Screen Time and Behaviour in Preschool-Aged Children: Associations with Sleep and Caregiver Perceptions

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This thesis is presented in partial fulfilment of the requirements for the degree of Master of Clinical Psychology, School of Psychological Sciences, The University of Newcastle, Australia.

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Declarations

Statement of Originality

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository**, subject to the provisions of the Copyright Act 1968.

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Acknowledgement of Collaboration

I hereby certify that the work embodied in this thesis has been done in collaboration with other researchers. I have included as part of the thesis a statement clearly outlining the extent of collaboration, with whom and under what auspices. The primary data collection for this study was undertaken by various team members including myself, Rachael Si Xuan Loo (Master of Clinical Psychology student), Madeleine Gale (a PhD student); Jenna Mace, Emily Brazier, Elena Stefanovska, Hayley Ayres (honours students), Darcie Fay (a work-integrated learning student) and Bret Sherwood (a summer scholarship student). We were also assisted by a research assistant, Alyssa Robson during our data collection process.

I contributed towards the development of the research question, the statistical analysis, interpretation of results and preparation of manuscript. The larger study was conceived by Dr. Emma Axelsson, Dr Alexandra Metse, and Dr Gemma Paech, who had explored associations between sleep, cognitive development, and preschoolers' engagement in an online screen time study. The online questionnaire, screen time diary, sleep diary and data collection protocol were initially developed Dr. Emma Axelsson. These materials were adapted to align with the specific hypotheses of my research. I conducted the literature

review, wrote the introduction, methods, results, and discussion section of this thesis. Dr. Emma Axelsson reviewed drafts and provided feedback for these sections. I extracted, cleaned, and prepared the raw data for analysis with the support of Dr. Emma Axelsson.

Acknowledgement of Authorship

I hereby certify that the work embodied in this thesis contains scholarly work of which I am a joint author. I have included as part of the thesis a written statement, endorsed by my supervisor, attesting to my contribution to the scholarly work. I wrote the thesis manuscript, and co-author Dr Emma Axelsson provided feedback.

Signed: Date: 03/11/2023

Sandhiya Nanthakumar (Research Student)

Signed: Date: 24/10/2023

Dr Emma Axelsson (Primary Supervisor)

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This research was approved by the Human Research Ethics Committee (HREC) at the University of Newcastle (H-2021-0216, Appendix A). The authors declared no conflicts of interest with respect to the authorship and publication of this article. The data that support the findings of this study are available from the author upon request.

This manuscript is for submission to the 'Journal of Infant and Child Development'. Submission guidelines are presented in Appendix B.

Abstract

Preschoolers often exceed the recommended one-hour per day of screen time limit. We investigated the association between screen time and behaviour (internalising and externalising) with sleep duration and caregiver perceptions of screen time in a sample of 62 preschool-aged children (aged two to five years). Sleep duration was assessed using actigraphy. Caregivers completed a measure on child behaviour, a measure on screen media use, and a screen time diary over three days. The relationship between screen time and behaviour was non-significant, but sleep duration significantly moderated the relationship. For children with short sleep durations (<8.49 hours), greater screen time was associated with greater internalising and externalising behaviours. The more caregivers viewed screen time as a calming the higher the externalising scores, but the lower the internalising scores on the measure of behaviour. Caregivers who associated conflict with setting screen limits had children with higher externalising scores. These findings provide insight into preschoolers' excessive screen time. The complexities of these relationships should be further investigated longitudinally.

Keywords: screen time, sleep, behaviour, preschool children, caregiver perception

Screen Time and Behaviour in Preschool-Aged Children: Associations with Sleep and Caregiver Perceptions

Over the past decade, technological devices have rapidly evolved, increasing accessibility, and changing the way young children engage with their environment (Arundell et al., 2022; McArthur et al., 2022). Screen time, defined as the length of time spent using digital devices with a screen (e.g., television, DVDs, electronic games, and computers) has increasingly become a regular part of young children's lives (Hinkley et al., 2018). The Australian National Guidelines recommend no more than one hour of screen time per day for children aged two to five years old (Josh & Hinkley, 2021). This recommendation aligns with international guidelines which suggest children under the age 4 years old should have no more than one hour of sedentary screen time (WHO, 2019). However, only 17% to 23% of children in this age group currently meet these guidelines (Howie et al., 2020). Early childhood, between the ages of three to five, has been identified as an important period of physical, brain, cognitive, and psychosocial development (Hanson et al., 2021; Wachs et al., 2014). Behaviours established during these years are foundational in the development of healthy behaviours as they can continue throughout development (Hinkley et al., 2018). With the rise in screen time, it is important to investigate screen time and behavioural outcomes amongst preschool-aged children.

Screen Time and Behaviour

Childhood externalising and internalising behaviours are significant public health concerns, and it is, therefore, important to understand what factors and/or activities contribute towards these behaviours (Mesman et al., 2001; Patwardhan et al, 2021). Externalising behaviours are characterised by impulsivity, aggression, and hyperactivity, whereas internalising behaviours are characterised by symptoms of anxiety, depression, loneliness, and sadness (Patwardhan et al., 2021). Children with internalising and externalising

behaviours are at an increased risk for psychopathology and maladaptation later in life (Eisenberg et al., 2005). Understanding activities that contribute to or exacerbate certain behaviours during the foundational years of childhood could help in ameliorating adverse consequences.

An increase in screen-related activities, which is largely sedentary in nature, has been associated with adverse behavioural outcomes (Hinkley et al., 2018; Kahn et al., 2021). A significant dose-response relationship between excessive screen time and behavioural and conduct problems has been found amongst preschoolers (Qu et al., 2023). Screen-based activities can reduce opportunities for more beneficial activities, such as interacting with peers or parents, impacting behavioural development and socialisation skills (Hinkley et al., 2018; Kirkorian et al., 2008). Increased screentime is also linked with decreased time for physical activities, which can have detrimental outcomes for cardiovascular health, psychosocial well-being, and academic achievements later in life (Hinkley et al., 2018). Screen time has also been associated with poorer scores on measures of cognition, language, and motor development (Hanson et al., 2021).

Findings on the relationship between screen time and behavioural outcomes in preschoolers have been inconsistent (McArthur et al., 2022; Oliveira et al., 2022; Tamana et al., 2019). One study found that preschoolers with higher levels of screen time was associated with increased externalising and internalising problems (McArthur et al., 2022). On the other hand, a cross-sectional study in the UK found no significant association between screen time and behavioural problems in preschoolers (Tamana et al., 2019). In a longitudinal study, Neville et al. (2021) sought to understand the bi-directional associations between screen time and externalising and internalising behaviours and found contrasting associations. They found that increased screen time was not significantly associated with externalising behaviours when reassessed three years later (Neville et al., 2021). Contrastingly, increased

screen time during the preschool years was associated with increased internalising behaviours three years later (Neville et al., 2021). Another cross-sectional study found that prolonged time on screen-based activities was associated with an increased risk of clinically significant externalising behavioural problems, and a significant relationship with inattention problems (Xie et al., 2020). The current findings are varied and inconsistent, necessitating further investigation.

Screen Time and Sleep

Sleep is crucial for child development, and children who get adequate sleep experience cognitive, social, and behavioural benefits (Beyens & Nathanson, 2019; Hale et al., 2018; Mukherjee et al, 2015). Australian sleep guidelines suggest that preschool-aged children require 10 to 13 hours of sleep in a 24-hour period (Pamula et al., 2017). Long-term relationships have been found between inadequate sleep during early childhood with psychosocial problems later in life (Hale et al., 2018). Screen time amongst preschoolers is associated with delayed bedtime, shorter sleep duration, longer sleep onset latency and overall reduced sleep quality (Hale et al., 2018; Janssen et al., 2020).

Multiple mechanisms have been theorised to explain the relationship between excessive screen time and sleep disturbances. Firstly, the content of screen-based activities may increase arousal impacting the onset of sleep (Parent et al., 2016). Specifically, screen content as well as the timing of screen time have been theorised to affect sleep; with violent content and evening time viewing associated with increased sleep problems (Garrison et al., 2011). Moreover, exposure to artificial light emitted from screens may also increase physiological arousal and alertness at night, affecting a child's circadian rhythms (Magee et al., 2014; Parent et al., 2016). Current findings regarding the associations between sleep and screen time during this critical preschool age range is inconsistent and the overall quality of current research has been argued to be low due to the reliance on subjective measures to

determine sleep duration and quality (Garrison et al., 2011; Janssen et al., 2020). Utilisation of subjective measures of sleep may be imprecise as parents tend to overestimate their child's sleep duration and are not fully aware of the frequency of night-time awakenings (Sadeh, 1996).

Screen Time and Caregiver Perceptions

A caregiver's understanding and perception of the usage and purpose of digital devices may impact the duration of screen time in preschoolers (Sanders et al., 2016). For example, caregivers may provide additional screen time to their children to address or manage behavioural issues (Tamana et al., 2019). When parents use screen time to address behavioural issues, parental-child interactions reduce (Zhao et al., 2018). Zhao et al. (2018) found in a cross-sectional study that parental-child interactions were a significant mediating factor in the relationship between screen time and psychosocial wellbeing in preschoolers. This suggests that the use of screen time as a tool to manage maladaptive behaviours may be counterproductive as they reduce opportunities for parental-child interactions, increasing the risk of poor psychological wellbeing. Literature suggests that there are varied caregiver perceptions of children's use of screens varies with many caregivers viewing technological devices as a useful tool for academic success (Ortiz et al., 2011). and some conscious about the negative impact of digital media on their child's behaviour (Padilla-Walker & Coyne, 2011). Restrictions on screen use have been associated with family conflict, with 62% of parents reporting that screen time restrictions led to conflict (Halpin et al., 2022). This suggests that implementing screen time restrictions in alignment with national guidelines is complicated by behaviours exhibited by children. Further understanding regarding associations between caregiver perceptions and child behaviour could provide better insight into why many preschoolers engage in screen time durations beyond national guidelines.

