discussion

Summary of Findings

The aim of the current review was to establish whether there was a link between children's screen use and externalising behaviour. In addition, we planned to inspect the effect of other factors on the strength of the association between children's screen use and externalising behaviour including; child age, reporters of screen use and externalising behaviour measure, scale of externalising behaviour and screen type. Finally, we anticipated using screen content as a covariate, however, due to the limited number of studies reporting content it was not possible to conduct this analysis.

The primary analysis demonstrated a significant relationship between children's screen use and externalising behaviour. This finding is consistent with previous literature examining the relationship between screen use and mental health outcomes. Wang, Li and Fan (2019), for example, conducted a meta-analysis and found that adults reporting higher screen use were significantly more likely to experience depression. In their systematic review Keikha et al (2020) found that children who spent more time watching television were at greater risk of displaying violent behaviours. It is important to note, however, that heterogeneity was high which reduces confidence in the findings (Imrey, 2020).

Child age did not moderate the strength of the association between screen use and externalizing behaviour. This is an interesting finding given that we were originally interested in primary aged children as opposed to adolescents, however, given the limited number of studies focussing specifically on this age group we included studies which reported on children aged 4-18 years. This result suggests that we'd have had similar results if we had focussed only on the primary aged children.

Screen type was examined as a moderator. We found that screen type significantly moderated the relationship between screen use and externalising behaviour and that this was significantly higher for 'non-video-game base screens' than 'video game based' screens. We had hoped to include screen content (e.g. educational, social media, cartoons etc) as a moderator in addition to screen type, however, unfortunately, this data was not available in the studies included in the analysis.

Reporter of screen use was also accounted for and found not to effect the primary outcome. In addition, there was no significant difference in the screen time report of children and parents. Teacher reports of screen use had been included in the analysis but data was unavailable for this sub-group. This finding supports previous literature which has demonstrated high concordance between parent and child reports of child screen use (Wood et al., 2019; Levine & Waite, 2000). The consistency in screen use reports across

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children and parents is interesting. Children, for example, may wish to under-report their screen use for fear that they will be encouraged to reduce it. Parents on the other hand might over-inflate their children's screen use as they want it to decrease or perhaps they're motivated to under-report out of concern for being judged negatively.

Reporter of externalising measure was found to affect the relationship between children's screen use and externalising behaviour. This was slightly higher when reported by parents than by teachers but not significantly so. This is consistent with previous findings which demonstrated high rater agreement between parents and teachers on the SDQ (Stone, Otten, Engels, Vermulst, & Janssens, 2010).

Finally, externalising behaviour scale was also examined as a moderator. Due to the relatively small number of studies reporting on scales of the CBCL, we decided to merge the SDQ outcome scales and compare these with the CBCL outcome scales. The relationship between screen use and externalising behaviour was significantly moderated by the scale used and found to be higher, though not significantly so, when measured by the SDQ as opposed to the CBCL.

It's possible that there were a number of other important mechanisms to consider which may explain the relationship between screen use and externalising behaviours amongst young people. Sleep has frequently been associated with psychological wellbeing (Cheng et al., 2020) and it's been suggested that excessive screen time may be displacing sleep (Carson et al., 2016). Alternatively, screen use may be displacing social interactions amongst children and their families which promote social-emotional development (Madigan, Browne, Racine, Mori, & Tough, 2019). Furthermore, family composition may be an important factor. Larger families in which children may need to compete more for resources may use screens more as a tool to reduce parental demand. Radesky, Peacock-Chambers, Zuckerman, & Silverstein (2016) argue that family dysfunction, associated with limited reinforcement strategies to tackle challenging behaviours and navigate media

usage, could be another alternative explanation for the link between screen use and externalising behaviours.

Strengths

There are a number of important strengths of the current meta-analysis. The review was pre-registered with PROSPERO and a broad systematic literature search was conducted informed by several databases with the support of a research librarian. This ensured that the review process was transparent and enhanced the validity of the findings. Additionally, abstract and full-text screening was completed blinded by two reviewers using pre-defined inclusion and exclusion criteria which increased the reliability of the review. Furthermore, two well-validated measures of externalising difficulties, the SDQ and the CBCL, were used as the outcome measures. Regarding analysis, meta-analysis was used to calculate effect size and robust variance estimation was used which allowed us to incorporate multiple effect sizes from an individual study whilst controlling for data dependencies.

Limitations

First, despite contacting authors of 49 included studies, there was a lack of data available limited to the age group, four to eleven year olds, with whom we were originally interested. Consequently, we extended our maximum age to 18 years. This has therefore limited our ability to draw conclusions solely relevant to primary aged children. Child age did not significantly moderate the association between screen use and externalising behaviours. The issue regarding the limited number of studies focussing on 4-11 year olds was in part due to the manner in which some studies reported their results. Whilst we identified 54 studies for inclusion in the meta-analysis, we were only able to use a total of 17 for various reasons (e.g. age group, reporting of total SDQ/CBCL only, no direct analysis between the variables of interest).

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There were a small number of papers reporting on certain facets of screen type and externalising scales which resulted in unreliable degrees of freedom (i.e. <4). To improve the reliability of the findings we amalgamated the data when conducting the moderation analyses on each of these variables. This mean, however, that we were unable to draw conclusions about more specific screen types and scales of externalising difficulties.

Studies relied on self-reported data which is prone to social desirability effects (Althubaiti, 2016) which impacts the validity of the findings. In a bid to improve this, we included data from a variety of reporters (i.e. child, parent and teacher). The majority of studies also used retrospective reports of screen use rather than time use diaries. Evidence suggests that there is a weak correlation between retrospective and time use diaries (Orben & Przybylski, 2019) which disputes the reliability of the screen use data.

The review is further limited by the over-reliance on cross-sectional studies. Although our inclusion criteria allowed for longitudinal studies, only one study used a longitudinal design. As such, the relationship between child screen use and externalising behaviours over time is still not well understood. Another methodological issue centres on the use of correlational rather than experimental approaches. Whilst there are valid ethical concerns around experimental manipulation of screen use in children, the nature of correlational designs means that causation cannot be inferred. Thus, the study designs predominantly used in the existing literature not only limit our knowledge about the causal relationship between these variables but also the direction of the relationship (Ophir, Lipshits-Braziler & Rosenberg, 2020).

Finally, the age of the papers used in the analysis may pose a threat to the validity of the findings. Whilst the majority of the studies included were conducted during the last three years, papers ranged from as early as 2002 to 2020. The rapid development of technology and specifically screen types, as well as evidence suggesting that children's

screen time grows year on year (Mediacom, 2019), some of the older papers incorporated in the analysis may not reflect current screen use.

Implications and Future Research

Our review suggests that there is a relationship between children's screen use and externalising behaviour although this relationship is moderated by a number of factors (screen type, reporter of externalising measure and type of externalising measure). Policy makers may wish to use it to help inform guidelines on screen use for children and young people, however, it will be important to use this review in conjunction with future research in the area. Clinically, health professionals may wish to include questions about the type of screen time a young person is usually engaging in within their assessments as well as consideration of the impact of screen use on the individual (e.g. regarding sleep and social-emotional development). An aim of our research had been to establish whether content of screens moderated the relationship between children's screen use and externalising behaviours. Unfortunately, due to a lack of data on screen content, we were unable to examine this. Previous studies have highlighted this as an issue (Dickson et al., 2018) and we would echo their recommendations for future research to specify the content of screen use. Furthermore, there were a number of studies that were eligible for the meta-analysis but were not used. This problem relates more widely to the need for an open science framework providing access to study data; we could have then analysed the data we required.

Conclusion

In summary, the current meta-analysis suggests that there is a relationship between children's screen use and externalising behaviours which is moderated by screen type, reporter of externalising measure and type of externalising measure. Whilst this review is limited by the age of the children included in the analysis, availability of study data, reliance on retrospective self-report measures and cross-sectional designs it does provide

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some helpful findings and guidance for future research with a specific suggestion around the content of children's screen use.

