Patterns of preschool children's screen time, parent–child interactions, and cognitive development in early childhood: A pilot study

by

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Abstract

Background: The objectives of this pilot study were to examine total duration and patterns of screen time use in preschool children, the correlations between total duration and patterns of screen time and cognitive development, and the differences in quality of parent–child interactions for two screen-based tasks and a storybook reading task.

Methods: Participants included 44 children aged 3 years and their parents from Edmonton, Alberta and surrounding areas. Children's screen time patterns (i.e., type, device, content, context) were parental-reported using a 2-week online daily diary design. Children's cognitive development (i.e., working memory, inhibitory control, self-control, and language) was measured with four separate tests virtually through a recorded Zoom session. Parent–child interactions during three separate tasks (i.e., video, electronic game, and storybook reading) were also measured virtually through a separate recorded Zoom session (n = 42). The quality of the interactions was determined by the Parent-Child Interaction System (PARCHISY). Spearman's Rho correlations and a one-way repeated measures ANOVA with a post-hoc Bonferroni test were conducted.

Results: On average, children spent 88.7 minutes/day (SD = 56.8) watching a show/movie/video of a total 103.5 minutes/day (SD =59.2) of screen time. After adjusting for child age and parental education, educational screen use was significantly positively correlated with vocabulary (r_s = 0.38; p = 0.018) while co-use was significantly negatively correlated with self-control (r_s = -0.32; p = 0.049). A medium effect size was also observed for the correlation between educational screen time and response inhibition (r_s = 0.33; p = 0.074), total screen time and working memory (r_s = -0.32; p = 0.056), and show/movie/video viewing and working memory (r_s = -0.32; p = 0.056). Finally, the quality of parent–child interaction was significantly different between all the three tasks, with the electronic game having the highest quality score.

Conclusions: Preschool children primarily used screen devices to watch shows/movies/videos for entertainment purposes, and parent–child interaction quality was the lowest for this type of screen time. Additionally, this type of screen time was negatively correlated with working memory. Conversely, high-quality educational screen time, in particular electronic games that may facilitate higher-quality parent–child interactions appeared to have a potential benefit for cognitive development. Findings should be confirmed in larger, more generalizable samples.

Preface

Ethics approval for this study was granted from the University of Alberta Research Ethics Board. The manuscript within Chapter 3, "Patterns of preschool children's screen time, parent-child interactions, and cognitive development in early childhood: A pilot study" is formatted according to the Canadian Journal of Behavioural Science (CJBS) where it will be submitted for publication. This manuscript is the work of Jasmine Rai in collaboration with Dr. Valerie Carson, Madison Predy, Dr. Sandra Wiebe, Dr. Christina Rinaldi and Dr. Yao Zheng. In detail, Dr. Carson and Dr. Wiebe conceived and designed the study, secured funding and oversaw the conduct of the study. Jasmine Rai and Madison Predy collected data for the study. Jasmine Rai also led the data analysis and interpretation of findings, and she drafted the manuscript. Dr. Valerie Carson assisted with data analysis and the interpretation of findings. All authors revised the manuscript for important content and will approve the final version of the manuscript prior to submission for peer review.

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Glossary of Terms

Preschool children or preschoolers are sometimes defined as 3 to 4 years (Tremblay et al., 2017) or 3-5 years (Australian Government Department of Health, 2021). This thesis will focus on preschool children that are 3 years old.

Sedentary behavior is defined as "any waking behaviors characterized by an energy expenditure ≤ 1.5 metabolic equivalents while in a sitting, lying, or reclining posture" (Tremblay et al., 2017).

Screen time, which is one type of sedentary behaviour, is defined as time spent using screen devices (e.g., TV, smartphones, tablets, DVDs and computers) (Tremblay et al., 2017).

Patterns of screen time refers to the time spent using screens (e.g., 1:30-2:00 pm), type of screen time (e.g., watching television, playing game), the device being used (e.g., tablet, smartphone), content (e.g., TV show/video/game name) and context (e.g., watching with a caregiver).

Parent-child interactions refers to the quantity and quality of social interactions that take place between parents and children (Anderson & Hanson, 2017). With regards to screen time, parent-child interactions could occur when parents and children co-use screen devices.

The term correlate is used to describe factors that are statistically associated or correlated with an outcome of interest (Bauman et al., 2002). Correlates can be further divided into modifiable correlates (e.g., behaviours, practices) or non-modifiable correlates (e.g., sex, race, ethnicity).

Chapter 1: Introduction

1.1 General Introduction

Early childhood, the period from birth to 5 years (Nelson & Luciana, 2008), is characterized by a period of rapid growth, especially in different domains of cognitive development (e.g., memory, executive functioning, language) (Bauer et al., 2010; Garon et al., 2008; Tomasello, 2010). Furthermore, the quality of children's cognitive development in early childhood is dependent on their experiences and the environment (Stern, 2005). Recently, technology such as smartphones, tablets and other mobile screen devices have become more accessible, and consequently the average age at which children begin to interact with screen devices has shifted dramatically earlier (Radesky & Christakis, 2016). As a result, many young children exceed recommended amounts of screen time (Chaput et al., 2017; Lee et al., 2017). Researchers have yet to come to a consensus about the impact of screen on cognitive development, especially the impact of mobile screen devices.