Screen Time Duration, Sleep Duration, and Caregiver Perceptions

It is difficult to know if poorer behavioural outcomes associated with screen time are due to screen time alone or are due to the poor sleep typically associated with screen time and with behaviour (Kahn et al., 2021; Qu et al., 2023). Current studies exploring associations between screen time and behaviour with the moderating effect of sleep amongst preschoolers is limited. There are only two known studies that have attempted to understand this association. Wu et al. (2017) found in a large sample of 8900 preschoolers in China that increased screen time and shorter nighttime sleep duration was associated with an increased risk of experiencing emotional and behavioural problems. The findings of this study were however limited due to self-report data of night-time sleep duration. In a study employing actigraphy as a measure of sleep, Kahn et al. (2021) found that the link between screen time and behavioural problems was only significant when preschoolers night-time sleep duration was 9.88 hours or less. Children who are sleep deprived may lack the regulatory abilities to mitigate the negative impacts of screen time, highlighting the important moderating role that sleep duration plays in the interplay between screen time and behaviour (Kahn et al., 2021).

The interaction between screen-based activities, behaviour and night time sleep should be adequately understood to inform parental guidelines, particularly given the inconsistent findings regarding the associations between screen time and behaviour amongst preschoolers (Neville et al., 2021; Oliveira et al., 2022; Tamana et al., 2019).

Caregivers are an important determinant of the daily activities of preschoolers. Thus, investigating caregiver perceptions of screen time and their associations with child behaviour would allow better understanding of children's screen times in this age group (Essex et al., 2022; Sanders et al., 2016). There are no known studies that have investigated the association between caregiver perception of screen time and preschoolers' behaviour.

This present study is therefore aimed at investigating the association between screen time and behaviour with consideration of nighttime sleep duration amongst preschool-aged

children. It was predicted that increased screen time duration would be associated with increased externalising and internalising behaviours and this relationship would be moderated by night sleep duration.

This study also aimed to investigate the association between caregiver perception of children's screen time and child behaviour. Whilst there are no known findings regarding the association between caregiver perception of screen time and child behaviour, Zhao et al. (2018) found that screen time can be perceived as a tool to manage externalising behaviours (Zhao et al., 2018). It was therefore hypothesised that increased child externalising behaviours may be associated with caregivers being more likely to (1) associate conflict with imposing screen limits and (2) interpret screen time as have a calming effect on their child.

Methods

Participants

Participants were recruited using advertisements on social media platforms (Facebook and Instagram), and flyers distributed at community settings (e.g., private preschools, libraries, community events, swimming pools) and through word of mouth (See Appendix C). The inclusion criteria required participants to be within driving distance to the university and to be within the age range of 2 years 10 months 16 days and 5 years 5 months (based on the Ages and Stages Questionnaire-3 as part of the larger study). Participants diagnosed with any neurodevelopmental or mental health disorders were excluded from the study. All participants and caregivers resided in and around the Hunter region of New South Wales.

Materials

Screen Time Diary

Caregivers completed a hard copy screen time diary where they recorded their child's screen time durations on each of three days of the study. The screen time diary was adapted from the SCREENS-Q questionnaire (Klakk et al., 2020). Caregivers were asked to specify

the duration of time engaged with different content types (educational, relaxing and/or entertainment) for each day of the study. Specifically, they were asked "*How much time did the child spend on the following [content type] screen-based activities?*". For each content type they were provided with 5-6 subcategories each with the following time intervals to select from 'none', '1 – 15 mins', '15 – 30 mins', '30 – 45 mins', '45 – 60 mins', '1.5 – 2 hours', '2 – 2.5 hours', '2.5 – 3 hours', '3 – 4 hours', '4 – 5 hours' or '5+ hours'. The midpoint value of each item was used to determine the screentime duration (Klakk et al., 2020). The screentime durations was summed over the subcategories for the three content types for each day. Then, the daily totals were averaged over the three days. Consistent with previous research, we ensured that children's screen time were recorded on least one weekday and one weekend day (Carson & Kuzik, 2017; Kahn et al., 2021; Madigan et al., 2021).

Online Questionnaire

The following sets of questions were presented using QuestionPro software (QuestionPro, 2023).

Sociodemographic Information. Information regarding the child's date of birth, country of origin, health history, caregivers' years of education and age, ethnicity was obtained through the online platform.

Caregiver Perception of Child's Media Use. The SCREENS-Q questionnaire covers different domains relating to child screen media use, their habits, their screen media environment as well as parental perception (Klakk et al., 2020). Two items of interest from the SCREENS-Q were from a set of 17 questions about caregivers' perceptions of their child's screen use: "*The use of screen media often helps the child calm down*" and "*It often causes conflict if I try to limit the child's screen media use*" (Klakk et al., 2020). Items were rated on a 4-point Likert scale ranging from "strongly agree" (1) to "strongly disagree" (4).

The caregiver perception of child's media use domain of the SCREENS-Q has demonstrated to have fair to almost perfect test-retest reliability, with an observed agreement of up to 99.6% (Klakk et al., 2020).

Child Behaviour Checklist Questionnaire (CBCL, 1.5-5 years; Achenbach & Rescorla, 2000). The CBCL is a standardised 99-item questionnaire where caregivers provide ratings about their child's emotions and behaviours over the past 2 months (Achenbach & Rescorla, 2000). Items were rated on a three-point Likert scale where caregivers are asked to endorse how true each of the statements are of their child (on a scale of 'not true', 'somewhat or sometimes true', 'very true or often true'). The CBCL provides a total score which indicates clinical status, as well as two broad-band scores categorised into total externalizing and total internalizing scores (Heflinger et al., 2000). Raw scores are transformed into T-scores to allow comparison with children from the same gender and age (Bordin et al., 2013). The cutting points for clinical status are based on these T-scores (Achenbach & Rescorla, 2000).

Actigraphy

Participants were provided with a 'Motion Watch 8' actigraphy watch (CamNtech, 2022) to wear for three nights. This wrist-worn actigraphy watch was used to objectively measure sleep duration (Fekedulegn et al., 2020). The MotionWatch 8 utilises a tri-axial digital accelerometer; allowing full range of movement to be measured during sleep time (CamNtech, 2022). The accelerometer was set to a two-second epoch to allow for recording over three nights, with movement measured every two seconds during the participants' sleep (Altenburg et al., 2021). The actigraphy watch has been validated against a polysomnography instrument and the two-epoch setting has been shown to accurately detect movement (Altenburg et al., 2021; CamNtech, 2022). The actigraphy watch has been validated for measuring sleep in preschool aged children (Belanger et al., 2013). The participants were

asked to wear the actigraphy watch over the entire three days. MotionWare software was utilised to extract data and calculate total night-time sleep duration (CamNtech, 2022). Total night sleep duration is calculated by subtracting the participants' wake time from their assumed sleep time and this value was averaged across the three nights of the study (CamNtech, 2022).

Sleep Diary

Caregivers were also asked to complete a hard copy sleep diary for the duration of the study. Caregivers provided information on their child's bedtime, morning wake time, the time they got out of bed, any night awakenings, and naps. This sleep diary was used to help interpret the actigraphy data and was used as contingency if the participant failed to wear the watch.

Procedure

This study was ethically approved by the University of Newcastle's Human Research Ethics Committee (Approval number: H-2021-0216) (See Appendix A). When caregivers expressed interest in the study via email, participants were screened for suitability prior to involvement in the study and provided with an information sheet (See Appendix D) via email. Two dates (one weekday and one weekend date) were organised for the caregiver and participant to attend the campus on the first day and after three days of the study. During the first visit to the campus, caregivers were provided with a consent form (See Appendix E), a link to the online questionnaire, the screen time diary, and the sleep diary to complete. Participants also completed language and cognitive tasks on an iPad as part of data collection of the broader study. During this visit, the actigraphy watch was fitted onto the participant's non-dominant hand. Caregivers were advised to keep the watch on the participant for the duration of the study (three nights, four days). During the second visit, all instruments were collected from the caregiver and the participant completed any remaining tasks for the

broader study. Upon completion of all questionnaires, caregivers were provided with a $AUD20 ‘Booktopia’ voucher as a token of appreciation for their involvement in the study.

Study Design and Data Analysis

This study was a cross-sectional study with a within-groups correlational design. Data was collected between July 2022 and August 2023.

The collected data was analysed using Jamovi 2.3.28.0. The first set of analyses utilised the “medmod” package to conduct moderation analyses. Specifically, the association between screen time and child behaviour and whether this association was moderated by sleep duration was assessed. The analysis was conducted separately for the total internalizing and externalizing T-scores. These were followed by simple slopes analyses that provided the associations between screen time and internalizing and externalizing T-scores and three levels of sleep duration: one standard deviation (*SD*) below the mean, one *SD* above the mean and the durations between +/1 *SD* of the mean.

The second set of analyses involved hierarchical multiple regression models to assess the relationship between children’s behaviour and caregivers’ perception of screentime. The analysis was conducted separately for the two items of interest on the SCREENS-Q (“*The use of screen media often helps the child calm down*” and “*It often causes conflict if I try to limit the child’s screen media use*”) (Klakk et al., 2020). The predictor variables were child age, caregiver years in education, total externalizing T-score and total internalizing T-score. Child age and caregiver age were input into the model first as previous literature indicates that the age of the child and caregiver factors may influence our variables of interest (Rues & Mosley, 2018).

Results

The final sample consisted of 62 children, with 28 male and 34 female participants *(M* age = 4.17*, SD* = 0.71; age range: between 2 years, 11 months, 8 days to 5 years, 7 months,

18 days; 28 males, 34 female*).* 57 caregivers completed the online questionnaire (see Table 1). All participants wore an actigraphy for the duration of the study.

Table 1

Sociodemographic Characteristics Self-Reported by Caregivers

Caregiver Characteristic	*N* = 57
Age - years (mean, *SD*)	36.39 (4.83), range:
Mother (*n* = 53)	36.39 (4.83)
Father (*n* = 4)	34.83 (4.01)
Years of education (mean, *SD*)	17.5 (2.53)
Educational attainment	
Year 10	1 (2%)
Higher School Certificate	3 (5%)
Diploma	8 (14%)
Undergraduate Degree	28 (50%)
Master's degree	13 (23%)
PhD	3 (5%)
Ethnicity	
Australian	40 (71%)
Australian-European	9 (16%)
Asian	4 (7%)
Australian-Asian	1 (1%)
European	1 (1%)
New-Zealander	1 (1%)

Screen Time and Externalizing T-Scores

The online questionnaire was completed in its entirety by 52 caregivers. Some items on the questionnaire were left uncompleted by caregivers, resulting in variability in the total number for each variable (see Table 2). First, the relationship between screen time duration and the externalizing T-scores with sleep duration as a moderating variable was assessed (see Table 1 for descriptive statistics). Screen time duration was positively skewed. After a square

root transformation, this improved the distribution (square-root screen time: $M = 9.15$, $SD = 3.88$). The relationship between screen time and the externalizing T-scores was non-significant ($b = 0.34$, CI [-0.25, 0.92], $Z = 1.12$, $p = .260$). The relationship between sleep duration and the externalizing T-scores was significant ($b = -0.06$, CI [-0.10, -0.01], $Z = -2.50$, $p = .01$). The shorter sleep, the higher (i.e., poorer) the externalizing T-scores. Night sleep duration did not significantly moderate the relationship between screen time and the externalizing T-scores ($b = -0.02$, CI [-0.03, 0.0023], $Z = -1.71$, $p = .088$).