References

- Abeele, M. V., Beullens, K., & Roe, K. (2013). Measuring mobile phone use: Gender, age and real usage level in relation to the accuracy and validity of self-reported mobile phone use. *Mobile Media & Communication, 1*(2), 213-236. doi: 10.1177/2050157913477095
- Achenbach, T., & Edelbrock, C. (1983). *Manual for the Child Behaviour Checklist and Revised Child Behaviour Profile*. Burlington: Department of Psychiatry, University of Vermont.
- Althubaiti, A. (2016). Information bias in health research: definition, pitfalls, and adjustment methods. *Journal of Multidisciplinary Healthcare, 9*(9), 211-217. doi:10.2147/jmdh.s104807
- Anderson, D. R., Huston, A. C., Schmitt, K. L., Linebarger, D. L., & Wright, J. C. (2001). Early childhood television viewing and adolescent behavior: The recontact study. *Monographs of the Society for Research in Child Development, 66*(1), 1-147.
- Auxier, B., Anderson, M., Perrin, A., & Turner, E. (2020, July 28). Parenting children in the age of screens. *The Pew Research Centre*. Retrieved from <https://www.pewresearch.org/internet/2020/07/28/parenting-children-in-the-age-of-screens/>
- Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. (1992). Converting among effect sizes. *Introduction to Meta-analysis* (pp. 45-49). Chichester, UK: John Wiley and Sons.
- Carson, V., Hunter, S., Kuzik, N., Gray, C., Poitras, V., & Chaput, J. ... & Tremblay, M. S. (2016). Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Applied Physiology, Nutrition, And Metabolism, 41*(6), 240-265. doi:10.1139/apnm-2015-0630

Cheng, W., Rolls, E., Gong, W., Du, J., Zhang, J., & Zhang, X. ... & Feng, J. (2020). Sleep duration, brain structure, and psychiatric and cognitive problems in children. *Molecular Psychiatry*. doi: 10.1038/s41380-020-0663-2

Davies S. C., Atherton F., Calderwood C., & McBride M. United Kingdom Chief Medical Officers' commentary on 'Screen-based activities and children and young people's mental health and psychosocial wellbeing: a systematic map of reviews'. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/777026/UK_CMO_commentary_on_screentime_and_social_media_map_of_reviews.pdf

Dickson, K., Richardson, M., Kwan, I., MacDowall, W., Burchett, H., Stansfield, C., ... & Thomas, J. (2018) *Screen-based activities and children and young people's mental health: A Systematic Map of Reviews*. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

Egger, M., Smith, G. D., Schneider, M., & Minder, C. (1997). Bias in meta-analysis detected by a simple, graphical test. *British Medical Journal*, 315(7109), 629–634.

Fisher, Z., & Tipton, E. (2015). Robumeta: An R-package for robust variance estimation in meta-analysis. Retrieved from <https://arxiv.org/pdf/1503.02220.pdf>

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38(5), 581-586. doi:10.1111/j.1469-7610.1997.tb01545.x

Gottschalk, F. (2019). Impacts of technology use on children: Exploring literature on the brain, cognition and well-being. *OECD Education Working Papers, No. 195*. OECD Publishing, Paris, <https://dx.doi.org/10.1787/8296464e-en>.

- Grondin, S. (2010). Timing and time perception: A review of recent behavioral and neuroscience findings and theoretical directions. *Attention, Perception, & Psychophysics*, 72(3), 561-582. doi:10.3758/app.72.3.561
- Hedges, L. V., Tipton, E., & Johnson, M. C. (2010). Robust variance estimation in meta-regression with dependent effect size estimates. *Research Synthesis Methods*, 1(1), 39-65. doi:10.1002/jrsm.5
- Ibbetson, C. (2020, March 13). How many children have their own tech? *YouGov*. Retrieved from <https://yougov.co.uk/topics/education/articles-reports/2020/03/13/what-age-do-kids-get-phones-tablet-laptops->
- Imrey, P. (2020). Limitations of meta-analyses of studies with high heterogeneity. *JAMA Network Open*, 3(1), e1919325. doi:10.1001/jamanetworkopen.2019.19325
- Kardefelt-Winther, D. (2019). Responding to screen time concerns: A children's rights approach. *Unicef*. Retrieved from <https://blogs.unicef.org/evidence-for-action/screen-time-concerns-children-participation-digital-online/>
- Kaye, L. K., Orben, A., Ellis, D. A., Hunter, S. C., & Houghton, S. (2020). The conceptual and methodological mayhem of "screen time". *International Journal of Environmental Research and Public Health*, 17(10), 3661. doi:10.3390/ijerph17103661
- Keikha, M., Qorbani, M., Sadat, M., Tabaei, K., Djalalinia, S., Kelishadi, R. (2020). Screen time activities and aggressive behaviors among children and adolescents: A systematic review. *International Journal of Preventive Medicine*, 11(1), 59. doi: 10.4103/ijpvm.ijpvm_71_20
- Kmet, L. M., Lee, R. C., & Cook, L. S. (2004). *Standard quality assessment criteria for evaluating primary research papers from a variety of fields*. Edmonton, AB, Canada.

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. doi:10.1001/jamapediatrics.2018.5056

Martin-Biggers, J., Spaccarotella, K., Hongu, N., Alleman, G., Worobey, J., & Byrd-Bredbenner, C. (2015). Translating it into real life: a qualitative study of the cognitions, barriers and supports for key obesogenic behaviors of parents of preschoolers. *BMC Public Health*, 15(1). doi:10.1186/s12889-015-1554-3

Mediacom. (2019). Connected kids. Retrieved from https://groupmp15170118135410.blob.core.windows.net/cmscontent/2019/10/Connected-Kids-Report-2019-V2_compressed.pdf

NHS Digital. (2017). Mental health of children and young people in England. Retrieved from <https://files.digital.nhs.uk/A6/EA7D58/MHCYP%202017%20Summary.pdf>

NHS Digital. (2020). Mental health of children and young people in England, 2020: Wave 1 follow up to the 2017 survey. Retrieved from https://files.digital.nhs.uk/AF/AECD6B/mhcyp_2020_rep_v2.pdf

Ofcom. (2019). Children and parents: Media use and attitudes report. Retrieved from https://www.ofcom.org.uk/_data/assets/pdf_file/0023/190616/children-media-use-attitudes-2019-report.pdf

Ophir, Y., Lipshits-Braziler, Y., & Rosenberg, H. (2019). New-media screen time is not (necessarily) linked to depression: Comments on Twenge, Joiner, Rogers, and Martin (2018). *Clinical Psychological Science*, 8(2), 374-378. doi:10.1177/2167702619849412

Orben, A., & Przybylski, A. (2019). Screens, teens, and psychological well-being: Evidence from three time-use-diary studies. *Psychological Science*, 30(5), 682-696. doi:10.1177/0956797619830329

- Paulus, M., Squeglia, L., Bagot, K., Jacobus, J., Kuplicki, R., & Breslin, F. ... & Tapert, S. F. (2019). Screen media activity and brain structure in youth: Evidence for diverse structural correlation networks from the ABCD study. *Neuroimage*, *185*, 140-153. doi: 10.1016/j.neuroimage.2018.10.040
- Poitras, V., Gray, C., Janssen, X., Aubert, S., Carson, V., & Faulkner, G.... Tremblay, M. S. (2017). Systematic review of the relationships between sedentary behaviour and health indicators in the early years (0–4 years). *BMC Public Health*, *17*(S5). doi:10.1186/s12889-017-4849-8
- Polanczyk, G., Salum, G., Sugaya, L., Caye, A., & Rohde, L., (2015). Annual Research Review: A meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. *Journal of Child Psychology and Psychiatry*, *56*(3), 345-365. doi:10.1111/jcpp.12381
- PRISMA. (n.d.). Welcome to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) website! Retrieved from <http://prisma-statement.org>
- Radesky, J., Peacock-Chambers, E., Zuckerman, B., & Silverstein, M. (2016). Use of mobile technology to calm upset children. *JAMA Pediatrics*, *170*(4), 397. doi: 10.1001/jamapediatrics.2015.4260
- Rideout, V., & Robb, M. B. (2019). The Common Sense census: Media use by tweens and teens. *Common Sense Media*. Retrieved from <https://www.commonsensemedia.org/sites/default/files/uploads/research/2019-census-8-to-18-key-findings-updated.pdf>
- Roseberry, S., Hirsh-Pasek, K., & Golinkoff, R. (2013). Skype me! Socially contingent interactions help toddlers learn language. *Child Development*, *85*(3), 956-970. doi:10.1111/cdev.12166

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Royal College of Paediatrics and Child Health. (2019). The health impacts of screen time:

A guide for clinicians and parents. Retrieved from

https://www.rcpch.ac.uk/sites/default/files/2018-12/rcpch_screen_time_guide_-_final.pdf

RStudio Team (2021). RStudio: Integrated Development Environment for R. RStudio,

PBC, Boston, MA URL <http://www.rstudio.com/>.