Previous research regarding children's screen time has been largely focused on duration or frequency of TV, computers, and videogames (Radesky & Christakis, 2016). However, there is some evidence that suggests that the content and context of screen time are important to consider when examining screen time. For example, one recent meta-analysis in children < 12 years reported that a greater quantity of screen use and background television were associated with lower language skills while better quality screen use, such as educational programs and co-viewing, were associated with stronger language skills (Madigan et al., 2020). However, the evidence was primarily based to television viewing, limiting our understanding of the impacts of mobile screen devices.

Given that few children meet the screen time recommendations, it is important to consider the role of parents as young children's access and use of screen devices is largely dependent on them. Parents are a vital influence on children's early development as they can help facilitate language and cognitive development (Pyper et al., 2016). Previous literature suggests that high quality interactions are important for children's cognitive development (Lukie et al., 2014) For example, high quality parent-child interactions are considered crucial for children's numeracy and literacy development (Lukie et al., 2014). With regards to screen time, parent-child interactions can occur when parents and children are co-using screen devices (Nikken & Schols, 2015) but the quality parent-child interactions may differ based on the type of screen time and activity (Korat & Or, 2010; Skaug et al., 2017).

Current evidence suggests all screen time and all co-use of screen time may not be equivalent. However, gaps and limitations in the evidence base make it difficult to draw firm conclusions. Therefore, examining the patterns of screen time, including, type, device being used, content, and context is important to comprehensively understand the associations between screen time and children's cognitive development. Additionally, understanding how the quality of parent-child interactions differ based on the type of activity is important to understand the role parents can play in fostering optimal cognitive development in technology focused societies.

1.2 Objectives and Hypotheses

The overall objective of this thesis is to conduct a pilot study to address current gaps in the literature, in order to better understand patterns of screen time use and its association with cognitive development among preschool children aged 3 years as well as examine the quality of parent-child interactions during different tasks.

This thesis has 3 specific objectives. **1)** Describe the total duration and the patterns of screen time use in preschool children. **2)** Examine the correlations between total duration, patterns of screen time and cognitive development. **Hypothesis 1:** The associations between screen time on cognitive development will depend on total duration and patterns of screen time use, with increased duration being negatively associated with cognitive development and educational screen time and co-use being positively associated with cognitive development. **3)** Examine if the quality of parent–child interactions differs between three sedentary behaviour tasks. **Hypothesis 2:** Parent–child interactions will differ in quality based on the type of task being performed, with the storybook reading task having the highest quality followed by the electronic game task and the video task.

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Chapter 2: Review of Literature

2.1 Early Childhood

Early childhood typically refers to the time period from birth to 5 years of age (Nelson & Luciana, 2008). This period is characterized by significant growth and development, including a dramatic increase in cognitive development within specific domains, including language, memory and executive functioning (Bauer et al., 2010; Carson et al., 2015; Garon et al., 2008; Radesky & Christakis, 2016; Tomasello, 2010). Early childhood is also important for establishing health related behaviours. For example, screen viewing habits that are established in early childhood are indicative of screen use during adolescence (Downing et al., 2017; Duch et al., 2013; Francis et al., 2011).

Setting

There are two main settings that children grow and learn in during early childhood, including the home and childcare settings. In general, there is a consensus in the existing literature that the home environment and children's experiences are crucial to growth and development (Britto et al., 2017; Stern, 2005). However, there is considerable variation in the stimulation, support, and structure that is available to children in the home setting (Bradley, 2015; Sarsour et al., 2011;). For example, one study found that children from single parent households performed worse on executive functioning tasks in comparison to children from two parent households from similar low socioeconomic backgrounds (Sarsour et al., 2011).

Approximately 54% of Canadian children attend some form of childcare, including center-based and non-parental childcare, for an average of 29 hours per week (Bushnik, 2006), making this another important setting for early childhood development. However, as young children spend a large proportion of their time at home with their parents, especially during the COVID-19 pandemic, the primary focus of this thesis is the home setting.

Cognitive Development

Cognitive development in early childhood is characterized by development in the language, memory, and executive function domains (Bauer et al., 2010; Garon et al., 2008; Tomasello, 2011). Optimal cognitive development in early childhood is important as growth in the different domains has been shown to be associated with school readiness and performance (Welsh et al., 2010). Additionally, sociocultural factors such as the environment and people present play a crucial role in children's cognitive development (Flavell, 1977).

As language development occurs, the production and comprehension of speech increases in its complexity. Gains in language development help foster subsequent development in other related cognitive abilities such as the ability to conceptualize objects, spatial relations and understanding of numbers (Kuhn et al., 2014). Language skills include both receptive (e.g., listening and reading) and expressive (e.g., speaking and writing) skills (Sénéchal, 1997). This thesis will focus on expressive language skills.

Language development occurs in parallel with development of higher order cognitive abilities such as executive functioning. Executive functioning development in early childhood is a crucial precursor to the development of other higher cognitive processes that continues into adulthood (Garon et al., 2008). Executive functioning is denoted by self-regulation of emotions, thoughts, actions and attention (Garon et al., 2008). For instance, the development of attention during the preschool years includes children's increased ability to focus on the task at hand while avoiding distractions (Garon et al., 2008). This thesis will focus on two measures of executive functioning, including response inhibition and self-control.