Table 2

Descriptive Statistics for Screen Time, Night Sleep, and Behaviour

	n	*M*	*SD*
Average screen time (mins)	62	98.6	76.2
Average night-time sleep duration (mins)	62	559	49.9
Total internalizing T-scores (CBCL)	52	46.8	10.5
Total externalizing T-scores (CBCL)	52	46.2	9.04

However, a follow-up simple slopes analysis revealed a significant relationship between screen time duration and total externalizing T-scores at low levels of night sleep duration. Higher screen time significantly predicted higher externalizing T-scores at short levels of sleep (509.1 minutes/8.49 hours and below). The relationship between screen time duration and externalizing T-scores at average (559 minutes/9.32 hours) and long levels (608.9 minutes/10.1 hours and above) of night sleep duration was non-significant (see Table 3 and Figure 1).

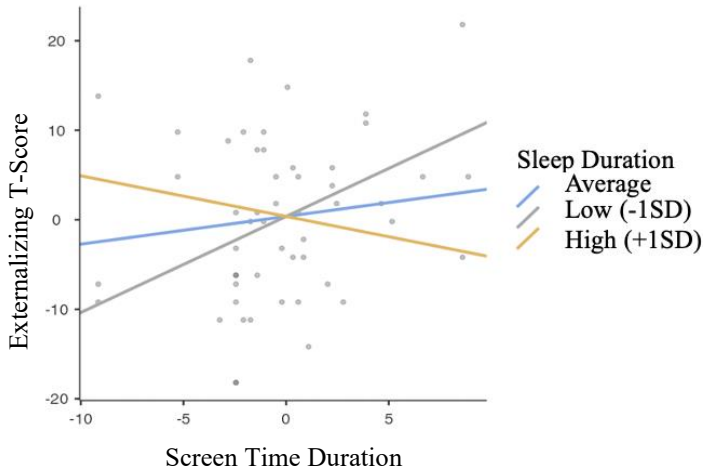
Table 3

Simple Slopes Estimates of the Relationship Between Screen Time and Externalizing T-Scores at Different Levels of Night-Sleep Duration

			95% Confidence Interval			
	Estimate	*SE*	Lower	Upper	*Z*	*p*
Average	0.31	0.32	-0.32	0.94	0.96	.335
Short (-1 SD)	**1.07**	**0.49**	**0.12**	**2.03**	**2.20**	**.028**
Long (+ SD)	-0.45	0.62	-1.66	0.75	-0.74	.462

Figure 1

Simple Slopes Plot of the Relationship Between Screen Time and Externalising T-Scores at Different Levels of Night-Sleep Duration



Screen Time and Internalizing T-Scores

The internalizing T-scores were positively skewed. The scores were square-root transformed which improved the distribution (square-root transformed internalizing T-scores: $M = 6.8$, $SD = 0.76$). The relationship between screen time and the internalizing T-scores was non-significant ($b = 0.02$, CI [-0.03, 0.07], $Z = 0.72$, $p = .472$). The relationship between

night sleep duration and the internalizing T-scores was also non-significant (*b* = -0.0035, *CI* [-0.00726, 1.94], *Z* = -1.86, *p* = .063). However, when moderated by night sleep duration, there was a significant negative relationship between screen time and the internalizing T-scores (*b* = -0.0020, *CI* [-0.0035, -5.61], *Z* = -2.71, *p* = .007).

A follow-up simple slopes analysis revealed a significant relationship between screen time and the internalizing T-scores at short levels of sleep duration (see Table 4). Higher screen time significantly predicted higher internalizing T-scores at short levels of sleep (509.1 minutes/8.49 hours and below). The relationship between screen time and the internalizing T-scores at average (559 minutes/9.32 hours) and long levels (608.9 minutes/10.1 hours and above) of sleep duration were non-significant (see Figure 2).

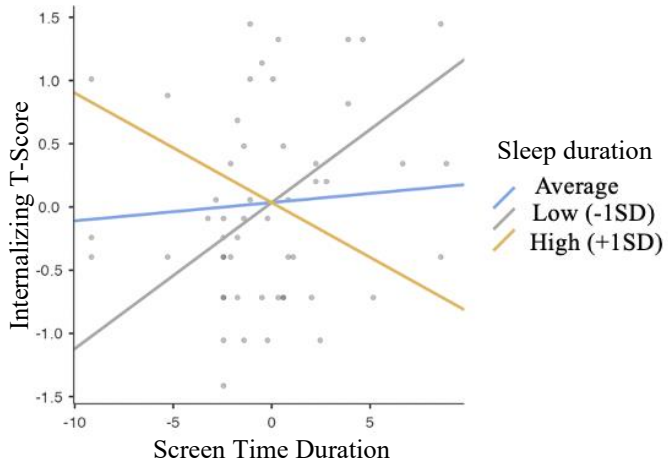
Table 4

Simple Slopes Estimates of the Relationship Between Screen Time Internalizing T-Scores at Different Levels of Night-Sleep Duration

			95% Confidence Interval			
	Estimate	*SE*	Lower	Upper	*Z*	*p*
Average	0.01	0.03	-0.04	0.07	0.50	.617
Short (-1 SD)	**0.12**	**0.04**	**0.03**	**0.20**	**2.70**	**.007**
Long (+ SD)	-0.09	0.05	-0.19	0.02	-1.63	.103

Figure 2

Simple Slopes Plot of the Relationship Between Screen Time and Internalizing T- Scores at Different Levels of Night-Sleep Duration



Caregiver Perception

Screen Time Helps My Child Calm Down

Next, how much children's behaviours predicted caregivers' perceptions that screen time helps calm their child was assessed (see Table 5 for descriptive statistics). Child age and caregivers' years in education were first entered into the model. The model fit was non-significant (R^2_{adj} = 0.02, F(2,49) = 1.65, p = .202), the two predictors (child age and caregivers' years of education) were also non-significant (see Table 6). A second model was added which included children's externalizing and internalizing T-scores. There was a significant model fit (R^2_{adj} = 0.20, F(4,47) = 4.27, p = .005) and a significant difference between the models (ΔR^2 = 0.20, F(2,47) = 6.52, p = .003). In the final model, caregiver years of education was a significant predictor (see Table 7). Specifically, the higher the years of education, the more the caregiver disagreed that screentime helps calm their child. The externalizing T-scores were a significant negative predictor. Specifically, the higher the externalizing T-scores (i.e., poorer), the more the caregiver agreed that screen time helps calm their child (see Figure 4). The internalizing T-scores were also a significant positive

predictor (see Figure 5). The lower the total internalizing T-scores, the more the caregiver disagreed that screen time helps calm their child. The graph includes original internalizing T-scores for ease of interpretation.

Table 5

Proportions of Caregivers' Selections of the Likert Scores for the Perceptions of Screen Time

Caregiver's perception	Strongly Agreed	Partly Agreed	Partly disagreed	Strongly disagreed
Screen time limit causes conflict	10.7%	33.9%	35.7%	19.6%
Use of screen time helps my child calm down	14.3%	53.6%	16.1%	16.1%

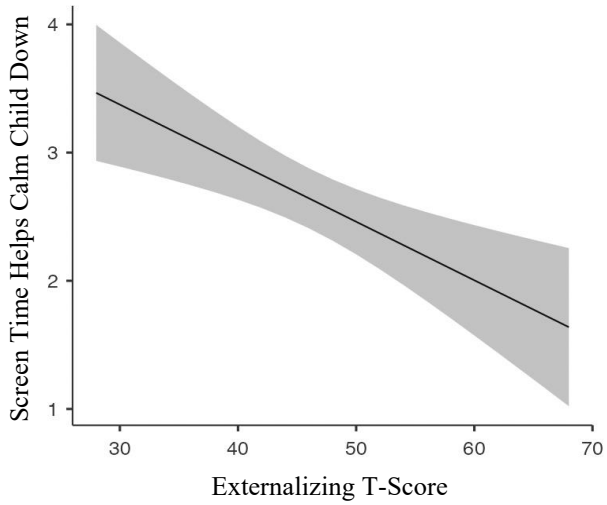
Table 6

Hierarchal Multiple Regression to Assess Child Behaviour and Caregiver Perception "Screen Time Helps Calm My Child Down"

				95% Confidence Interval			
Model	Predictor	Estimate	*SE*	Lower	Upper	*t*	*p*
1	(Intercept)	0.54	1.09	-1.66	2.74	0.49	.625
	Caregiver Years of Education	0.09	0.19	-0.33	0.43	0.29	.777
	Child Age in Months	0.05	0.06	-0.02	0.21	1.66	.104
2	(Intercept)	-0.74	1.35	-3.45	1.98	-0.55	.590
	Caregiver Years of Education	**0.16**	**0.06**	**0.05**	**0.28**	**2.85**	**.006**
	Child Age in Months	0.11	0.17	-0.24	0.45	0.63	.530
	Externalizing T-Score	**-0.06**	**0.02**	**-0.10**	**-0.03**	**-3.61**	**<.001**
	Internalizing T-Score	**0.41**	**0.20**	**0.02**	**0.81**	**2.10**	**.041**

Figure 3

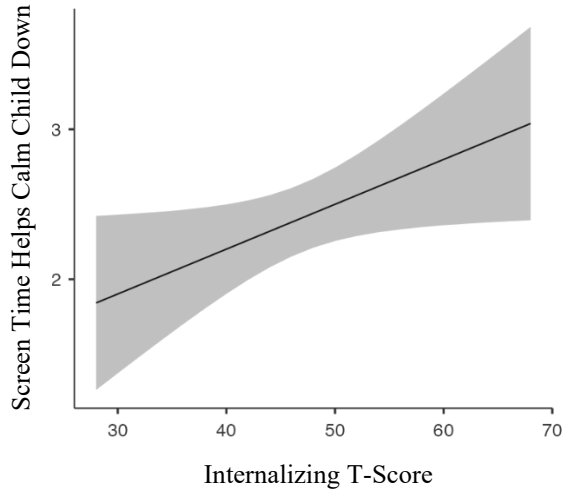
Externalizing T-Scores as Predictor of Caregivers' Perception 'Screen Time Calms Child Down'



Note. Higher caregiver perception scores indicate greater disagreement with statement.