Stone, L., Otten, R., Engels, R., Vermulst, A., & Janssens, J. (2010). Psychometric properties of the parent and teacher versions of the Strengths and Difficulties Questionnaire for 4- to 12-year-olds: A Review. *Clinical Child and Family Psychology Review*, 13(3), 254-274. doi:10.1007/s10567-010-0071-2

Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *Journal of Statistical Software*, 36(3), 1 - 48.

Wang, X., Li, Y., & Fan, H. (2019). The associations between screen time-based sedentary behavior and depression: a systematic review and meta-analysis. *BMC Public Health*, 19(1). doi: 10.1186/s12889-019-7904-9

Wilson, D. B. (n.d.). Practical meta-analysis effect size calculator. Retrieved from

<https://www.campbellcollaboration.org/escalc/html/EffectSizeCalculator-Home.php>

Wood, C., Skinner, A., Brown, J., Brown, C., Howard, J., & Steiner, M., ... & Perrin, E. M. (2019). Concordance of child and parent reports of children's screen media use. *Academic Pediatrics*, 19(5), 529-533. doi:10.1016/j.acap.2019.04.002

World Health Organisation. (2019). Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age. Retrieved from

<https://www.who.int/publications/i/item/9789241550536>

Chapter 2 Examining the Relationship between Pre-schoolers' Screen Use and Externalising Behaviours during the Covid-19 Pandemic; A Co-Spyce Study

The following paper has been prepared in line with author guidelines for the Journal of Child Psychiatry and Psychology.

Abstract

Background;

Pre-schoolers mental health is important and previous research has examined the relationship between screen use and mental health in this population. Concerns have been raised about children's screen use during the Covid-19 pandemic. The current study aims to explore the relationship between pre-schoolers mental health and screen use in the context of a global pandemic and to overcome some of the methodical limitations of existing research.

Methods;

Data was drawn from the Co-Spyce dataset. Six hundred and two caregivers of pre-schoolers provided information on their 2-4 year old pre-schoolers' screen use and externalising behaviours between April and June 2020 via monthly online surveys. Separate data was obtained for active and passive screen use. Cross-lagged analysis was used to analyse the two screen use models.

Results;

One cross-lagged effect was found; increases in active screen use at baseline significantly predicted externalising behaviours at one month follow-up ($\beta = 0.25$, $p = .013$). This relationship was not bi-directional. There was no over-time relationship between passive screen use and externalising behaviours but there was a within-time relationship.

Conclusions;

Active screen use significantly predicts externalising behaviour overtime whilst passive screen use does not. The strength of this relationship is weak but suggests that the

mechanisms underlying the relationship between active and passive screen use and externalising behaviour differs.

Keywords; screen use, pre-schoolers, externalising behaviour, mental health

Introduction

Pre-schoolers' mental health is important. The prevalence of emotional and behavioural difficulties in this age group is estimated to be 7 – 21% (Gothelf et al., 2006). It may be argued that these difficulties are transient, however, research suggests that such problems are more chronic (Hughes & Ensor, 2007). Mental health difficulties at this life stage can negatively impact children's development (Caspi et al., 1997; Shaw, Gilliom, Ingoldsby & Nagin, 2003). This is a key period for the emergence of social relationships outside the family and preparation for formal education settings (American Academy of Pediatrics, 2021; Ladd, 2009). Longitudinal research also indicates that poor mental health during the early years tends to predict poorer mental health outcomes throughout an individual's life (Lavigne et al., 1998). Therapeutic input prior to school commencement has shown efficacy over later intervention (Dawson & Osterling, 1997) and appears to offer lasting treatment effects (Webster-Stratton & Hammond, 1997).

Pre-schoolers mental health during the Covid-19 pandemic has received relatively little attention compared to the research emerging about school-aged children. According to the Mental Health of Children and Young People Survey (MHCYP; Vizard et al., 2020) there has been a rise in the number of mental health conditions affecting this age group from 10.8% in 2017 to 16% in July 2020. This is likely to have affected the number of referrals to children's mental health services; there was a 35% increase between 2019/2020 compared to the previous year (Children's Commissioner, 2021). Ford, John & Gunnell (2021) argue that factors influencing mental health amongst children, such as isolation, familial disputes, separation from peers and financial strain, are perpetuated by pandemic restrictions. Parents of UK children aged 4 – 11 years have reported worsening mental health difficulties and augmented behavioural problems between the start of lockdown restrictions and May 2020 (Waite et al., 2020). The MHCYP (Vizard et al., 2020) found

that around 5% of 5 to 16 year olds experienced loneliness during the pandemic whilst over a quarter had difficulties sleeping. The aforementioned research indicates that the pandemic has had an impact on young people's mental health and provides support for the importance exploring pre-schoolers mental health at this time.

Parents have been particularly concerned about their children's screen use during the pandemic (Marsh, 2021). According to a report by Ofcom (2021), three in ten parents of pre-schoolers found it difficult to control their child's screen time during the pandemic whilst 90% of parents implemented rules around their pre-schoolers gaming. Poitras et al (2017) examined the relationship between screen based sedentary behaviour and psychosocial outcomes in under five year olds. They found mixed results across 17 studies. Externalising behaviours were most consistently negatively associated with screen use whilst null effects were reported for internalising difficulties. Despite this research, the theoretical link between childhood screen time and psychological difficulties is unclear. There is some budding neurobiological evidence concerning the maturational coupling hypothesis (i.e. the idea that changes in brain structure are associated with specific behaviours). Research has shown that certain regions of the brain are associated with screen media activity and some of these have been related to elevated externalising problems in young people (Paulus et al., 2019).

There are, however, a number of limitations of existing screen use literature. There is an over-reliance on cross-sectional correlational research which limits our ability to draw conclusions about the direction(s) of the relationship between screen use and children's mental health outcomes (Dickson et al., 2018). Type of screen use is also considered to be important. Sweetser, Johnson, Ozdowska and Wyeth (2012) provide definitions which distinguish passive ("sedentary screen-based activities and/or passively receiving screen-based information, such as watching TV or a DVD") from active screen use ("cognitively or physically engaging in screen-based activities, such as playing video games or completing homework on a computer"). Type of screen use has been found to moderate the

relationship between screen use and mental health outcomes (Sanders, Parker, Pozo-Cruz, Noetel & Lonsdale, 2019). Despite this finding, the differentiation between active and passive screen use has rarely been included in previous studies (Dickson et al., 2018). Given that the sample used by Sanders et al (2019) comprised of 10 and 11 year olds, it would be interesting to establish whether the same findings apply to a population of pre-schoolers who may spend more time passively, rather than actively, watching screens. To overcome the methodological limitations of previous research, longitudinal studies are required to examine the direction of associations between screen use and externalising behaviour problems and distinguish different types of screen use.

When considering pre-schoolers' mental health it is essential to consider family context. Family mental health has been put under strain during the Covid-19 pandemic (Prime, Wade & Browne, 2020). Prime and colleagues identified a variety of different stressors facing caregivers including financial worries, health concerns, reduced social support associated with social restrictions and extended isolation, changes to work roles and routines, meeting the social and educational needs of children with the closure of schools and childcare settings. Consequently, caregivers are pressured with increased demand and reduced resources which can lead to maladaptive ways of coping. Research has suggested that such a combination leads to poorer relationship quality between parents and their children as well as poor psychosocial adjustment in children (Patterson, 2016). It is therefore important to consider systemic factors, such as parents' mental health and stress, in research on pre-schoolers' mental health in the context of the Covid-19 pandemic.

Existing literature regarding the importance of pre-schooler's mental health, their screen use and limitations of cross-sectional research warrants examination of the longitudinal associations between pre-schoolers' screen use and mental health in the context of the Covid-19 pandemic. We hypothesise that:

1. There will be a positive prospective relationship between pre-schoolers' active screen use and externalising behaviour problems over the course of the Covid-19 pandemic.
2. There will also be a positive prospective relationship between pre-schoolers' passive screen use and externalising behaviour during the Covid-19 pandemic.
3. These relationships will be bi-directional.