Development in the memory domain of cognitive development is characterized by children's increased ability to encode and access information using recognition and recall as they age (Bauer et al., 2011). Children are able to remember events easier if they occur in a temporal order in comparison to an arbitrary order and recall more information and after longer periods of delay as they age (Bauer et al., 2011). This thesis will focus on working memory.

Predictors of cognitive development

Previous research has established the importance of demographic characteristics on children's cognitive development. For example, children from lower income households have decreased functional brain development in comparison to their higher income counterparts (Tomalski et al., 2013). These differences may be the result of economic limitations that make it difficult to provide children with stimulating experiences (Santos et al., 2008). Furthermore, previous research studies have documented similar associations between race/ethnicity and language development in early childhood. For instance, one study found that African American children and children from lower socioeconomic status (SES) families displayed a slower rate of growth of language in comparison to European American children and children from higher SES families (Pungello et al., 2009). Similar findings were reported for executive functioning (Rhoades et al., 2011). Thus, the quality and quantity of cognitive development in children maybe dependent on demographic characteristics.

Additionally, parents play a pivotal role in children's cognitive development. Scaffolding is one mechanism by which parents aid in children's cognitive development. Parents help children carry out a task or solve a problem by providing different levels of assistance depending on the child's ability (Wood, Burner & Ross, 1976). Parent scaffolding includes the use of praise, elaboration, redirection and prompts during interactions with their children (Obradović et al., 2016). One review examining parental scaffolding and executive functioning found that increased use of scaffolding behaviours such as praise and elaboration were associated with higher levels of executive functioning (Fay-Stammbach, Hawes, & Meredith, 2014). Similarly, a higher frequency of verbal scaffolding was associated with greater gains in expressive language

(Guttentag et al., 2014). Therefore, children's cognitive development may also be dependent on parent-child interactions, which will be described further in section 2.4.

2.2 Sedentary Behaviour

Guidelines

The Canadian 24-Hour Movement Guidelines for the Early Years were released to address the trends of decreased sleep and physical activity and increased sedentary behaviour in children, which have been found to negatively affect growth and development (Carson, Langlois & Colley, 2020; Tremblay et al., 2017). The guidelines classify the early years into three categories: infants aged less than 1 years old, toddlers aged 1 to 2 years, and preschool children aged 3 to 4 years (Tremblay et al., 2017). This thesis focuses on preschool children aged 3 years. The guidelines recommend that children in the early years should not be restrained for more than an hour at a time and toddlers and preschool children should not sit for extended periods. No screen time is recommended for infants or toddlers less than 2 years of age. For toddlers aged 2 years and preschool children, it is recommended that screen time should be limited to one hour or less. The guidelines also specify that time spent engaging in sedentary behaviour should be spent reading or storytelling with the caregiver instead of screen time.

Prevalence

The reality is technology is becoming increasingly prevalent and relied on by both children and parents (Reus & Mosley, 2018). For instance, screen time is no longer limited to watching TV or playing computer or video games. One study in the United States reported that 97% of households had at least one television, 83% had tablets and 77% had smartphones and even more troubling is that 96.6% of children had used a mobile device by age one (Kabali et al., 2015). A recent study of toddlers from Edmonton, Canada found that only 15.2% met the screen time recommendations (Lee et al., 2017) while another study found that 24.4 % of Canadian preschool children met the guidelines (Chaput et al., 2017). When looking at toddlers under the age of 2, researchers found that less than 25% met the screen time recommendations (Saunders & Vallance, 2017) and another study found that 93% of infants had watched TV while 57% had used a computer and 28% had used a cell phone the previous day (Vanderloo & Tucker, 2015). Taken together, these findings suggest that young children are engaging in excessive screen time and this issue needs to be addressed due to the negative health implications.

Health Indicators

Researchers have identified potential health risks of sedentary behaviour that are distinct from other health behaviours such as physical activity, diet and sleep (Saunders & Vallance, 2017). Two systematic reviews have examined the associations between sedentary behaviour and health indicators in children aged 0-4 years. Poitras and colleagues (2017) included 96 studies in their systematic review in order to clarify the associations between sedentary time and health indicators in children aged 0-4 years while LeBlanc and colleagues (2012) included 21 studies in their review. Both systematic reviews included studies examining health indicators such as adiposity, bone and skeletal health, motor development, psychosocial health, cognitive development and cardiometabolic health. Both systematic reviews reported that screen time was either unfavourably associated or not associated with adiposity, psychosocial health and cognitive development (LeBlanc et al., 2012; Poitras et al., 2017). Additionally, the systematic review conducted by Poitras and colleagues (2017) reported that the associations between total sedentary time and adiposity and motor development were null. Another systematic review conducted by Carson and colleagues (2015) included 37 studies specifically to examine the associations between sedentary behaviour and cognitive development. This systematic review reported that increased screen time was either negatively or not associated with cognitive development but reported beneficial associations between the duration and frequency of reading and cognitive development (Carson et al., 2015). In their systematic review, Poitras and colleagues (2017) reported that the associations between reading or storytelling and cognitive development were favourable or null.