Figure 4

Internalizing T-Scores as Predictor of Caregiver Perception 'Screen Time Calms Child Down'



Note. Higher caregiver perception scores indicate greater disagreement with statement.

Screen Time Limits Causes Conflict

Child age and caregivers' number of years in education were first entered into the model, which led to a non-significant fit ($R^2_{adj} = 0.04$, $F(2,49) = 1.97$, $p = .150$,see Table 6). A second model including the externalizing and internalizing T-scores was significant ($R^2_{adj} = 0.29$, $F(4,47) = 4.87$, $p = .002$), and there was a significant difference between the models ($\Delta R^2 = 0.22$, $F(2,47) = 7.27$, $p = .002$). Child age was a significant predictor of the caregiver's belief that screen time limits cause conflict (see Table 7). Specifically, the younger the child, the more the caregiver disagreed that screen time limits create conflict. The externalizing T-scores were also a significant negative predictor. The higher the total externalizing score (i.e., poorer), the more the caregiver agreed that screen time limits cause conflict.

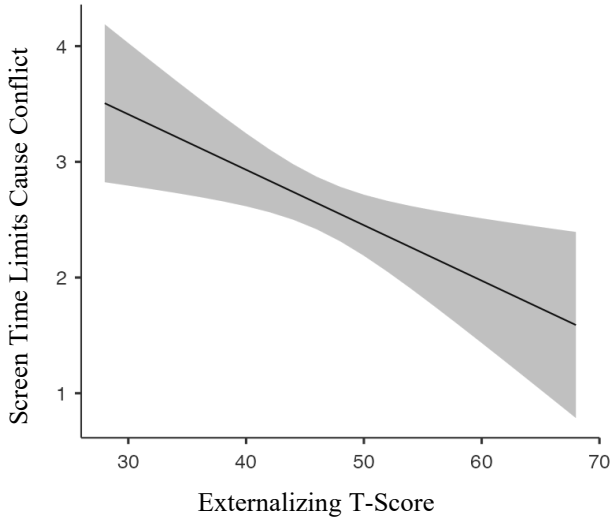
Table 7

Hierarchal Multiple Regression to Assess Child Behaviour and Caregiver Perception "Screen Time Limits Cause Conflict"

				95% Confidence Interval			
Model	Predictor	Estimate	*SE*	Lower	Upper	*t*	*p*
1	(Intercept)	4.00	1.11	1.78	6.23	3.61	<.001
	Caregiver Years of Education	0.01	0.06	-0.11	0.13	0.18	.860
	Child Age in Months	-0.37	0.19	-0.76	0.01	-1.95	.056
2	(Intercept)	5.23	1.35	2.51	7.94	3.88	<.001
	Caregiver Years of Education	0.10	0.06	-0.01	0.22	1.81	.078
	Child Age in Months	**-0.36**	**0.17**	**-0.71**	**-0.02**	**-2.10**	**.041**
	Externalising Score	**-0.05**	**0.02**	**-0.08**	**-0.01**	**-2.72**	**.009**
	Internalising Score	-0.10	0.20	-0.50	0.30	-0.51	.61

Figure 5

Externalizing T-Scores as Predictor of Caregiver Perception 'Screen Time Limits Cause Conflict'



Note. Higher caregiver perception scores indicate greater disagreement with statement.

Further Exploratory Analysis. Our findings raised questions on whether caregivers who tended to agree more with the statement *"Screen time limits cause conflict"* were allowing their child to engage with screens for longer durations. Thus, a linear regression analysis between the perception *'screen time limits cause conflict'* and screen time duration was conducted. The relationship between the two variables were significant ($R^2_{adj} = 0.20$, $F(1,54) = 14.8$, $p = <.001$). Greater agreeance with the statement was significantly associated higher screen time duration.

Discussion

The current study was aimed at investigating the association between screen time and behaviour with consideration of nighttime sleep duration. We also aimed to further understand the association between caregivers' perception of their child's screen time and child behaviour. The average screen time duration for our sample was 1.64 hours per day, which is above both Australian and World Health Organization (WHO) guidelines for screen

time of one hour of screen time per day (Joshi & Hinkley, 2021; WHO, 2019). The average night-time sleep duration for our sample was 9.32 hours, which is below the Australian 24-hour sleep guidelines which state that preschool-aged children require 10 to 13 hours of sleep (Pamula et al., 2017).

Screen Time Duration and Behaviour

Our initial hypothesis that increased screen time duration would be associated with increased internalising and externalising behaviours was not supported. Our results indicated that the direct relationship between screen time and both externalising and internalising behaviour was positive but non-significant. These findings do not align with previous findings that increased screen time is associated with a risk of poorer psychosocial wellbeing, poorer behavioural outcomes, and increased externalising behaviours in pre-school aged children (McArthur et al., 2021; Tamana et al., 2019; Xie et al., 2020; Zhao et al., 2018). There has however been a previous cross-sectional study that did not find an association between increased screen time and problem behaviour (Tansriratanawong et al., 2017).

Our findings perhaps reinforce the idea that behaviour is a multi-faceted construct that might have multiple correlates, and factors such as media content type, family contextual factors, parental mental health were not accounted for in the current study (Axelsson et al., 2022; Hajal & Paley, 2020; Malcolm-Smith et al., 2023). Specifically, both cross-sectional and longitudinal studies have suggested that screen media with violent content is significantly associated with increased aggressive behaviour in preschool-aged children (Coyne et al., 2017; Daly & Perez, 2009). Contrastingly, educational screen content has been demonstrated to benefit children in learning empathy and antiviolent attitudes (Thakkar et al., 2006). Additionally, a child's home environment could inevitably impact their behaviours. For example, a single parent household can have significant impacts on a child's behaviour and their access to screen time (Xie et al., 2020). Single caregivers have been reported to provide

more leeway regarding screen time restrictions (Xie et al., 2020). Caregiver mental health is also a significant positive predictor of preschool behavioural disorders (Karimzadeh et al., 2017). Put together, there are several factors that were not taken into consideration in this study that may have attributed towards finding of no significant association between screen time and behaviour (e.g., media content, child home environment, and caregiver mental health).

Furthermore, studies that found an association between higher problem behaviours (e.g., externalising and internalising) with increased screen time duration used different methods to categorise screen times. Specifically, these studies categorised high and low screen time based on whether screen time duration was more than one hour (McArthur et al., 2022). This differential assessment of screen time as well as a smaller sample size within our study may have accounted for the differences in findings.

Screen Time Duration, Behaviour and Night-Time Sleep Duration

Our hypothesis that the association between screen time duration and externalising behaviour would be moderated by nighttime sleep duration was not supported, but it was for internalising behaviour. In the follow-up simple slopes analyses, there was a significant relationship between screen time duration and behaviour at short nighttime sleep durations. This was the case for both internalising and externalising behaviours. Our findings align with previous literature that found a link between screen time duration and increased behavioural problems, with an actigraphy study reporting a significant relationship for children with sleep duration of 9.94 hours and less (Wu et al., 2016). Our results indicate an association between screen time and increased externalising and internalising behaviour at 8.48 hours or less of nighttime sleep, reinforcing that at lower levels of nighttime sleep, the relationship between screen time and behaviour might be problematic. In contrast, as the relationship was non-significant at average and long levels of nighttime sleep, suggesting that nighttime sleep may

play less of a role in the adverse behavioural consequences associated with increased exposure to screens.

Shorter sleep duration has been found to be associated with poorer emotional regulation in preschool-aged children, with children with higher durations of sleep shown to demonstrate better self-regulation strategies (Berger et al., 2012). Participants in our study within the short night sleep duration group had sleep durations that were below Australian and WHO recommendations for sleep (Pamula et al., 2017; WHO, 2019). Our study however did not account for day-time sleep duration. Research indicates that the prevalence of habitual napping decreases from three to four years of age (Spencer et al., 2016; Weissbluth, 1995). Sleep duration outside of the recommended range is associated with inattention, learning problems, mental health problems as well as increased risk of accidents and injuries (Paruthi et al., 2016).

Screen Time, Behaviour and Caregiver Perceptions

Our study sought to investigate the relationship between children's behaviour and caregivers' perception of their children's screen time. We found that higher externalising behaviours and lower internalising behaviours predicted a higher level of agreement regarding the statement "*The use of screen media often helps the child calm down*". Fewer years of caregiver education significantly predicted higher level of agreement with the statement when behaviour was added to the model. The relationship between increased externalising behaviour and greater agreeance that screen media can be calming for the child may be explained by literature that suggests that screen media is often used a short-term solution to manage emotional outbursts (Radesky et al., 2014). The understanding of differential temperamental and regulatory behaviours between children who present with internalising problems versus children with externalising problems could perhaps explain our findings (Blair et al., 2004). Specifically, inhibitory behaviours of negative emotionality are

predictive of internalising behaviours (Blair et al., 2004). Children with more internalising problems socially withdraw to cope with their emotions (Blair et al., 2004). Contrastingly, aggression is a maladaptive way a child with externalising problems may cope with their emotions (Blair et al., 2004). Put together, caregivers may be less likely to interpret digital media to have a calming impact when a child presents with increased inhibitory behaviours at baseline. On the other hand, caregivers with children with greater externalising behaviours who demonstrate more overt manners for emotional regulation may be more likely to interpret screen time to have a calming impact.

When child internalizing and externalizing behaviour were introduced into the model, fewer years of caregiver education predicted the belief that screen time can help calm their child. This suggests a complex interplay between child behaviour and caregiver education may impact perception regarding screen time use. Studies have also previously reported that parental cognitive factors are important predictors of preschool children's screen time (Carson & Janssen, 2012). Prior research indicates that caregivers with greater years of education reported lower screen time duration in comparison to caregivers with less years of education (Maatta et al., 2017). Caregivers with lower years of education may be less able to manage problem behaviours or have less information regarding the negative consequences of excessive screen time.