We also **included** a number of control variables. Gender differences in externalising behaviour have previously been reported (Bulotsky-Shearer, Fantuzzo, & McDermott, 2008); thus we controlled for child gender. Findings by Prime et al. (2020) highlight the impact of the pandemic on family mental health and therefore the study controls for caregiver mental health. Caregiver educational achievement has also been controlled for given that the impact of Covid-19 disproportionately affects those from low socio-economic backgrounds (Whitehead & Duncan, 2021). Finally, we included reporter age given evidence that the severity of Covid-19 increases with age (Centre for Disease Control and Prevention, 2021).

Method

Participants

Opportunity sampling was used to recruit parents and carers of pre-school aged children between the ages of 2 and 4 years old living in the UK. The current study focusses on a subsample of 602 participants who completed a survey at T1 – during the month prior to the easing of social restrictions and a second survey at T2 - in the month following this. Demographic information is displayed in Table 1.

Table 1

Demographics

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Variable	N (%)	M (<i>SD</i>)
Country of Origin		
England	530 (88.04)	
Northern Ireland	4 (0.66)	
Scotland	59 (9.80)	
Wales	8 (1.33)	
Child Gender		
Female	311 (51.66)	
Male	290 (48.17)	
Not reported	1 (0.17)	
Reporter Age		36.63 (4.86)
Reporter Type		
Parent	598 (99.34)	
Grandparent	3 (0.50)	
Not available	1 (0.17)	
Reporter Educational Attainment		
No qualification	5 (0.83)	
Post 16 vocational course	6 (1)	
GCSEs or equivalent	23 (3.82)	
A Levels or equivalent	36 (5.98)	
Undergraduate degree	254 (42.19)	

Variable	N (%)	M (SD)
Postgraduate degree	275 (45.68)	
Not available	3 (0.50)	
Reporter DASS score		25.75 (19.59)

Procedure

The study received ethical approval from The University of Southampton Research Ethics Committee (Ergo No: 56217; Appendix D). As part of the Co-SPYCE project, a baseline survey was disseminated between April and May 2020 through which parents/carers provided informed consent and subsequent surveys were e-mailed to participants on a monthly basis. Participants were asked to choose an ‘index’ child upon which to base their responses if they had more than one child within the specified age range. Specific cut-off dates were identified for T1 and T2 for each of the devolved nations according to when social restrictions began easing and are outlined in Table 2. Full procedural information can be found in the protocol (https://osf.io/rukpt/?view_only=).

Table 2

Data on easing of social restrictions for each of the devolved nations.

Country	Date Social Restrictions Eased ^a	Time 1 Data	Time 2 Data
England	1 st June 2020	30 th April 2020 – 31 st May 2020	28 th May 2020 – 28 th June 2020
Northern Ireland	19 th May 2020	18 th April 2020 – 18 th May 2020	19 th May 2020 – 19 th June 2020
Scotland	28 th May 2020	27 th April 2020 – 27 th May 2020	28 th May 2020 – 28 th June 2020

Wales	1 st June 2020	30 th April 2020 –	1 st June 2020 –
		31 st May 2020	1 st July 2020

^a Social restrictions easing varied across the devolved nations. The ‘rule of six outdoors’ was implemented in England (Stewart, 2020) and Northern Ireland (McCormack, 2020). The ‘rule of two households outdoors’ was used in Scotland (Brooks, 2020) and in Wales (Evans, 2020).

Measures

Demographics

Participants provided data on their age and highest educational qualification as well as their child’s gender. Educational attainment was used an indicator of socio-economic status rather than income (“No qualifications”, “completed GCSE/CSE/O-levels or equivalent (at school till aged 16)”, “completed post-16 vocational course”, “A levels or equivalent (at school till aged 18)”, “undergraduate degree or professional qualification” and “postgraduate degree”).

Parental Mental Health

Participants completed the Depression Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995) as a measure of their own mental health. The DASS includes 21 items rated on a four point Likert scale reflecting severity from 0 (“Did not apply to me at all”) to 3 (“Applied to me very much or most of the time”). The total score is obtained by multiplying each of the three sub-scale scores by two and summing together. DASS scores were included as a continuous variable.

Screen Use

Participants were asked to report how much time per day their child had spent on screens over the previous week. Separate answers were provided for active screen use

(“Playing a screen-based game e.g., on phone, tablet, computer) and passive screen use (“Watching a screen, but not interacting with it e.g. watching a programme on CBeebies on BBC i-player, or videos on youtube, whether on a television, tablet, phone, computer etc.) Participants responded using a five point Likert scale ranging from 1 (“Did not do”) to 5 (6+ hours).

Child Externalising Difficulties

The externalising scale of the parent/carer report version of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 1997) was used to assess child externalising difficulties. Participants were asked to answer the questions in relation to their child’s behaviour over the last month. The SDQ comprises 25 items which are rated on a three point Likert scale from 0 (“not at all”) to 2 (“certainly true”). The externalising scale of the SDQ comprises of two subscales; conduct problems and hyperactivity/inattention. An externalising score is generated by summing the responses for the two sub-scales.

Data Analysis

All analyses were conducted using R Studio (RStudio Team, 2021). To test our hypotheses, two cross lagged panel models were performed using structural equation modelling in the Lavaan package (Rosseel, 2012). A number of pre-analysis checks were undertaken. Little’s Missing Completely at Random test was used from the Baylor Ed Psych package (Beaujean, 2015) to assess for patterns of missing data. This showed that there were not any significant issues with missing data. Chronbach alphas were generated to assess reliability of measures over time. Correlations were conducted to test for linearity. Histograms and qqplots were used to inspect the distribution of residuals amongst the outcome variables.

The first model explored whether active screen use and externalising problems at T1 predicted each other at T2, whilst the second model investigated whether passive screen use

and externalising problems at T1 predicted each other at T2. The following were explored as potential control variables; child gender, reporter age, educational attainment and DASS score. For each model, we built an initial model which involved regressing each of the outcome variables onto one another to produce auto-regressive, co-variant and cross-lagged relationships (Figure 3). We then used a bottom up approach to remove constraints on the control variables using the top five recommendations from the model indices. This was repeated either until removing constraints did not improve the model or there were not any additional relevant (i.e. did not explore the relationships with which we were interested) recommendations. The final step involved constraining the co-variances of the outcome variables. If they did not significantly worsen the model then they were included in the final model.

Model fit was evaluated using the following fit indices; X^2 , comparative fit index (CFI), root mean square error of approximation (RMSEA) and standardized root mean squared residual (SRMR). We adopted cut-offs from Kline (2005), who suggests that model fit is good when X^2 is $>.05$, CFI $\geq .90$, RMSEA $<.08$ and SRMR $<.08$.

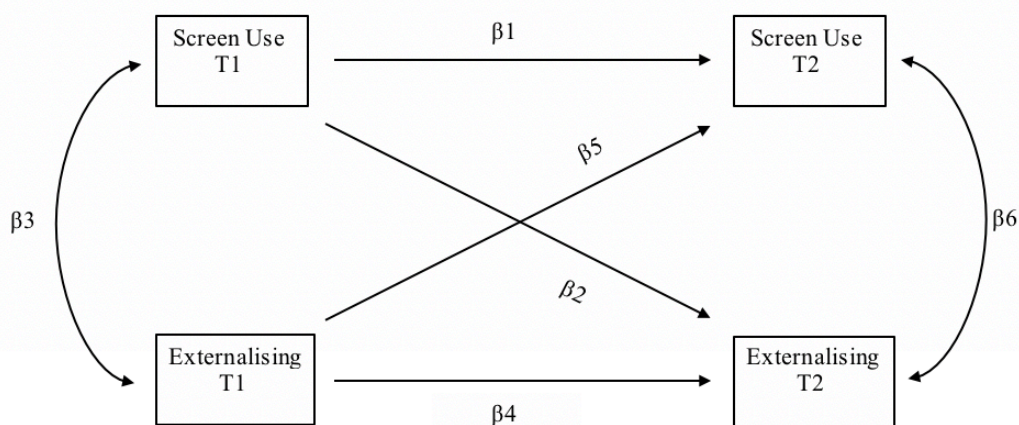


Figure 3. The general cross-lagged panel model for screen use and externalising behaviour.

Results

Descriptive Statistics

The most common response for passive screen use at each time point was '30 minutes to 2 hours' whilst the most common response for active screen at each time point was 'did not do' although the spread was more evenly distributed amongst the first three categories ('did not do', 'less than. 30 minutes' and '30 minutes to 2 hours') than it was for passive screen use. Externalising behaviour was similar at T1 ($M = 8.36$, $SD = 3.78$) and T2 ($M = 7.99$, $SD = 3.80$). Reliability of measures over time was good for active screen use ($\alpha = .80$) and externalising problems ($\alpha = .86$) and acceptable for passive screen use ($\alpha = .68$).