The effects of screen time on cognitive development might depend on the patterns of screen time, such as the content and type of media (Anderson & Subrahmanyam, 2017; Domingues-Montanari, 2017). The systematic review conducted by Carson and colleagues (2015) considered TV content and associations with cognitive development outcomes. Specifically, for the duration and frequency of child specific TV content and associations between cognitive development, 11% of reported associations were negative and 11% of reported associations were positive (Carson et al., 2015). In contrast, 25% of the reported associations between the duration and frequency of adult specific TV content and cognitive development were negative (Carson et al., 2015). Additionally, three studies included in this review reported beneficial associations for some content (i.e., educational content, ABC and PBS channels) and detrimental for some content (i.e., children's cartoons and educational cartoons) (Carson et al., 2015). Similarly, a recent meta-analysis reported that increased duration of screen time was negatively associated with language development while educational screen time and co-viewing was positively associated with language development (Madigan et al., 2020). One recent study examined the effects of screen media content on young children's executive functioning. This study found that children were more likely to delay gratification and, in some cases, perform better on measures of working memory after playing an educational app (Huber et al., 2018). These findings suggest that content may be an important factor in determining the associations between screen time and cognitive development.

The evidence included in previous systematic reviews on sedentary behaviour and cognitive development have primarily focused on television, computer and video games and little is known about the effects of mobile screen devices (Carson et al., 2015; Poitras et al., 2017). Though mobile screen devices can be used passively like these more traditional screen devices, they also have the ability to be more interactive. Interactive screen media can be classified as mentally active screen time as it can be more cognitively engaging in that it requires motor responses (Kirkorian, 2018). Though the research regarding the effects of interactive screen devices on cognitive development are scarce, there is some evidence that children can learn from interactive media. For example, researchers reported that children were able to learn novel words from live interactions as well as from video chatting (Kirkorian, 2018; Myers et al., 2017; Roseberry, Hirsh-Pasek & Golinkoff, 2014). Interactive media such as story books with animated pictures, music and sounds may also facilitate learning and comprehension. For example, one pilot study examining preschool children's tablet access and emergent literacy found preschool children's tablet access at home was positively associated with recognizing letters and sounds as well as being able to write out names (Neumann, 2014). The study included a measure of the types of tablet apps children use at home and found that out of apps classified into gaming, creating, e-book, literacy, math and other educational apps, gaming (75%) and literacy (55%) apps were used the most by pre-schoolers (Neumann, 2014). Additionally, one study looking at executive functioning in 2 and 3-year-old children found that using educational apps positively affected children's performance on executive functioning tasks, especially working memory, in comparison to simply watching a cartoon (Huber et al., 2018). However, one study found that the majority of apps labeled as educational were of low quality in different aspects of learning including active learning, engagement in learning, meaningful learning and social interaction (Meyer et al., 2021).

Interactive media may also have some negative implications on cognitive development. For example, interactive media with extra features like games may be detrimental because they require children to multitask, which is cognitively challenging (Bus, Takacs & Kegel, 2015). Interactive media may also distract from the task at hand and there may be a limit to what children can learn from interactive media. One study suggests that children can learn concrete knowledge from interactive media but skills like problem solving are learned through interactions with the environment and others around them (Radesky, Schumacher & Zuckerman, 2015). Therefore, overall current research suggests is important to consider patterns of screen time when considering associations with cognitive development.

2.3 Correlates

There is limited research regarding the identification of the correlates of screen time in young children. Only two systematic reviews have included mobile screen devices such as smartphones and tablets while others have focused on TV, computer and videogames as measures of screen time (Duch et al., 2013; Paudel et al., 2017). Before effective interventions can be developed, relevant correlates need to be identified. Non-modifiable correlates such as child sex, child race/ethnicity, and family socioeconomic status may be important for identifying groups in need of intervention, whereas modifiable correlates such as access to screen media and parental rules regarding screen media may be important for identifying avenues of intervention development (Cillero & Jago, 2010). Of the research that has been conducted, the focus has typically been on individual, parental, and environmental correlates of screen time.

Individual Correlates of Screen Time

For individual correlates of screen time, several systematic reviews have found that children's sex is not associated with screen time (Cillero & Jago, 2010; Duch et al., 2013; Paudel et al., 2017). However, age was consistently found to be positively associated with screen time such that the older the child, the more screen time reported (Cillero &Jago, 2010; Duch et al., 2013; Paudel et al., 2017). Race/ethnicity is another correlate that has been consistently positively associated with screen time. For example, two systematic reviews reported that non-white race/ethnicity was associated with higher screen time (Cillero & Jago, 2010; Duch et al., 2013). Additionally, one study examining Canadian children reported similar findings, concluding that race/ethnicities other than European-Canadian/Caucasian were significantly positively associated with screen time (Carson & Kuzik, 2017).

Parental Correlates of Screen Time

For parental correlates of screen time, studies have found that parents and their practices regarding screen time are critical factors of children's screen time (Maitland et al., 2013; Tandon et al., 2012; Veldhuis et al., 2014). In their systematic review, Cillero and Jago (2010) found that parental rules and media access were strongly and positively associated with screen time, where less parental screen time rules were associated with higher screen time. Paudel and colleagues (2017) reported similar findings in their review, as they concluded that less media use rules are associated with higher screen time. These findings represent important targets for intervention as parental rules and access to media can be modified.