The second aspect of caregivers' perception that was explored in our study was the association between behaviour and caregivers' limits on screen time. We found that caregivers with children that demonstrated increased externalising behaviours were more likely to agree that *"It often causes conflict if I try to limit the child's screen media use".* Moreover, when behaviour was introduced into the model; older child age was a significant predictor of whether caregivers would agree with the statement. Greater agreeance with this statement was also associated with greater screen time duration. These findings align with

literature that suggests that caregivers are more likely to allow children who have trouble down regulating anger to have increased screen time (Fitzpatrick et al., 2022). Screen time has also been shown to increase across development (Tandon et al., 2012). Put together, perhaps an interplay between disruptive behaviour and increased leniency regarding accessibility to screen media as children age could explain our findings.

Internalising behaviours were not found to be a significant predictor of agreeance to the statement that *"It often causes conflict if I try to limit the child's screen media use."*. The word 'conflict' perhaps insinuates a more externalising association. Specifically, internalising behaviours such as withdrawal and inhibition are less likely to be interpretated as discord by parents (Blair et al., 2004). Whereas children with externalising problems such as anger and aggression demonstrate a lower ability to control their behaviours when rules are imposed on them (Fitzpatrick et al., 2022). These findings provide us with insights into why caregivers have trouble in limiting screen time usage. Screen time is often utilised as a reward or to control a child's behaviour (Neshteruk et al., 2021). Over time, this may be detrimental as this may reinforce the child to display disruptive behaviour to obtain more screen time. Specifically, if caregivers are allowing screen time use to mitigate any expressions of defiance by the child; over time this may increase the behaviour.

Limitations and Future Directions

Whilst our findings shed unique perspectives on these relationships, there are several limitations that should be considered. A bidirectional association cannot be concluded from our study due to the cross-sectional design. Specifically, whether increased screen time results in poor behavioural outcomes, or if behavioural problems lead to increased screen time duration is unclear. Further, we have some initial understandings regarding the associations between caregiver perceptions, screen time, and behaviour. Future studies should

seek to understand the direction of the association between screen time duration and behaviour using a longitudinal study design.

Our study was based on primary caregiver reports on child behaviour and screen time. However, the use of multiple informants (such as preschool teachers and a secondary caregiver) and comparative information is essential for effective assessment of child psychopathology (Grigorenko et al., 2010). Multiple informants would have increased reliability and provided more accuracy in terms of both the behaviour scores and screen time. Since behavioural problems and screen times were exclusively reported by primary caregivers, the data may be subject to social desirability bias and imprecision. Further studies should utilise data from multiple informants to measure behaviour to help reduce any bias in the data. Measurement of screen time duration using an objective measure such as directly obtaining screen duration data from technological devices would increase precision.

Future studies could seek to understand caregivers' awareness regarding screen time duration. Specifically, including a question on the online questionnaire regarding their current knowledge of screen time guidelines could have contributed to us to further understand why many participants exceeded screen time guidelines. An exploration of caregiver awareness would allow us to ascertain whether lack of knowledge is a contributing factor towards inflated screen times.

Additionally, differential components of screen time may also impact behavioural outcomes such as interactivity with media content, and screen content types (Axelsson et al., 2022). The use of screens in an interactive manner may have differential impacts on behaviour. Specifically, increased parental involvement in the selection of screen content mediates the likelihood that children will watch inappropriate and/or fast-paced content which can have negative behavioural consequences (Swider-Cios et al., 2023). Further, screen content that specifically facilitates learning or actively engages children using visual

and auditory cues can be beneficial to both working memory and attention skills (Barr, 2019). In contrast, it has been found that children who engage in screen content with someone else is associated with lower problem-solving skills (Axelsson et al., 2022). Thus, future studies should assess the association between screen time and behaviour in a more comprehensive manner by investigating the nature of interaction with screen content and division of screen media into different content types.

Similarly, healthy sleep is not limited to night-sleep duration but also other factors such as appropriate timing, sleep quality, sleep latency, napping, and regularity (Gruber et al., 2014). Daytime sleep was not accounted for within our study. Our findings are therefore limited by this factor as increased daytime sleep may have impacted night-time sleep duration as well as overall sleep quality. Our future studies should account for these variables in our analyses to increase validity of our findings.

Conclusion and Practical Implications

Our findings provide insights into the relationships between screen time, night-time sleep, and behaviour. Investigations into these relationships among preschoolers utilising an objective measure of sleep have been limited. Our findings indicate that the relationship between screen time and behaviour is moderated by short sleep duration. The results also indicated, caregivers that are more likely to interpret screen time as having a calming effect are more likely to have greater years of education and children that exhibit externalising behaviours. Whereas caregivers' who do not interpret screen time to have a calming impact are more likely to have children that exhibit internalising behaviours. Caregivers who associate conflict with setting screen time limits are more likely to have children with greater observed externalizing behaviours.

Our findings have several important implications. One is the need for increased caregiver education regarding adverse outcomes of increased screen time as well as the

benefits of quality sleep. Knowledge and education regarding adverse impacts of screen media usage has been associated with less exposure (Wentz et al., 2023). Thus, caregivers should ideally be provided with adequate information and education regarding the impacts of screen time. Perhaps education provided to caregivers could highlight the importance of parental role-modelling from a young age to help preschoolers establish appropriate screen viewing habits (Reid et al., 2016).

During these early stages of development, caregivers have a large role in dictating the child's daily activities (Mantziki et al., 2015). Thus, education could also encompass differential sedentary and non-sedentary activities that caregivers can incorporate in their daily routine. Child-directed education content and actively discussing media with children can also have protective effects on children (Reid et al., 2016). Thus, psychoeducation on how screen media can be utilised and engaged with in a positive manner should be delivered to caregivers. Moreover, information regarding alternative forms of behavioural management can help caregivers utilise other manners to help address their child's behaviours and manage screen time and sleep.

References

Achenbach, T. M., & Rescorla, L. A. (2000). Manual for the ASEBA Preschool Forms & Profiles. University of Vermont, Research Center for Children, Youth, and Families.

Altenburg, T. M., Wang, X., Van Ekris, E., Andersen, L. B., Møller, N. C., Wedderkopp, N., & Chinapaw, M. J. (2021). The consequences of using different epoch lengths on the classification of accelerometer based sedentary behaviour and physical activity. *PloS One*, *16*(7), e0254721. https://doi.org/10.1080/02640414.2021.1994726

Arundell, L., Gould, L., Ridgers, N., Ayala, A., Downing, K., & Salmon, J. et al. (2022). "Everything kind of revolves around technology": A qualitative exploration of families' screen use experiences, and intervention suggestions. *BMC Public Health*, *22*(1). https://doi.org/10.1186/s12889-022-14007-w

Axelsson, E. L., Purcell, K., Asis, A., Paech, G., Metse, A., Murphy, D., & Robson, A. (2022). Preschoolers' engagement with screen content and associations with sleep and cognitive development. *Acta Psychologica*, *230*, 103762. https://doi.org/10.1016/j.actpsy.2022.103762

Berger, R. H., Miller, A. L., Seifer, R., Cares, S. R., & LeBourgeois, M. K. (2012). Acute sleep restriction effects on emotion responses in 30-to 36-month-old children. *Journal of Sleep Research*, *21*(3), 235-246. https://doi.org/10.1111/j.1365-2869.2011.00962.x

Beyens, I., & Nathanson, A. I. (2019). Electronic media use and sleep among preschoolers: Evidence for time-shifted and less consolidated sleep. *Health Communication*, *34*(5), 537-544. https://doi.org/10.1080/10410236.2017.1422102

Blair, K. A., Denham, S. A., Kochanoff, A., & Whipple, B. (2004). Playing it cool: Temperament, emotion regulation, and social behavior in preschoolers. *Journal of School Psychology*, *42*(6), 419-443. https://doi.org/10.1016/j.jsp.2004.10.002

Bordin, I. A., Rocha, M. M., Paula, C. S., Teixeira, M. C. T., Achenbach, T. M., Rescorla, L. A., & Silvares, E. F. (2013). Child Behavior Checklist (CBCL), Youth Self-Report (YSR) and Teacher's Report Form (TRF): An overview of the development of the original and Brazilian versions. *Cadernos de saúde pública*, *29*, 13-28. https://doi.org/10.1590/S0102-311X2013000100004

Carson, V., & Janssen, I. (2012). Associations between factors within the home setting and screen time among children aged 0–5 years: A cross-sectional study. *BMC Public Health*, *12*, 1-8. https://doi.org/10.1186/1471-2458-12-539

Carson, V., & Kuzik, N. (2017). Demographic correlates of screen time and objectively measured sedentary time and physical activity among toddlers: a cross-sectional study. *BMC Public Health*, *17*(1), 1-11. https://doi.org/10.1186/s12889-017-4125-y

Coyne, S. M., Stockdale, L., Linder, J. R., Nelson, D. A., Collier, K. M., & Essig, L. W. (2017). Pow! Boom! Kablam! Effects of viewing superhero programs on aggressive, prosocial, and defending behaviors in preschool children. *Journal of Abnormal Child Psychology*, *45*, 1523-1535.https://doi.org/10.1007/s10802-016-0253-6

Daly, L. A., & Perez, L. M. (2009). Exposure to media violence and other correlates of aggressive behavior in preschool children. *Early Childhood Research & Practice*, *11*(2), n2. https://files.eric.ed.gov/fulltext/EJ868537.pdf

Eisenberg, N., Zhou, Q., Spinrad, T. L., Valiente, C., Fabes, R. A., & Liew, J. (2005). Relations among positive parenting, children's effortful control, and externalizing problems: A three-wave longitudinal study. *Child Development*, *76*(5), 1055-1071. https://doi.org/10.1111/j.1467-8624.2005.00897.x

Emond, J. A., Tantum, L. K., Gilbert-Diamond, D., Kim, S. J., Lansigan, R. K., & Neelon, S. B. (2018). Household chaos and screen media use among preschool-aged children: A

cross-sectional study. *BMC Public Health*, *18*(1), 1-8. https://doi.org/10.1186/s12889-018-6113-2

Essex, C., Gliga, T., Singh, M., & Smith, T. J. (2022). Understanding the differential impact of children's TV on executive functions: A narrative-processing analysis. *Infant Behavior and Development*, *66*, 101661. https://doi.org/10.1016/j.infbeh.2021.101661

Fekedulegn, D., Andrew, M. E., Shi, M., Violanti, J. M., Knox, S., & Innes, K. E. (2020). Actigraphy-based assessment of sleep parameters. *Annals of Work Exposures and Health*, *64*(4), 350-367. https://doi.org/10.1093/annweh/wxaa007