Main Results

The results are displayed for each model in Figure 4.

Model 1 – Active Screen Use

The final active screen model included regressions amongst each of the outcome variables (active screen use at each time point and externalising behaviours at each time point), externalising behaviour at T1 was regressed on to child gender and DASS score, active screen use at T1 was regressed on to education and reporter age and the co-variances were constrained to be equal. The overall model exhibited good fit based on fit indices. X^2 was 0.142, CFI was 0.994, RMSEA was 0.026 and SRMR was 0.039.

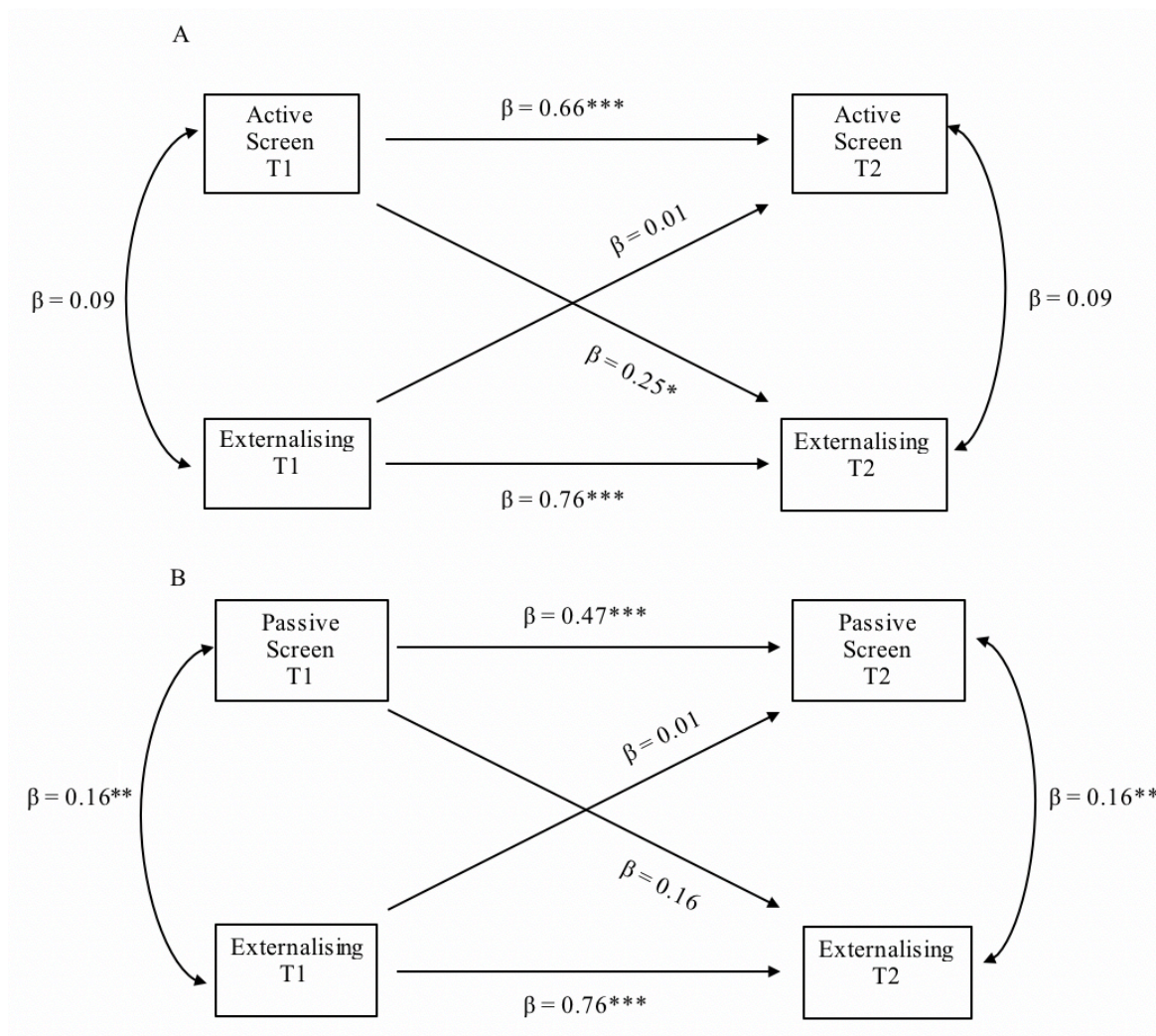


Figure 4. (A) The cross-lagged panel model including standardised structural regression co-efficients for active screen use and externalising behaviour. (B) The cross-lagged panel model including standardised structural regression co-efficients for passive screen use and externalising behaviour. * $p < .05$, ** $p < .01$, *** $p < .001$.

In terms of the auto-regressive effects, active screen use at T1 significantly predicted active screen use at T2 ($\beta = 0.66$, $p < .001$) whilst externalising behaviour at T1 significantly predicted externalising behaviour at T2 ($\beta = 0.76$, $p < .001$).

Within time co-variances between active screen use and externalising behaviours demonstrated that these variables were not significantly correlated ($\beta = 0.09$, $p = .200$).

The cross-lagged effects revealed that active screen use at T1 significantly predicted externalising behaviour at T2 ($\beta = 0.25$, $p = .013$). However, this relationship

was not reciprocal as externalising behaviour at T1 did not significantly predict active screen use at T2 ($\beta = 0.01$, $p = .537$).

Model 2 – Passive Screen Use

The final passive screen model included regressions amongst each of the outcome variables, externalising behaviour at T1 was regressed on to DASS score, passive screen use at T1 was regressed on to DASS score and reporter age and the co-variances were constrained to be equal. Child gender and parental educational achievement were excluded from this model as releasing them did not significantly improve the model fit. The overall model exhibited good fit based on fit indices. X^2 was 0.335, CFI was 0.999, RMSEA was 0.016 and SRMR was 0.022.

In terms of the auto-regressive effects, passive screen use at T1 significantly predicted passive screen use at T2 ($\beta = 0.47$, $p < .001$) whilst externalising behaviour at T1 significantly predicted externalising behaviour at T2 ($\beta = 0.76$, $p < .001$).

Within time co-variances between passive screen use and externalising behaviours demonstrated that there was a significant positive correlation between these variables ($\beta = 0.16$, $p = .002$).

The cross-lagged effects revealed that passive screen use at T1 did not significantly predict externalising behaviour at T2 ($\beta = 0.16$, $p = .255$) and that externalising behaviour at T1 did not significantly predict passive screen use at T2 ($\beta = 0.01$, $p = .537$).

Discussion

Finding 1 – Cross Lagged Effects

The primary findings relates to the cross-lagged effects. A cross-lagged effect is demonstrated for active screen use suggesting that active screen use at baseline significantly predicts externalising behaviour at follow-up, however, this relationship is not

bi-directional which supports hypothesis 1 but is inconsistent with hypothesis 3. Passive screen use and externalising behaviours were not significantly related over time in either direction which disproves hypothesis 2. Research has previously shown that mental health difficulties are associated with higher screen use (Zink, Belcher, Kechter & Stone, 2019) but our results do not support this assertion. It is possible that children who dealt with pandemic related stress by playing on screens more frequently displayed more externalising difficulties as restrictions were eased but we did not have pre-pandemic data available so could not explore this idea. An alternative explanation for the differences between each model over time could be accounted for by passive screen use being a quieter activity compared to active screen use. Caregivers may be more inclined to report externalising difficulties when active screen use is high if the child becomes distressed about losing a game for example. It's important to note that externalising behaviour is a very poor predictor of screen use in both models and although passive screen use at baseline does not significantly predict later externalising behaviour the β value isn't much smaller than that in the active model. The findings do, however, suggest that the mechanisms underlying the effects of active and passive screen use on externalising behaviour are slightly different.

Finding 2 – Auto-regressive Effects

Observing the auto-regressive effects also provides us with some important findings. Each of active and passive screen use at baseline significantly predicted screen use one month later although the association was stronger for active use of screens. Furthermore, externalising behaviours at baseline significantly predicted externalising behaviours at follow-up. These findings illustrate that each of the three main constructs remain stable over time and suggest that the easing of social restrictions did not have a short-term impact on either active screen use, passive screen use or externalising behaviour. We would not necessarily expect a dramatic reduction in externalising behaviours so quickly after the easing of social restrictions although we may have expected a decrease in screen use if

parental concerns about increased screen time during lockdown are to be taken into account. We did not assess adherence to guidelines on social restrictions and this may have impacted our findings.