An extensive review conducted by Paudel and colleagues (2017) looked at additional parental correlates of screen time. This review reported positive associations between parent screen time and children's use of screen devices such as tablets and other screen devices (Paudel et al., 2017). One study on mobile screen devices reported similar findings, concluding that higher smartphone and tablet use by parents were associated with higher levels of smartphone and tablet use by children (Lauricella, Wartella & Rideout, 2015). Another important finding from this review is that parent's self-efficacy to limit screen time was negatively associated with tablet use (Paudel et al., 2017). Downing and colleagues (2017) reported similar findings between parental self-efficacy to limit screen time, screen time rules and total reported screen time. Another study reported that parent's higher self-efficacy to limit screen time was associated with higher parental screen time limiting practices, which as a result was associated with lower screen time (Lee et al., 2018). These results suggest there are several important modifiable parental correlates of screen time that can inform potential interventions to reduce children's screen time.

Environmental Correlates of Screen Time

With regards to screen time, the home environment refers to accessibility of screen devices and in the past studies have used parental reports of number and types of devices in the household and whether devices are located in the children's bedroom (Maitland et al., 2013; Tandon et al., 2012; Veldhuis et al., 2014). Researchers found that the presence of a TV or computer in children's bedrooms was associated with an increased odds ratio of more than two hours of screen time a day (Veldhuis et al., 2014). These odds ratios may be higher when other portable screen devices such as tablets and smartphones are taken into consideration.

In addition to the home environment, there is some evidence that built and social environments may be important correlates of screen time in children aged 5 years and older (Veitch et al., 2011). However, there is limited research regarding social and built environments and screen time in young children. Built environments refer the characteristics that reduce sedentary behaviour by promoting active transport and recreational physical activity such as the availability of parks, sidewalks, trails, and traffic safety (O. Ferdinand et al., 2012). One study examining neighborhood characteristics in relation to TV viewing in 5- and 6-year-old children found that neighborhoods with more playgrounds and sports venues was related to less TV viewing 3 years later (Timperio et al., 2017). In addition, parent perceptions of built environments have been identified as important factors of screen time. One study examining mothers' perceived proximity to green spaces found that children living more than 20 minutes walking distance from a green space watched 2 hours more of TV in comparison the children that lived less than 5 minutes from a green space (Aggio et al., 2015). A recent study examining parents' perceptions of the neighborhood environment found that favorable perceptions were negatively associated with preschool children's screen time (Hunter et al., 2020). To date, screen time is usually limited to TV viewing and computer use. Overall, the results of systematic reviews suggest that parental correlates may be particularly important targets when developing interventions geared towards reducing children's screen time.

2.4 Parent-Child Interactions

Joint Media Engagement

Joint media engagement encompasses all activities parents and children engage in together, including parent-child co-use of screen devices (Ewin et al., 2020). An extensive systematic review conducted by Ewin and colleagues (2020) examined the effects of joint media engagement on parent-child interactions in parent-child dyads with children aged 0 to 10 years. The systematic review reported inconsistent associations between parent-child interactions, in terms of language, and co-use of screen devices (Ewin et al., 2020). In general, the studies included in the systematic review found that parents used less language during the activity and about the activity (Ewin et al., 2020). For example, these studies found that while co-using screen media with their children, parents displayed reduced verbal responsiveness to children's speech, reduced story related comments, and reduced language variation in comparison to playing with toys (Ewin et al., 2020). Only one study included in the systematic review reported increased language, specifically about the media platform being used, during screen media co-use. For instance, parents used more verbalizations to help their children to navigate the e-book in comparison to print books (Lauricella, Barr & Calvert, 2014). The systematic review also reported that children were more engaged in joint media activities in comparison to non-device activities (Ewin et al., 2020). For instance, children paid more attention, gesticulated more, and had a more positive attitude while co-using screen media with parents in comparison to non-device activities, such as reading print books or playing with toys (Ewin et al., 2020). The associations between parent-child interactions during joint media engagement need to be clarified and examining scaffolding may provide an avenue to do so.

Scaffolding

High quality parent-child interactions while the child uses a mobile screen device have been examined in the literature as parent's scaffolding of children's use of mobile screen devices. Scaffolding can be categorized several ways including the CAT coding scheme, which refers to cognitive, affective and technical scaffolding (Neumann, 2018). Cognitive scaffolding includes giving directions and asking questions (e.g., What letter does dog start with? Which one is missing? etc.) while affective scaffolding includes using positive encouragement (e.g., good job, that's right etc.) and technical scaffolding refers to any built-in features of the software that can aid learning (e.g., press the button, click on it etc.) (Neumann, 2018). One study examining mother's scaffolding of children's use of a touch screen tablet found that cognitive scaffolding was observed the most, then affective scaffolding while technical scaffolding was observed the least (Neumann, 2018). Another study analyzing parent scaffolding of children's use of mobile technology using a different coding scheme found that on average parents provide various forms of support including verbal, emotional-verbal, physical and emotional-physical support (Wood et al., 2016).