Fitzpatrick, C., Almeida, M. L., Harvey, E., Garon-Carrier, G., Berrigan, F., & Asbridge, M. (2022). An examination of bedtime media and excessive screen time by Canadian preschoolers during the COVID-19 pandemic. *BMC pediatrics*, *22*(1), 1-11. https://doi.org/10.1186/s12887-022-03280-8

Garrison, M. M., Liekweg, K., & Christakis, D. A. (2011). Media use and child sleep: The impact of content, timing, and environment. *Pediatrics*, *128*(1), 29-35. https://doi.org/10.1542/peds.2010-3304

Grigorenko, E. L., Geiser, C., Slobodskaya, H. R., & Francis, D. J. (2010). Cross-informant symptoms from CBCL, TRF, and YSR: Trait and method variance in a normative sample of Russian youths. *Psychological Assessment*, *22*(4), 893. https://doi.org/10.1037/a0020703

Gruber, R., Somerville, G., Enros, P., Paquin, S., Kestler, M., & Gillies-Poitras, E. (2014). Sleep efficiency (but not sleep duration) of healthy school-age children is associated with grades in math and languages. *Sleep Medicine*, *15*(12), 1517-1525. https://doi.org/10.1016/j.sleep.2014.08.009

Hajal, N. J., & Paley, B. (2020). Parental emotion and emotion regulation: A critical target of study for research and intervention to promote child emotion

socialization. *Developmental Psychology*, *56*(3), 403. https://doi.org/10.1037/dev0000864

Hale, L., Kirschen, G. W., LeBourgeois, M. K., Gradisar, M., Garrison, M. M., Montgomery-Downs, H., Kirschen, H., McHale, M., Chang, A. M., & Buxton, O. M. (2018). Youth screen media habits and sleep: sleep-friendly screen behavior recommendations for clinicians, educators, and parents. *Child and Adolescent Psychiatric Clinics of North America*, *27*(2), 229-245. https://doi.org/10.1016/j.chc.2017.11.014

Halpin, S., Mitchell, A. E., Baker, S., & Morawska, A. (2022). Parenting and child behaviour barriers to managing screen time with young children. *Journal of Child and Family Studies*, *30*(3), 824-838. https://doi.org/10.1007/s10826-020-01881-4

Hanson, K. G., Lavigne, H. J., Gover, S. G., & Anderson, D. R. (2021). Parent language with toddlers during shared storybook reading compared to coviewing television. *Infant Behavior and Development*, *65*, 101646. https://doi.org/10.1016/j.infbeh.2021.101646

Heflinger, C. A., Simpkins, C. G., & Combs-Orme, T. (2000). Using the CBCL to determine the clinical status of children in state custody. *Children and Youth Services Review*, *22*(1), 55-73. https://doi.org/10.1016/S0190-7409(99)00073-0

Hinkley, T., Brown, H., Carson, V., & Teychenne, M. (2018). Cross sectional associations of screen time and outdoor play with social skills in preschool children. *PloS One*, *13*(4), 193700. https://doi.org/10.1371/journal.pone.0193700

Howie, E. K., Joosten, J., Harris, C. J., & Straker, L. M. (2020). Associations between meeting sleep, physical activity or screen time behaviour guidelines and academic performance in Australian school children. *BMC Public Health*, *20*(1), 1-10. https://doi.org/10.1186/s12889-020-08620-w

Janssen, X., Martin, A., Hughes, A. R., Hill, C. M., Kotronoulas, G., & Hesketh, K. R. (2020). Associations of screen time, sedentary time and physical activity with sleep in

under 5s: A systematic review and meta-analysis. *Sleep Medicine Reviews*, *49*, 101226. https://doi.org/10.1016/j.smrv.2019.101226

Joshi, A., & Hinkley, T. (2021). Too Much Time on Screens? Screen Time Effects and Guidelines for Children and Young People. *Australian Institute of Family Studies*. https://aifs.gov.au/resources/short-articles/too-much-time-screens

Kahn, M., Schnabel, O., Gradisar, M., Rozen, G. S., Slone, M., Atzaba-Poria, N., Tikotzky, L., & Sadeh, A. (2021). Sleep, screen time and behaviour problems in preschool children: An actigraphy study. *European Child & Adolescent Psychiatry*, *30*(11), 1793-1802. https://doi.org/10.1007/s00787-020-01654-w

Karimzadeh, M., Rostami, M., Teymouri, R., Moazzen, Z., & Tahmasebi, S. (2017). The association between parental mental health and behavioral disorders in pre-school children. *Electronic Physician*, *9*(6), 4497. https://doi.org/10.19082/4497

Kirkorian, H. L., Wartella, E. A., & Anderson, D. R. (2008). Media and Young Children's Learning. *The Future of Children*, *18*(1), 39–61. http://www.jstor.org/stable/20053119

Klakk, H., Wester, C. T., Olesen, L. G., Rasmussen, M. G., Kristensen, P. L., Pedersen, J., & Grøntved, A. (2020). The development of a questionnaire to assess leisure time screen-based media use and its proximal correlates in children (SCREENS-Q). *BMC Public Health*, *20*(1), 1-12. https://doi.org/10.1186/s12889-020-08810-6

Lippold, M. A., Davis, K. D., Lawson, K. M., & McHale, S. M. (2016). Day-to-day consistency in positive parent–child interactions and youth well-being. *Journal of Child and Family Studies*, *25*, 3584-3592. https://doi.org/10.1007/s10826-016-0502-x

Määttä, S., Kaukonen, R., Vepsäläinen, H., Lehto, E., Ylönen, A., Ray, C., Erkkola, M., & Roos, E. (2017). The mediating role of the home environment in relation to parental educational level and preschool children's screen time: a cross-sectional study. *BMC Public Health*, *17*(1), 1-11. https://doi.org/10.1186/s12889-017-4694-9

Madigan, S., Browne, D., Racine, N., Mori, C., & Tough, S. (2019). Association between screen time and children's performance on a developmental screening test. *JAMA Pediatrics*, *173*(3), 244-250. https://doi.org/10.1001/jamapediatrics.2018.5056

Magee, C. A., Lee, J. K., & Vella, S. A. (2014). Bidirectional relationships between sleep duration and screen time in early childhood. *JAMA Pediatrics*, *168*(5), 465-470. https://doi.org/10.1001/jamapediatrics.2013.4183

Malcolm-Smith, S., Lake, M. T., Krwece, A., du Plooy, C. P., Hoffman, N., Donald, K. A., Zar, J. H., & Stein, D. J. (2023). Externalizing behavior in preschool children in a South African birth cohort: Predictive pathways in a high-risk context. *Development and Psychopathology*, *35*(2), 982-999. https://doi.org/10/1017/S095457942200027X

Mantziki, K., Vassilopoulos, A., Radulian, G., Borys, J. M., Du Plessis, H., Gregório, M. J., Graca, P., De Henauw, S., Handjiev, S., Visscher, LS. T., & Seidell, J. C. (2015). Inequities in energy-balance related behaviours and family environmental determinants in European children: baseline results of the prospective EPHE evaluation study. *BMC Public Health*, *15*, 1-13. https://doi.org/10.1186/s12889-015-2540-5

McArthur, B. A., Tough, S., & Madigan, S. (2022). Screen time and developmental and behavioral outcomes for preschool children. *Pediatric Research*, *91*(6), 1616-1621. https://doi.org/10.1038/s41390-021-01572-w

Mesman, J., Bongers, I. L., & Koot, H. M. (2001). Preschool developmental pathways to preadolescent internalizing and externalizing problems. *The Journal of Child Psychology and Psychiatry and Allied Disciplines*, *42*(5), 679-689. https://doi.org/10.1017/S0021963001007351

MotionWatch 8. (2020, February 1). CamNtech. https://www.camntech.com/motionwatch-8/

Mukherjee, S., Patel, S. R., Kales, S. N., Ayas, N. T., Strohl, K. P., Gozal, D., & Malhotra, A. (2015). An official American Thoracic Society statement: The importance of healthy

sleep. Recommendations and future priorities. *American Journal of Respiratory and Critical Care Medicine*, *191*(12), 1450-1458. https://doi.org/10.1164/rccm.201504-0767ST

Nathanson, A. I., & Beyens, I. (2018). The role of sleep in the relation between young children's mobile media use and effortful control. *British Journal of Developmental Psychology*, *36*(1), 1-21.

Neshteruk, C. D., Tripicchio, G. L., Lobaugh, S., Vaughn, A. E., Luecking, C. T., Mazzucca, S., & Ward, D. S. (2021). Screen time parenting practices and associations with preschool children's TV viewing and weight-related outcomes. *International Journal of Environmental Research and Public Health*, *18*(14), 7359. https://doi.org/10.3390/ijerph18147359

Neville, R. D., McArthur, B. A., Eirich, R., Lakes, K. D., & Madigan, S. (2021). Bidirectional associations between screen time and children's externalizing and internalizing behaviors. *Journal of Child Psychology and Psychiatry*, *62*(12), 1475-1484. https://doi.org/10.1111/jcpp.13425

Oliveira, T. D. O., Costa, D. S., Alvim-Soares, A., de Paula, J. J., Kestelman, I., Silva, A. G., Malloy-Diniz, L. F., & Miranda, D. M. (2022). Children's behavioral problems, screen time, and sleep problems' association with negative and positive parenting strategies during the COVID-19 outbreak in Brazil. *Child Abuse & Neglect*, *130*, 105345. https://doi.org/10.1016/j.chiabu.2021.105345

Ortiz, R. W., Green, T., & Lim, H. (2011). Families and home computer use: Exploring parent perceptions of the importance of current technology. *Urban Education*, *46*(2), 202-215. https://doi.org/10.1177/004208591037743

Padilla-Walker, L. M., & Coyne, S. M. (2011). “Turn that thing off!” parent and adolescent predictors of proactive media monitoring. *Journal of Adolescence*, *34*(4), 705-715. https://doi.org/10.1016/j.adolescence.2010.09.002

Pakpour, A. H., Griffiths, M. D., Ohayon, M. M., Broström, A., & Lin, C. Y. (2020). A good sleep: The role of factors in psychosocial health. *Frontiers in Neuroscience*, *14*, 520.