Finding 3 – Co-variance Effects

The third finding relates to the within time co-variances. There was not a significant relationship between active screen use and externalising behaviours when measured at the same time point. On the other hand, passive screen use and externalising behaviours were significantly related when measured at the same time point. It's likely, however, that there is a third variable which better predicts each construct and therefore explains why the relationship between these variables over time is not significant. Interestingly, caregiver DASS score predicted both passive screen use and externalising behaviour. Therefore, it may be that caregivers who are struggling with their own mental health difficulties, due in part to perhaps balancing the demands of working from home and caregiving, are more likely to allow their children to watch more screens.

Alternative Explanations

There are other important factors to incorporate when thinking about the function of the relationship between pre-schoolers screen use and externalising difficulties. Firstly, sleep, which is particularly important during the early years (Jiang, 2019) may be replaced by screen time which subsequently leads to elevated externalising problems (Carson et al., 2016). Secondly, social interaction, which promotes social-emotional growth, may also be replaced by screen time again resulting in increased externalising difficulties. It's important to note, however, in the context of the pandemic that screen time may have enhanced social interaction at a time when this was otherwise limited. Finally, family dysfunction might underlie the relationship between screen use and externalising problems. Families with few or poor reinforcement strategies may use screens as a way of managing difficult behaviours (Radesky, Peacock-Chambers, Zuckerman, & Silverstein, 2016).

Strengths

There were a number of strengths of the current study. First, we included a large sample reporting on an approximately even number of boys and girls. This will have enhanced statistical power (Suresh & Chandrashekara, 2012) and generalisability of the findings across genders. The longitudinal design was also a strength as it allowed us to assess relationships amongst the variables over time whilst employing cross lagged analysis enabled us to look at multiple relationships simultaneously as well as bi-directionality (Selig & Little, 2012). Whilst our time points were theoretically informed, as we predicted that the changing of social restrictions would influence screen time and externalising behaviours, it would have been interesting to include further time points to explore these variables as the pandemic progressed. Previous screen time literature has been criticised for ignoring the type of children's screen use (Dickson et al., 2018). In an attempt to overcome this limitation, we explored the relationships between externalising behaviour and active/passive screen use separately and found that these relationships did differ based on type of screen time. **Finally, we focussed on a topical area of research with important clinical implications and areas for further research that will be of interest to the general public, politicians and health care professionals.**

Limitations

The current study was limited in a number of ways. Its sample predominantly consisted of higher educated individuals residing in England. The sampling method was also flawed in that participants were self-selecting. This may explain the disproportionate number of well-educated people completing the study, consistent with previous findings (Brall et al., 2021), as they may have been more likely to hear about the study or value the contribution of research. Research has also shown that screen use tends to be higher amongst families of a lower socio-economic background (Cameron et al., 2015), as are mental health difficulties (Gutman, Joshi, Parsonage, & Schoon, 2015), which would likely

have had an impact on our results. Furthermore, although electronic questionnaires were an effective method for collecting large volumes of data, they are limited by the potential for socially desirable responses and reliance on participant memory (Abeele, Beullens & Roe, 2013; Grondin, 2010) as well as the potential for exclusion of hard to reach populations who do not have easy access to the internet. Furthermore, we did not explore the impact of co-viewing screen content with pre-schoolers. Spending time with a parent watching screens may be beneficial for pre-schoolers, however, the benefits would likely be associated with proximity to the caregiver or opportunities for displays of affection at these times as opposed to being directly linked to the screen content itself. Finally, whilst we did explore active and passive screen use separately, these variables could have been better defined. The findings for passive screen use, for example, could differ depending on whether the child was watching a violent cartoon or educational content (Prescott, Sargent and Hull, 2018; Baydar, Kağıtçıbaşı, Küntay, & Gökşen, 2008). We also did not account for whether the child was actively engaged in discussion about the content which therefore could be classified as active rather than passive screen use as defined by Sweetser et al (2012).

Implications and Future Research

The current study offers some interesting findings but emphasises the need for further high quality research. The study highlights the differences between active and passive screen use and as such has clinical implications for the assessment of externalising difficulties in pre-schoolers (i.e. incorporating questions about screen use) and advice clinicians offer which should focus on the type and quality of screen use rather than time spent engaging in screens. This advice may only be relevant to those of a higher socio-economic background, however, given that the population in the current study was heavily skewed in terms of SES. This raises implications regarding the recruitment of under-represented backgrounds in research. Creativity should be employed in recruitment e.g. approaching those who have direct involvement with these populations such as religious

leaders, teachers and social services. In terms of future search, we focussed on externalising behaviours which have been reported more predominantly in boys (Bulotsky-Shearer et al., 2008) and so exploration of internalising difficulties, which tend to be more frequently reported in girls, is warranted. Further differentiation between types of passive and active screen use is also recommended in future research to establish whether relationship differ between screen content which promotes learning vs competitive gaming for example. We would also suggest using more than two time points for data analysis to explore how these relationships differ over a more significant period of time.

Conclusions

To conclude, the current study suggests that the underlying processes of how active and passive screen use predict externalising behaviours in pre-schoolers are slightly different but ultimately there is not strong compelling evidence that increased screen use, active or passive, predicts behaviour problems later on.

References

- Abeele, M. V., Beullens, K., & Roe, K. (2013). Measuring mobile phone use: Gender, age and real usage level in relation to the accuracy and validity of self-reported mobile phone use. *Mobile Media & Communication*, 1(2), 213-236. doi: 10.1177/2050157913477095
- American Academy of Pediatrics. (2021). Social development in pre-schoolers. In *Healthy Children*. Retrieved from <https://www.healthychildren.org/English/ages-stages/preschool/Pages/Social-Development-in-Preschoolers.aspx>
- Baydar, N., Kağıtçıbaşı, Ç., Küntay, A., & Gökşen, F. (2008). Effects of an educational television program on preschoolers: Variability in benefits. *Journal of Applied Developmental Psychology*, 29(5), 349-360. doi: 10.1016/j.appdev.2008.06.005
- Beaujean, A. A. (2015). Package 'BaylorEdPsych'. Retrieved from <https://mran.microsoft.com/snapshot/2017-08-21/web/packages/BaylorEdPsych/BaylorEdPsych.pdf>
- Brall, C., Berlin, C., Zwahlen, M., Ormond, K. E., Egger, M., & Vayena, E. (2021). Public willingness to participate in personalized health research and biobanking: A large-scale Swiss survey. *PLoS ONE* 16(4), e0249141. <https://doi.org/10.1371/journal.pone.0249141>
- Brooks, L. (2020). People in Scotland allowed to meet with another household as lockdown eased. *The Guardian*. Retrieved from <https://www.theguardian.com/world/2020/may/28/people-scotland-can-meet-groups-eight-lockdown-eased>
- Bulotsky-Shearer, R., Fantuzzo, J., & McDermott, P. (2008). An investigation of classroom situational dimensions of emotional and behavioral adjustment and

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cognitive and social outcomes for Head Start children. *Developmental Psychology*, 44(1), 139-154. doi: 10.1037/0012-1649.44.1.139

Cameron, A., Spence, A., Laws, R., Hesketh, K., Lioret, S., & Campbell, K. (2015). A Review of the Relationship Between Socioeconomic Position and the Early-Life Predictors of Obesity. *Current Obesity Reports*, 4(3), 350-362.
doi:10.1007/s13679-015-0168-5

Carson, V., Hunter, S., Kuzik, N., Gray, C., Poitras, V., & Chaput, J. ... & Tremblay, M. S. (2016). Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Applied Physiology, Nutrition, And Metabolism*, 41(6), 240-265. doi:10.1139/apnm-2015-0630

Caspi, A., Begg, D., Dickson, N., Harrington, H., Langley, J., Moffitt, T., & Silva, P. (1997). Personality differences predict health-risk behaviors in young adulthood: Evidence from a longitudinal study. *Journal of Personality and Social Psychology*, 73(5), 1052-1063. doi:10.1037/0022-3514.73.5.1052

Centre for Disease Control and Prevention. (2021). Older adults at greater risk of requiring hospitalization or dying if diagnosed with COVID-19. Retrieved from <https://www.cdc.gov/coronavirus/2019-ncov/need-extra-precautions/older-adults.html>

Children's Commissioner. (2021). *The state of children's mental health services 2020/21*. Retrieved from <https://www.childrenscommissioner.gov.uk/wp-content/uploads/2021/01/cco-the-state-of-childrens-mental-health-services-2020-21.pdf>

Dawson, G., & Osterling, J. (1997). Early intervention in autism: effectiveness and common elements of current approaches. In M. J. Guralnick (Ed.). *The*

effectiveness of early intervention: second generation of research (pp. 307-326).