Co-use of mobile screen devices provides parents with more opportunities for higher quality parent-child interactions, such as scaffolding, which is characterized by asking and answering questions as well as emphasizing content to ensure optimal learning outcomes (Skaug et al., 2017). For example, a pilot study examined how the quality of parent-child interactions differed during tablet use specifically in comparison to TV viewing or toy play. Researchers found that mothers were more physically and emotionally responsive and provided children with more structure by guiding, scaffolding and, supporting children's learning when co-using a tablet in comparison to TV viewing or toy play (Skaug et al., 2017). Parents' scaffolding while using mobile screen devices is usually examined in the context of e-book reading. For instance, one study looking at mother-child interactions during e-book reading compared to print book reading found that children initiated more conversations and that children were more responsive when mothers initiated conversations when reading e-books (Korat & Or, 2010). However, a similar study comparing parent-child interactions during reading traditional books and e-books found that parents initiated more conversations about the formatting and environment of the books in the e-book condition compared to the traditional book condition, which ultimately hindered children's comprehension (Krcmar & Cingel., 2014). These findings suggest that appropriate scaffolding may be an important strategy that can be used by parents while using mobile screen devices with their children. Due to the limited studies examining the quality of parent-child interactions with regards to mobile screen devices, future research is needed to fill this gap in the literature.

Disruptions During Parent-child Interactions

Though there is some research on parent-child interactions while a child uses a screen device, more evidence exists on parent-child interactions in the context of the parent using a device. TV and screen device use by parents may affect development negatively by displacing parent-child interactions that are the foundation of language acquisition and imaginative play (Radesky, Schumacher & Zuckerman, 2015). For instance, researchers found that mothers who spontaneously used a device during a structured interaction task initiated less verbal, nonverbal and encouragement interactions than mothers that did not use a device (Radesky et al., 2015). Another study reported that children with mothers disrupted by a phone call when trying to teach them two novel words did not learn the novel words compared to children whose mothers were not interrupted even though the words were spoken the same number of times (Reed, Hirsh-Pasek & Golinkoff, 2017). These findings suggest that device usage by parents negatively impacts parent-child interactions however, the present study focuses on parent-child interactions during children's screen time.

2.5 Summary

Due to the ubiquity of screen devices, research regarding the effects of these devices on the children's development has increased. The majority of studies have been conducted in the United States, Canada and Australia, which all have released similar guidelines outlining screen time recommendations for children. Previous studies have been limited to the effects of TV viewing and computer use on different health indicators and to a lesser extent they explore the effects of other screen devices such as smartphones and tablets. Some studies have found that screen devices negatively impact cognitive development (Barr et al., 2010; Tomopoulos et al., 2010; Zimmerman & Christakis, 2005), language acquisition (Anderson & Subrahmanyam, 2017; Domingues-Montanari, 2017; Duch et al., 2013) and reduce parent-child interactions if screens are present (Anderson & Subrahmanyam, 2017). In contrast, some studies have found that screen devices can be used to aid cognitive development (Sweetser et al., 2012) and language acquisition (Neumann & Neumann, 2017; Radesky, Schumacher & Zuckerman, 2015; Roseberry, Hirsh-Pasek & Golinkoff, 2013). Moreover, these studies suggest that parent-child interactions, co-viewing, and scaffolding can mitigate the negative effects screen devices on developing children (Neumann, 2014) while others suggest co-viewing has no effect on the parent-child interactions (Anderson & Hanson, 2017). The proposed thesis will address gaps in the current literature by examining total duration and patterns of screen time use, the correlation between children's total duration and patterns of screen time and cognitive development, and whether the quality of parent-child interactions differ based on the type of task being performed.

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Chapter 3: Research Study

Patterns of preschool children's screen time, parent–child interactions, and cognitive development in early childhood: A pilot study

This manuscript will be submitted to the Canadian Journal of Behavioural Sciences (CJBS) and is presented according to the journal requirements.

3.1 Abstract

This pilot study aimed to examine: 1) patterns of screen time use in preschool-aged children, 2) the correlations between total duration, patterns of screen time, and cognitive development, and 3) the differences in quality of parent–child interactions for three tasks. Participants included 44 children aged 3 years and their parents. A 2-week online daily diary design was used to assess total duration and patterns of children's screen time (i.e., type, device, content, context). Different domains of children's cognitive development and parent–child interactions during the three tasks were assessed virtually through two separate Zoom sessions. On average, children spent 103.5 minutes/day engaged in screen time, including 88.7 minutes/day watching a show/movie/video, 7.3 minutes/day playing an electronic game,14.2 minutes/day engaged in educational screen time and 48.1 minutes/day co-using with an adult. After adjusting for child age and parental education, medium effect sizes were observed for total screen time (r_s = -0.32, p = .056), show/movie/video viewing (r_s = -0.32, p = .056) and working memory. Educational screen time was significantly positively correlated with vocabulary (r_s = 0.38, p = .020), while co-use was significantly negatively correlated with self-control (r_s = -0.32, p = .049). The quality of parent–child interactions differed significantly, with the electronic game having the highest quality followed by the storybook and video tasks. Type, content, and context of screen time appear important for understanding the association between screen time and different domains of cognitive development. Findings should be confirmed in a larger and more generalizable sample.