Pamula, Y., Nixon, G. M., Edwards, E., Teng, A., Verginis, N., Davey, M. J., Waters, K., Suresh, S., Twiss, J., & Tai, A. (2017). Australasian Sleep Association clinical practice guidelines for performing sleep studies in children. *Sleep Medicine*, *36*(1), S23-S42. http://dx.doi.org/10.1016/j.sleep.2017.03.020

Parent, J., Sanders, W., & Forehand, R. (2016). Youth screen time and behavioral health problems: The role of sleep duration and disturbances. *Journal of Developmental and Behavioral Pediatrics: JDBP*, *37*(4), 277. https://doi.org/10.1097/DBP.0000000000000272

Paruthi, S., Brooks, L. J., D'Ambrosio, C., Hall, W. A., Kotagal, S., Lloyd, R. M., Malow, A. B., Maski, K., Nichols, C., Quan, S. F., Rosen, L. C., Troester, M. M., & Wise, M. S. (2016). Recommended amount of sleep for pediatric populations: A consensus statement of the American Academy of Sleep Medicine. *Journal of Clinical Sleep Medicine*, *12*(6), 785-786. https://doi.org/10.5664/jcsm.5866

Patwardhan, I., Nelson, T. D., McClelland, M. M., & Mason, W. A. (2021). Childhood cognitive flexibility and externalizing and internalizing behavior problems: Examination of prospective bidirectional associations. *Research on Child and Adolescent Psychopathology*, *49*(4), 413-427. https://doi.org/10.1007/s10802-020-00757-x

Qu, G., Hu, W., Meng, J., Wang, X., Su, W., Liu, H., Ma, S., Sun, C., Huang, C., Lowe, S., & Sun, Y. (2023). Association between screen time and developmental and behavioral

problems among children in the United States: Evidence from 2018 to 2020 NSCH. *Journal of Psychiatric Research*, *161*, 140-149. https://doi.org/10.1016/j.jpsychires.2023.03.014

QuestionPro. (2023). Screen Time, Sleep and Child Development Survery. Retrieved from https://www.questionpro.com

Reid Chassiakos, Y. L., Radesky, J., Christakis, D., Moreno, M. A., Cross, C., Hill, D., ... & Swanson, W. S. (2016). Children and adolescents and digital media. *Pediatrics*, *138*(5). https://doi.org/10.1542/peds.2016-2593

Sadeh, A. (1996). Evaluating night wakings in sleep-disturbed infants: A methodological study of parental reports and actigraphy. *Sleep*, *19*(10), 757-762. https://doi.org/10.1093/sleep/19.10.757

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

Spencer, R. M., Campanella, C., de Jong, D. M., Desrochers, P., Root, H., Cremone, A., & Kurdziel, L. B. (2016). Sleep and behavior of preschool children under typical and nap-promoted conditions. *Sleep Health*, *2*(1), 35-41. https://doi.org/10.1016/j.sleh.2015.12.009

Swider-Cios, E., Vermeij, A., & Sitskoorn, M. M. (2023). Young children and screen-based media: The impact on cognitive and socioemotional development and the importance of parental mediation. *Cognitive Development*, *66*, 101319. https://doi.org/10.1016/j.cogdev.2023.101319

Tamana, S. K., Ezeugwu, V., Chikuma, J., Lefebvre, D. L., Azad, M. B., Moraes, T. J., Subbarao, P., Becker, A. B., Turvey, S. E., Sears, M. R., Dick, B. D., Carson, V.,

Rasmussen, C., Pei, J., & Mandhane, P. J. (2019). Screen-time is associated with inattention problems in preschoolers: Results from the CHILD birth cohort study. *PloS One*, *14*(4), e0213995. https://doi.org/10.1371/journal.pone.0213995

Tandon, P. S., Zhou, C., Sallis, J. F., Cain, K. L., Frank, L. D., & Saelens, B. E. (2012). Home environment relationships with children's physical activity, sedentary time, and screen time by socioeconomic status. *International Journal of Behavioral Nutrition and Physical Activity*, *9*(1), 1-9. https://doi.org/10.1186/1479-5868-9-88

Tansriratanawong, S., Louthrenoo, O., Chonchaiya, W., & Charnsil, C. (2017). Screen viewing time and externalising problems in pre-school children in Northern Thailand. *Journal of Child & Adolescent Mental Health*, *29*(3), 245-252. https://doi.org/10.2989/17280583.2017.1409226

Thakkar, R. R., Garrison, M. M., & Christakis, D. A. (2006). A systematic review for the effects of television viewing by infants and preschoolers. *Pediatrics*, *118*(5), 2025-2031. https://doi.org/10.1542/peds.2006-1307

The jamovi project (2021). *jamovi.* (Version 2.2) [Computer Software]. Retrieved from https://www.jamovi.org.

Wachs, T. D., Georgieff, M., Cusick, S., & McEwen, B. S. (2014). Issues in the timing of integrated early interventions: Contributions from nutrition, neuroscience, and psychological research. *Annals of the New York Academy of Sciences*, *1308*(1), 89-106. https://doi.org/10.1111/nyas.12314

Weissbluth, M. (1995). Naps in children: 6 months–7 years. *Sleep*, *18*(2), 82-87. https://doi.org/10.1093/sleep/18.2.82

Wentz, E. E., Hoose, D. L., Holliday, K., McDonald, T., Silsby, K., Podvin, S., & Hirsh, A. (2023). Knowledge is power: Relationship between professional recommendations,

maternal attitudes, and screen time exposure of infants. *Journal of Pediatric Nursing*. https://doi.org/10.1016/j.pedn.2023.09.012

Wiseman, N., Harris, N., & Downes, M. (2019). Preschool children's preferences for sedentary activity relates to parent's restrictive rules around active outdoor play. *BMC Public Health*, *19*(1), 1-11. https://doi.org/10.1186/s12889-019-7235-x

World Health Organization. (2019). *Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age*. World Health Organization. https://iris.who.int/bitstream/handle/10665/311664/9789240001749-chi.pdf

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

Xie, G., Deng, Q., Cao, J., & Chang, Q. (2020). Digital screen time and its effect on preschoolers' behavior in China: Results from a cross-sectional study. *Italian Journal of Pediatrics*, *46*(1), 1-7. https://doi.org/10/1186/s13052-020-0776-x

Zhao, J., Zhang, Y., Jiang, F., Ip, P., Ho, F. K. W., Zhang, Y., & Huang, H. (2018). Excessive screen time and psychosocial well-being: The mediating role of body mass index, sleep duration, and parent-child interaction. *The Journal of Pediatrics*, *202*, 157-162. https://doi.org/10.1016/j.jpeds.2018.06.029

Appendix A

Ethics Approval

HUMAN RESEARCH ETHICS COMMITTEE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Notification of Expedited Approval

To Chief Investigator or Project Supervisor:	**Doctor Emma Axelsson**
Cc Co-investigators / Research Students:	**Miss Alliyah Asis** **Miss Madeleine Gale** **Ms Kate Purcell** **Miss Alyssa Robson** **Miss Rachael Si Xuan Loo** **Miss Sandhiya Nanthakumar** **Miss Jenna Mace** **Doctor Gemma Paech**
Re Protocol:	**Screen time, sleep, and child development**
Date:	**26-Sep-2023**
Reference No:	**H-2021-0216**

Thank you for your **Variation (v3)** submission to the Human Research Ethics Committee (HREC) seeking approval in relation to a variation to the above protocol.

Variation to:

1. Expand recruitment methods to include listing within SONA.
2. Add the Social Responsiveness Scale-2.
3. Remove Darcie Fay, Declan Murphy and Bret Sherwood from the protocol.

- PIS (v8, dated 19.9.23)
- SRS-2 [Preschool] (version submitted 21.9.23)
- SRS-2 [School] (version submitted 21.9.23)

Your submission was considered under **Expedited** review by the Chair/Deputy Chair.

We are pleased to advise that the decision on your submission is **Approved** effective **26-Sep-2023**.

The full Committee will be asked to ratify this decision at its next scheduled meeting. A formal *Certificate of Approval* will be available upon request.

Human Research Ethics Committee

For communications and enquiries:
Human Research Ethics Administration

Research & Innovation Services
Research Integrity Unit
The University of Newcastle
Callaghan NSW 2308
T +61 2 492 17894
Human-Ethics@newcastle.edu.au

RIMS website - https://RIMS.newcastle.edu.au/login.asp

Linked University of Newcastle administered funding:

Funding body	Funding project title	First named investigator	Grant Ref

Funding body	Funding project title	First named investigator	Grant Ref
The Waterloo Foundation/Child Development Research Grant(**)	** UNDER EMBARGO ** Incorporating sleep in an investigation of screen time and cognitive, language, and behavioral development of typically developing preschoolers and those with a developmental disorder.	Axelsson, Emma	G2300188

Appendix B

Submission Guidelines for the Journal of Infant and Child Development

***Infant and Child Development: Prenatal, childhood, adolescence, emerging adulthood* submission guidelines**

This journal participates in the Wiley Developmental Science Publishing Network. This exciting collaboration between a number of high-quality journals simplifies and speeds up the publication process, helping authors find a home for their research. At the Editors' judgement, suitable papers not accepted by one journal may be recommended for referral to another journal(s) in the network. Authors decide whether to accept the referral, with the option to transfer their paper with or without revisions. Once the referral is accepted, submission happens automatically, along with any previous reviewer reports, thereby relieving pressure on the peer review process. While a transfer does not guarantee acceptance, it is more likely to lead to a successful outcome for authors by helping them to find a route to publication quickly and easily.

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Infant and Child Development: prenatal, childhood, adolescence, emerging adulthood now offers Free Format submission for a simplified and streamlined submission process.

Before you submit, you will need:

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or format, as long as it is consistent throughout the manuscript. Supporting information should be submitted in separate files or via a stable link to an open-access repository (e.g., OSF, GitHub, Figshare). If the manuscript, figures or tables are difficult for you to read, they will also be difficult for the editors and reviewers, and the editorial office will send it back to you for revision. Your manuscript may also be sent back to you for revision if the quality of English language is poor.

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    - Your co-author details, including affiliation and email address. *(Why is this important? We need to keep all co-authors informed of the outcome of the peer review process.)*
    - Statements relating to our ethics and integrity policies, which may include any of the following *(Why are these important? We need to uphold rigorous ethical standards for the research we consider for publication):*
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Sample Description

Samples should be described in as much details as possible, including information about nationality, race/ethnicity, gender, social class, and any other relevant details that will help understand sample composition. All arguments and conclusions should be made with consideration for the sample characteristics. The journal encourages submissions reporting on research from under-represented populations, both within and between countries.

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Theoretical Articles involve an original contribution that advances theory for understanding developmental phenomena from prenatal to emerging adulthood. These papers need to clearly focus on new advances in theory development. These manuscripts are limited to 10,000 words of main text (not including abstract, references, tables, or figures).