Paul Brookes Publishing Co, Baltimore (MD).

Dickson, K., Richardson, M., Kwan, I., MacDowall, W., Burchett, H., Stansfield, C., ... & Thomas, J. (2018) *Screen-based activities and children and young people's mental health: A Systematic Map of Reviews*. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education, University College London.

Evans, F. (2020). Coronavirus: Two households 'can meet outdoors next week'. *BBC News*. Retrieved from <https://www.bbc.co.uk/news/uk-wales-52832552>

Ford, T., John, A., & Gunnell, D. (2021). Mental health of children and young people during pandemic. *British Medical Journal*, n614. doi: 10.1136/bmj.n614

Goodman, R. (1997). The Strengths and Difficulties Questionnaire: A research note. *Journal of Child Psychology and Psychiatry*, 38(5), 581-586. doi:10.1111/j.1469-7610.1997.tb01545.x

Gothelf, D., Gertner, S., Mimouni-Bloch, A., Freudenstein, O., Yirmiya, N., Weitz, R. ... & Spitzer, S. (2006). Follow-up of preschool children with severe emotional and behavioral symptoms. *The Israel Journal of Psychiatry and Related Sciences*, 43(1), 16-20.

Grondin, S. (2010). Timing and time perception: A review of recent behavioral and neuroscience findings and theoretical directions. *Attention, Perception, & Psychophysics*, 72(3), 561-582. doi:10.3758/app.72.3.561

Gutman, L., Joshi, H., Parsonage, M., & Schoon, I. (2015). *Children of the new century: Mental health findings from the Millennium Cohort Study*. London: Centre for Mental Health.

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Hughes, C., & Ensor, R. (2007). Positive and protective: Effects of early theory of mind on problem behaviors in at-risk preschoolers. *Journal of Child Psychology and Psychiatry*, 48(10), 1025-1032. doi: 10.1111/j.1469-7610.2007.01806.x

Jiang, F. (2019). Sleep and early brain development. *Annals of Nutrition and Metabolism*, 75(1), 44-54. doi:10.1159/000508055

Kline, R. B. (2005). *Methodology in the social sciences. Principles and practice of structural equation modeling* (2nd ed.). Guilford Press.

Ladd, G. W. (2009). School readiness: Preparing children for the transition from preschool to Grade School. Comments on Love and Raikes, Zill and Resnick, and Early. In *Encyclopaedia of Early Childhood Development*. Retrieved from <https://www.child-encyclopedia.com/school-readiness/according-experts/school-readiness-preparing-children-transition-preschool-grade>

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

Lovibond, P., & Lovibond, S. (1995). The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research And Therapy*, 33(3), 335-343. doi: 10.1016/0005-7967(94)00075-u

Marsh, S. (2021). 'I worry about their social skills': parents on children's screen time in lockdown. *The Guardian*. Retrieved from <https://www.theguardian.com/uk>

- McCormack, J. (2020). Coronavirus: NI Executive agrees to lift more lockdown measures. *BBC News*. Retrieved from <https://www.bbc.co.uk/news/uk-northern-ireland-52711301>
- Ofcom. (2021). Children and parents: media use and attitudes report. Retrieved from https://www.ofcom.org.uk/_data/assets/pdf_file/0025/217825/children-and-parents-media-use-and-attitudes-report-2020-21.pdf
- Patterson, G. R. (2016). Coercion theory: The study of change. In T. J. Dishion & J. J. Snyder (Eds.), *The Oxford handbook of coercive relationship dynamics* (pp. 7–22). New York, NY: Oxford University Press.
- Poitras, V. J., Gray, C. E., Janssen, X., Aubert, S., Carson, V., Faulkner, G., ... & Tremblay, M. S. (2017). Systematic review of the relationships between sedentary behaviour and health indicators in the early years (0–4 years). *BMC Public Health*, *17*(5), 66-89. doi:10.1186/s12889-017-4849-8
- Prescott A. T., Sargent J. D., Hull J. G. (2018). Metaanalysis of the relationship between violent video game play and physical aggression over time. Proceedings of the National Academy of Sciences of the United States of America, *115*(40), 9882-9888. doi:10.1073/pnas.1611617114
- Prime, H., Wade, M., & Browne, D. (2020). Risk and resilience in family well-being during the COVID-19 pandemic. *American Psychologist*, *75*(5), 631-643. doi:10.1037/amp0000660
- Paulus, M., Squeglia, L., Bagot, K., Jacobus, J., Kuplicki, R., & Breslin, F. ... & Tapert, S. F. (2019). Screen media activity and brain structure in youth: Evidence for diverse structural correlation networks from the ABCD study. *Neuroimage*, *185*, 140-153. doi: 10.1016/j.neuroimage.2018.10.040

Radesky, J., Peacock-Chambers, E., Zuckerman, B., & Silverstein, M. (2016). Use of mobile technology to calm upset children. *JAMA Pediatrics*, 170(4), 397. doi: 10.1001/jamapediatrics.2015.4260

Rosseel, Y. (2012). Lavaan: An R package for structural equation modeling. *Journal of Statistical Software*, 48, 1–36.

RStudio Team (2021). RStudio: Integrated Development Environment for R. RStudio, PBC, Boston, MA URL <http://www.rstudio.com/>.

Sanders, T., Parker, P., del Pozo-Cruz, B., Noetel, M., & Lonsdale, C. (2019). Type of screen time moderates effects on outcomes in 4013 children: evidence from the Longitudinal Study of Australian Children. *International Journal of Behavioral Nutrition and Physical Activity*, 16(1). doi: 10.1186/s12966-019-0881-7

Selig, J. P., & Little, T. D. (2012). Autoregressive and cross-lagged panel analysis for longitudinal data. In B. Laursen, T. D. Little, & N. A. Card. (Eds.). *Handbook of Developmental Research Methods*. (pp. 307-326). Paul Brookes Publishing Co, Baltimore (MD).

Shaw, D., Gilliom, M., Ingoldsby, E., & Nagin, D. (2003). Trajectories leading to school-age conduct problems. *Developmental Psychology*, 39(2), 189-200. doi: 10.1037/0012-1649.39.2.189

Suresh, K., & Chandrashekar, S. (2012). Sample size estimation and power analysis for clinical research studies. *Journal of Human Reproductive Sciences*, 5(1), 7. doi: 10.4103/0974-1208.97779

Stewart, H. (2020). Groups of up to six people allowed to meet in England from Monday. *The Guardian*. Retrieved from

<https://www.theguardian.com/world/2020/may/28/groups-up-to-six-people-allowed-meet-england-monday-coronavirus-lockdown-easing>

Vizard, T., Sadler, K., Ford, T., Newlove-Delgado, T., McManus, S., Marcheselli, F., ...

Cartwright, C. (2020). *Mental health of children and young people in England, 2020: Wave 1 follow up to the 2017 survey*. Retrieved from https://files.digital.nhs.uk/CB/C41981/mhcyp_2020_rep.pdf

Waite, P., Pearcey, S., Shum, A., Raw, J., Patalay, P., & Creswell, C. (2021). How did the mental health symptoms of children and adolescents change over early lockdown during the COVID-19 pandemic in the UK?. *Journal of Child Psychiatry and Psychology Advances*, 1(1). doi: 10.1111/jcv2.12009

Webster-Stratton, C., & Hammond, M. (1997). Treating children with early-onset conduct problems: a comparison of child and parent training interventions. *Journal of Consulting and Clinical Psychology*, 65, 93-109.