Keywords: preschool children, screen time, parent–child interactions, cognitive development

Public Significance Statement

The vast majority of preschool children exceed the recommended amount of screen time outlined by national and international guidelines and it has been suggested that excessive screen time leads to poor cognitive developmental outcomes for young children. The present study also found that excessive screen time was detrimental for some domains of cognitive development. However, the associations between patterns of screen time and preschool children's cognitive development varied, with findings highlighting areas for future research.

3.2 Background

Early childhood (birth to 5 years) is characterized by rapid growth and development (Sharma & Cockerill, 2014). During this period, children begin to develop their language, memory, and executive functioning domains of cognitive development (Bauer et al., 2010; Garon et al., 2008; Tomasello, 2011). Children's experiences and environment during this period of growth can support or hinder cognitive development (Stern, 2005). As technology has advanced overtime, children's experiences and environment have changed drastically. For example, there has been a dramatic shift in the age at which children begin to engage in screen-based sedentary behaviour or screen time, from 4 years of age in 1970 to 4 months of age in 2016 (Radesky & Christakis, 2016). This shift is troubling as previous research suggests screen time, especially television viewing, is unfavorably associated with cognitive development or has no benefits for cognitive development and is replacing activities that are beneficial (Poitras et al., 2017). Additionally, increased screen time during early childhood is positively associated with increased screen time during adolescence (Downing et al., 2017; Duch et al., 2017). There is also evidence that screen time is unfavourably associated with physical and mental health indicators (e.g., adiposity, anxiety, depression; Saunders & Vallance, 2017) in older children and youth (Carson et al., 2016) and adults (Saunders & Vallance, 2017).

The Canadian 24-Hour Movement Guidelines for the Early Years (0–4 years) were created to address the balance of movement behaviours (i.e., physical activity, sleep, sedentary behaviour) in a day for healthy development. In accordance with these guidelines, children aged 3 to 4 are recommended to engage in a maximum of one hour of screen time while children aged 2 and under are recommended to engage in no screen time (Tremblay et al., 2017). Similar international guidelines have also been developed by the World Health Organization (World

Health Organization, 2019). The accessibility and variety of mobile screen devices may explain why most children are not meeting screen time recommendations. For example, one recent study of toddlers (1–2 years) from Edmonton, Canada found that only 15.2% met the screen time recommendations (Lee et al., 2017), while another study found that 24.4% of Canadian preschool children (3–4 years) met the screen time recommendation within the guidelines (Chaput et al., 2017).

Given that so few children are meeting the Canadian 24-Hour Movement Guidelines, it is important to understand the patterns of screen time that contribute to increased exposure to screens in young children. The patterns of screen time go beyond total duration and can include the type of screen time (e.g., watching TV, playing a game), the device being used (e.g., tablet, smartphone), the content (e.g., education preschool, educational school age, entertainment, adult, other), and the context (e.g., co-viewing). However, the majority of studies in the current literature have only focused on total duration or frequency. This issue highlights an important gap in the literature because a recent meta-analysis reported that the total duration of screen time was negatively associated with language development in children, but educational content and co-viewing were positively associated with language development (Madigan et al., 2020). However, the majority of studies in this review focused on television viewing, and little is known about the effects of mobile screen devices (e.g., smart phones, tablets) on cognitive development. Therefore, considering the patterns of screen time, including mobile devices, can provide important insight into the impacts of screen time on children's cognitive development.

In terms of screen time context, co-use of mobile screen devices may provide opportunities for parent–child interactions. For example, previous research has found that when parents and children co-use mobile screen devices, parents have more opportunities to ask and answer questions, as well as ensure optimal learning outcomes by emphasizing content (Skaug et al., 2017). There is strong evidence to indicate that high-quality interactions are important for children's cognitive development (Lukie et al., 2014). However, there is some evidence that the quality of parent–child interactions differs depending on the type of activity. For instance, one study found that mothers were more physically and emotionally responsive when they co-used a tablet with their child in comparison to TV viewing or toy play (Skaug et al., 2017). Another study found that children initiated more conversations and were more responsive to their mothers when reading e-books compared to print books (Korat & Or, 2010). Further research is needed to better understand if the quality of parent–child interactions differs depending on the type of task or screen device being used and how much screen time involves co-use with parents versus independent screen time (e.g., keep children engaged while parents perform other tasks).

To address current evidence gaps regarding screen time and cognitive development in early childhood, we conducted a pilot study in a sample of 3-year-olds and their parents. The objectives of this study were to: 1) describe total duration and patterns (type, device, content, context) of screen time, 2) examine the correlations between total duration, patterns of screen time, and cognitive development (working memory, inhibitory control, vocabulary, self-control), and 3) examine if the quality of parent–child interactions differs between three tasks (i.e., television viewing, electronic game, storybook reading). We hypothesized that: 1) the associations between screen time on cognitive development will depend on the total duration and patterns of screen time use, with increased total duration being negatively associated with cognitive development, and educational screen time and co-use being positively associated with cognitive development. 2) Parent–child interactions will differ in quality based on the type of task being performed, with the storybook reading task having the highest quality followed by the electronic game task and the video task.