Appendix C

Social Media Advertisement

Kids' Development Research
March 22 ·

Are you a parent of a 3- to 5-year-old? Would you like to take part in a study to learn more about children's development and their screen time? If you are interested, please contact us at kidsdev21@gmail.com
The study involves:
- A survey about your child's screen use, sleep, behaviour and development
- iPad games for your child to complete at the University of Newcastle
- A watch for your child to wear that measures their sleep

Appendix D

Information Statement

Information Statement

Dr Emma Axelsson – Principal Investigator
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THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Information Statement for the Research Project:

Screen time, sleep, and child development: an investigation of the associations between screen media use and pre-schoolers' sleep and development.

Document Version 8; 19/9/2023

Dear Potential Participant

You are invited to participate in the research project identified above which is being conducted by Dr Emma Axelsson, Dr Gemma Paech, Alyssa Robson, Sandhiya Nanthakumar, Rachael Si Xuan Loo, Madeleine Gale, and Jenna Mace from the School of Psychological Sciences at the University of Newcastle.

The research is part of Sandhiya Nanthakumar, Rachael Si Xuan Loo, Madeleine Gale, and Jenna Mace's studies at the University of Newcastle, supervised by Dr Emma Axelsson from the School of Psychological Sciences.

Why is the research being done?

The purpose of the research is to investigate preschoolers' use of screen media such as the time spent using it, time of day, and type of content typically viewed. We will also measure child sleep and development to see if there are any relationships between children's use of screen media and sleep and development. Children's time using screen devices is increasing and it is important to understand whether this is associated with children's sleep and development such as learning, language and behaviour. These effects could be positive, negative, or neutral and it is important to understand this better. The findings might help parents and educators guide children's use of screen devices. We are interested to see what the patterns of use are in preschool children, and whatever your answers, we hope any parents taking part do not feel any need to judge or be too harsh on themselves. If the questionnaires cause any distress, Lifeline.org.au or 13 11 14 can offer support.

Who can participate in the research?

We are seeking parents of children between the ages of 2 years and 10 months to 5 years and 6 months. Any parents of children are invited to participate whether their children use screen devices or not. Any children who have not been diagnosed with a sleep disorder or neurological or learning condition are invited to participate. You have received this invitation as you expressed interest in our experiment by contacting one of our researchers or you saw the study listed on the university SONA system.

What would you be asked to do?

The study will span over four days. On Day 1, the students and/or researchers will provide you with the surveys/questionnaires that ask questions about your child and their use of screen devices, sleep habits and their development. These can be completed either online or a paper version, which we will collect on Day 4. Each day, we would like you to also complete a Nap/Sleep diary (bedtimes, wake up times etc.) for your child and a Screen Time diary (times and screen content) over the three days/nights. On Day 1, we will ask your child to complete three game-like tasks on an iPad and on Day 4, two game-like tasks. These can be completed either at the university or we can visit you at your home. One is a vocabulary task, which asks your child to name pictures on a screen. Another is a memory task where children are asked to remember the locations of stickers on a character. The third, asks your child to catch a character that moves across a screen. The fourth task, involves asking your child to find objects on a screen to look at

your child's memory for new words. You will be with your child at all times. We will also ask your child to wear a watch for three nights, which measures activity levels and along with the sleep diary helps us to determine how much sleep your child is getting. This will help to measure any naps and night-time sleep on Days 1 – 3. Your notes in the sleep diary will help us interpret the information from the watch. Finally, on Day 4, we will ask your child to complete two of the iPad tasks.

With regards to the questionnaires, one questionnaire asks about background information such as the child's age, health, and number of siblings. There are also questions regarding parents' age, education, and employment. Another questionnaire will ask about your child's general screen device usage, and the type of content, how long they tend to use them and at what time of day. Another questionnaire will ask general questions about your child's development (e.g., problem solving, communication). There is also a questionnaire about your child's sleep quality and sleep habits.

What choice do you have?

Participation in this research is entirely your choice. Only those who give their informed consent will be included in the project. Whether or not you decide to participate, your decision will not disadvantage you. If you do decide to participate, you and your child may withdraw from the project at any time prior to completion of the study. If your child refuses to wear the watch, we can use the sleep diary instead (asking for bedtimes and sleep durations and night awakenings). Please note that due to the anonymous nature of the questionnaires, you will not be able to withdraw your response after it has been submitted.

How much time will it take?

The surveys/questionnaires can be completed either online or with a paper version, which we will collect on Day 4. They take around 35-50 minutes to complete. The questionnaires do not need to be completed in one sitting, and if filling them in online, the website saves your answers and you can recommence when ready. The daily Nap/sleep diary and Screen Time diary would take around 5-10 minutes to complete each day. On Day 1 and Day 4, when your child completes the iPad tasks – these take about 8-15 minutes each (approximately up to 45-60 minutes on each day).

What are the risks and benefits of participating?

There are no anticipated risks associated with participating in this research. Research staff and students will follow current government health advice, such as wearing masks. At all times, the actigraphy watches and iPads will be anti-bacterialised prior to the visit with your child.

Currently there has been very little research on the associations between Australian preschool children's use of screen devices and their sleep and development. By participating in this research you will have the opportunity to provide information to help researchers, educators and caregivers have a better understanding of the types of screen device usage (e.g., content, amount, time of day) and whether these have any positive or negative effects on child development. This might help provide clearer guidelines on ideal usage conditions in childcare settings and in the home.

If you joined the study via SONA, you will be remunerated with the appropriate course credit.

How will your privacy be protected?

The management of the data will be consistent with the Australian Code for the Responsible Conduct of Research (ACRCR, 2007). The data will be stored in a form that is anonymous and not personally identifiable to the researchers for a period of 5 years. Consistent with the ACRCR and the University of Newcastle's Research Data and Materials Management Guideline (https://policies.newcastle.edu.au/document/view-current.php?id=72), other researchers will be provided with access to the research data upon request and allowed to analyse the data. Furthermore, consistent with the University of Newcastle's Research Data and Materials Management Guideline (Parts 14 & 22), the de-identified research data and primary materials may be made available in online public data repositories (e.g., Open Science Framework) that can be accessed by other researchers for further research. All data will be destroyed by deletion 5 years after publication.
QuestionPro is the platform used to present the questions and collect answers. According to QuestionPro's privacy policy statement, all data is accessed and owned by the survey creator who must provide a username and password. For more see: https://www.questionpro.com/security/index.html
Any questionnaires completed on paper will be stored in locked filing cabinets that is only accessible to the research staff.

How will the information collected be used?

The collected data will be summarised and analysed and communicated to the scientific community. The findings will be used to guide future research and may also be compared to results from other studies and/or be presented in academic journals and conferences. It will also be posted on the University of Newcastle FINDLab (Family Interaction and Neurodevelopment Lab) Facebook page and webpage http://www.findlab.net.au/ and the Kids' Development Research Facebook page https://www.facebook.com/kidsdevelopmentresearch. Individual participants will not be identifiable in any reports arising from the project. Non-identifiable data may be also be shared with other parties to encourage scientific scrutiny, and to contribute to further research and public knowledge.

What do you need to do to participate?

Please read this Information Statement and be sure you understand its contents before you consent to participate. If there is anything you do not understand, or you have questions, please contact the researcher kidsdevelopment@newcastle.edu.au (or kidsdev21@gmail.com).

If you would like to participate, please email kidsdevelopment@newcastle.edu.au (or kidsdev21@gmail.com) who will send you a weblink to a consent form and once this has been filled out, the questionnaires can be accessed. Alternatively, you can complete hard copies when we see you. If you have signed up via SONA systems, we will be in contact with you. We will then arrange a time that is convenient for you and your child to either visit us at the university or for us to visit you so your child can complete the iPad tasks and commence wearing the watch.

As part of the consent process, we will ask your permission to contact you with information about follow-up studies. If you consent to be contacted in the future for follow-up studies, this by no means obligates you to participate. We thank you for taking the time to consider this study.

Further information

If you would like further information please contact kidsdevelopment@newcastle.edu.au (or kidsdev21@gmail.com)

Thank you for considering this invitation.

Dr Emma Axelsson
Chief Investigator

Madeleine Gale
Research Student

Sandhiya Nanthakumar
Research Student

Dr Gemma Paech
Chief Investigator

Alyssa Robson
Research Student

Rachael Si Xuan Loo
Research Student

Jenna Mace
Research Student

Complaints about this research

This project has been approved by the University's Human Research Ethics Committee, Approval No. H-2021-0216

Should you have concerns about your rights as a participant in this research, or you have a complaint about the manner in which the research is conducted, it may be given to the Chief Investigator Dr Emma Axelsson, emma.axelsson@newcastle.edu.au, or, if an independent person is preferred, to the Ethics Officer, Research and Innovation Services, The University of Newcastle, University Drive, Callaghan NSW 2308, Australia, telephone (02) 4921 6333 or email Human-Ethics@newcastle.edu.au.

Appendix E

Informed Consent Form

Dr Emma Axelsson – Principal Investigator
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THE UNIVERSITY OF NEWCASTLE AUSTRALIA

Consent Form for the Research Project:

Screen Time, Sleep and Child Development: An investigation into the impact of screens on pre-schoolers development.
Dr Emma Axelsson, Dr Gemma Paech, Hayley Ayres, Emily Brazier, Elena Stefanovska, Alyssa Robson, Declan Murphy

Document Version 3; dated 27/4/2022

I agree to participate in the above research project and give my consent freely.

I understand that the project will be conducted as described in the Information Statement, a copy of which I have retained.

I understand I can withdraw from the project at any time, and do not have to give any reason for withdrawing. I understand that my personal information will remain confidential to the researchers.

I have had the opportunity to have questions answered to my satisfaction.

In completing this form, I agree to my participation in this research study.

In addition (please circle as appropriate)

I consent to completing questionnaires that ask questions about my child and their use of screens, sleep habits, and their development.	YES / NO
I consent to be contacted about follow-up studies, in the next five years	YES / NO
I consent to my child wearing an actigraphy watch for 3 nights	YES / NO
I consent to completing a Nap/Sleep diary and Screen Time diary for my child for 3 days	YES / NO
I consent to my child completed 4 iPad tasks to measure vocabulary and cognition (4 on Day 1 and 3 on Day 4)	YES / NO

Child's Name: _____

Caregiver Name: _____

Date: _____