Whitehead, M., Taylor-Robinson, D., & Barr, B. (2021). Poverty, health, and covid-19. *British Medical Journal*, n376. doi: 10.1136/bmj.n376

Zink, J., Belcher, B., Kechter, A., Stone, M., & Leventhal, A. (2019). Reciprocal associations between screen time and emotional disorder symptoms during adolescence. *Preventive Medicine Reports*, 13, 281-288.
doi:10.1016/j.pmedr.2019.01.014

Appendix A – Search Syntax

“television watch*” or “tv watch*” or “cartoon watch*” or “television viewing” or
Screentime or (screen or computer or television) N3 time or (watch* or view*) N2 (dvd*
or video*) or “social media” or “screen media” or (SUBJECT HEADING) “social media”
or “video gam* or videogam* or “computer gam*” or “electronic gam*” or gaming or
“screen based entertainment” or Smartphone* or “smart phone*” or “cell phone*” or
“mobile phone*” or “small screen*” or (SUBJECT HEADING) “mobile devices” or
Texting or “text messag*” or app or apps or “mobile applications” or Iphone* or ipad* or
ipod* or tablet* or laptop*

AND

“aggressive behavio?r” or “anger control” or “emotion* control” or “emotion* regulation”
or “impulse control disorder” or SUBJECT HEADING) “aggressive behavio?r” or
“behavio?r disorder” or “anti-social behavio?r” or “behavio?r problem*” or “interpersonal
relationships” or “interpersonal interaction” or “prosocial behavio?r” or “social behavio?r”
or “cognitive ability” or “cognitive development” or “cognitive ability” or attention or
“attention deficit disorder” or concentrat* or distract* or (SUBJECT HEADING) attention
or (SUBJECT HEADING) memory or (SUBJECT HEADING) “executive function”

AND

Child* or “pre-teen” or (primary or elementary N1 (school or age*))

Appendix B - Quality Assessment Criteria Scores

Paper	1. Question/objective sufficiently described.	2. Study design evident and appropriate.	3. Method of subject/comparison group selection OR source of info/input variable described and appropriate.	4. Subject characteristics sufficiently described.	8. Outcome well defined and robust to measurement/misclassification bias?	9. Sample size appropriate.	10. Analytic methods described/justified and appropriate?	11. Some estimate of variance is reported for the main results?	12. Controlled for confounding?	13. Results reported in sufficient detail?	14. Conclusion supported by results?	Total Score	Summary Score
Ahn (2017)	2	1	2	2	2	2	2	2	2	2	2	21	0.95
Basay (2020)	2	2	2	2	2	2	1	2	0	2	2	19	0.86
Guxens (2019)	2	2	2	1	2	2	2	0	2	2	2	19	0.86
Hosokawa (2018)	2	1	2	2	2	2	2	0	2	2	2	19	0.86

Paper	1. Question/objective sufficiently described.	2. Study design evident and appropriate.	3. Method of subject/comparison group selection OR source of info/input variable described and appropriate.	4. Subject characteristics sufficiently described.	8. Outcome well defined and robust to measurement/misclassification bias?	9. Sample size appropriate.	10. Analytic methods described/justified and appropriate?	11. Some estimate of variance is reported for the main results?	12. Controlled for confounding?	13. Results reported in sufficient detail?	14. Conclusion supported by results?	Total Score	Summary Score
Kahn (2020)	2	2	2	2	2	2	2	2	2	2	2	22	1.00
Kostyrka-Allchorne (2020)	2	1	1	2	2	1	2	2	2	2	2	19	0.86
Kovess-Masfety (2016)	2	1	2	2	2	2	2	0	0	2	2	17	0.77
Lobel (2017)	2	2	2	1	2	2	2	2	2	2	2	21	0.95
Pujol (2016)	1	2	2	1	2	2	2	2	2	2	2	20	0.91

Paper	1. Question/objective sufficiently described.	2. Study design evident and appropriate.	3. Method of subject/comparison group selection OR source of info/input variable described and appropriate.	4. Subject characteristics sufficiently described.	8. Outcome well defined and robust to measurement/misclassification bias?	9. Sample size appropriate.	10. Analytic methods described/justified and appropriate?	11. Some estimate of variance is reported for the main results?	12. Controlled for confounding?	13. Results reported in sufficient detail?	14. Conclusion supported by results?	Total Score	Summary Score
Alonso (2017)	2	1	2	2	2	1	2	0	0	2	2	16	0.73
Hastings (2009)	2	2	2	2	2	1	1	0	0	2	2	16	0.73
Jamnik (2018)	2	1	2	2	2	1	2	2	1	2	2	19	0.86
Leiner (2014)	1	2	2	2	2	2	2	2	0	2	2	19	0.86
Milani (2015)	2	1	1	2	2	2	2	0	2	2	2	18	0.82
Ozmert (2002)	1	1	2	1	2	2	2	0	0	2	2	15	0.68

												Total Score	Summary Score
	14. Conclusion supported by results?												
	13. Results reported in sufficient detail?												
	12. Controlled for confounding?												
	11. Some estimate of variance is reported for the main results?												
	10. Analytic methods described/justified and appropriate?												
	9. Sample size appropriate.												
	8. Outcome well defined and robust to measurement/misclassification bias?												
	4. Subject characteristics sufficiently described.												
	3. Method of subject/comparison group selection OR source of info/input variable described and appropriate.												
	2. Study design evident and appropriate.												
	1. Question/objective sufficiently described.												
Paper													
Xie (2020)	2	2	2	2	2	2	2	2	2	2	22	1.00	
Yousef (2014)	1	2	2	2	2	2	2	0	2	2	19	0.86	

Appendix C – Summary of Data Extracted from Studies included in Analysis

Author	Year	Number of Participants	Mean Age (Years)	Design	Type of Screen	Reporter of Screen	Measure	Scale	Reporter of Measure
Ahn	2017	327	11.9	Cross-sectional	Screen Time	Parent	SDQ	Hyperactivity-Inattention	Parent
Alonso	2017	88	-	Cross-sectional	Computer/Videogames Internet	Child Parent	CBCL	Attention Aggression	Parent
Basay	2020	277	11.98	Cross-sectional	Screen Time	Parent	SDQ	Hyperactivity-Inattention Conduct	Parent
Guxens	2019	3102	5.15	Cross-sectional	TV Computer/Videogames	Parent	SDQ	Hyperactivity-Inattention Conduct	Parent Teacher
Hastings	2009	70	7.8	Cross-sectional	Videogames	Parent	CBCL	Attention Aggression Delinquency	Parent

Hosokawa	2018	1642	-	Cross-sectional	Mobile Devices	Parent	SDQ	Hyperactivity- Inattention Conduct	Parent
Jamnik	2018	184	5	Cross-sectional	TV/Videogames	Parent	CBCL	Aggression	Parent
Kahn	2020	145	4.9	Cross-sectional	Screen Time	Parent	SDQ	Externalising	Parent
Kostyrka- Allchorne	2020	520	6.7	Cross-sectional	Screen Time	Parent	SDQ	Hyperactivity- Inattention Conduct	Parent
Kovess- Masfety	2016	3195	8.7	Cross-sectional	Videogames	Parent	SDQ	Hyperactivity- Inattention Conduct	Parent Teacher
Leiner	2014	579	11.1	Cross-sectional	Videogames	Child	CBCL	Attention Aggression	Parent
Lobel	2017	194	9.22	Longitudinal	Videogames	Child	SDQ	Hyperactivity- Inattention Conduct	Parent

Milani	2015	346	11.64	Cross-sectional	Videogames	Child	CBCL	Externalising	Parent
Ozmert	2002	689	7.95	Cross-sectional	TV	Parent	CBCL	Attention Aggression Delinquency	Parent
Pujol	2016	2014	8.6	Cross-sectional	Videogames	Parent	SDQ	Hyperactivity- Inattention Conduct	Parent
Xie	2020	1897	-	Cross-sectional	Screen Time	Parent	CBCL	Attention Aggression	Parent
Yousef	2014	179	8.7	Cross-sectional	TV/Videogames	Child	CBCL	Attention Externalising	Parent

Appendix D – Ethics Approval Confirmation

Approved by Research Integrity and Governance team - ERGO II 56217.A1

UNIVERSITY OF
Southampton

ERGO II – Ethics and Research Governance Online <https://www.ergo2.soton.ac.uk>

Submission ID: 56217.A1

Submission Title: COVID-19: Supporting Parents and Young Children during Epidemics (Co-SPAYCE) (Amendment 1)

Submitter Name: Pete Lawrence

The Research Integrity and Governance team have reviewed and approved your submission.

You can begin your research unless you are still awaiting specific Health and Safety approval (e.g. for a Genetic or Biological Materials Risk Assessment) or external review.

The following comments have been made:

-
-

TId: 23012_Email_to_submitter___Approval_from_RIG Id: 249669 P.J.Lawrence@soton.ac.uk coordinator

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