3.3 Methods

Participants and Procedures

Participants included 47 parents and their children aged 3 years from Edmonton, Alberta and surrounding areas. A combination of registries and online advertising was used to recruit participants between August and December 2020. Inclusion criteria for participants included children being 36–48 months old and living with their main caregiver in or around Edmonton, Canada. Participants were excluded if children were born preterm (gestational age of <37 weeks) or underweight (<2500 g) or if children had been diagnosed with a neurological or psychiatric disorder that affects neurocognitive development. The screening form included 15 different illnesses or medical conditions (e.g., autism spectrum disorder, attention deficit hyperactivity disorder). Participants were also excluded if parents could not speak or read English fluently or if they did not have a laptop, computer, or tablet with a camera and microphone. Interested families were screened via phone to determine if they were eligible for the study.

Data was collected virtually through separate Zoom sessions and REDcap, an electronic data capture tool (Harris et al., 2009), to ensure safety during the COVID–19 pandemic. A consent form and questionnaire were sent to eligible participants to complete online via REDcap before the first Zoom session. During the first session, parent–child interactions were assessed using three tasks: (a) watching one of two TV shows via YouTube, (b) playing one of two electronic games, and (c) reading one of two eBooks. All the tasks took approximately 5 to 8 minutes to complete. Each session took approximately 25–30 minutes to complete. The order of the tasks was randomized, and participants were randomly assigned to 1 of the 2 options for each task. In the case that the child was familiar with the assigned option, the alternate option was used (n = 3). After the first session, the parents completed a 2-week online daily diary of screen time use via REDcap. The second session took place approximately one week after the first session. During this session, children's cognitive development was assessed using four different tests in the following order: expressive vocabulary test, head shoulders knees toes (HSKT) test, the word span test, and a snack delay test. These tests were selected because they capture key domains of cognitive development (memory, executive functioning, and language), the tests have been validated in preschool children (Bergman Nutley et al., 2011; Howard & Melhuish, 2017; Ponitz et al., 2008, Wiebe et al., 2011). and they are feasible to administer virtually. Each Zoom session took approximately 25–30 minutes to complete. If children were unable to complete all four tests during the second Zoom session, a third Zoom session was scheduled. For the cognitive development tests and parent–child interaction tasks, inter-rater reliability was calculated for two raters using a random sample of eight participants.

Measures

Screen Time Patterns

To measure screen time patterns, parents completed a 2-week online daily diary survey. They recorded all morning, afternoon, and evening sessions of children's screen time use each day. A session was defined as any time children engaged in screen time. Morning sessions were defined as any time children engaged in screen time starting before 12:00 PM, afternoon sessions were defined as any time children started engaging in screen time between 12:00–4:59 PM, and evening sessions were defined as any time children started engaging in screen time that started at 5:00 PM or later. Additional sessions were recorded if children engaged in screen time at multiple times during the day (e.g., morning session 1, morning session 2, afternoon session 1, etc.). For each session, parents recorded what time the session began and ended (e.g., 1:00–1:20 pm), the device used (i.e., TV, tablet, smartphone/cell phone, computer, laptop, video game console, or other), the type of screen time (i.e., show/movie/video, electronic game, communication, or other), the content (i.e., program/game name) and the context (e.g., if and who watched/played with the child). For device and type, parents were given response options and they could specify if they responded other. For time, content, and context, response options were open ended. Members of the research team categorized content into entertainment, education preschool, education school aged, adult, and other (see Table 1). The context was categorized into co-use with an adult (e.g., parent, other relative, caregiver), co-use without an adult (e.g., sibling, other child) and no co-use. Only co-use with an adult was included in this study because we wanted to examine parent–child interactions. During the first Zoom session, parents were asked if children spent time in care other than that of the parent. If parents responded yes (n = 16), they were emailed a copy of the other caregiver dairy that they could give to the other caregivers in order to capture any screen time that took place under their supervision. The diary also included questions about whether it was a typical day, as defined by the parent, and any factors that could have impacted the day (e.g., childcare, sleep, illness). If parents identified a day as atypical because it was a weekend day, it was coded as a typical day. Daily diaries have been shown to be more accurate than global time estimates because they do not rely on the participant to recall events from the entire day but rather focus on discrete time periods (Vanderwater & Lee, 2009).

Cognitive development

Working memory was assessed using the forward and backward span phases of a word span test (Bergman Nutley et al., 2010; Thorell & Wåhlstedt, 2006). The researcher read a sequence of words and the children were asked to repeat the words back in the same order (forward span phase). The children were then asked to reverse the sequence of words in order (backward span phase). Each block in the forward and backward span phases had three trials unless the child responded correctly to the first two trials, at which point the third trial was skipped and they moved onto the next block. If all three trials were incorrect in a block, the phase was terminated. The trials increased in length for each subsequent block. The outcome variable for this test was a final score that was an average of all the trials attempted for the forward and backward span phases (Thorell & Wåhlstedt, 2006). Possible scores ranged from 0–5 and a higher score indicates better working memory. The words used for the trials included age appropriate, monosyllabic nouns that were different enough to minimize semantic or phonological interference (e.g., cake, stick). High inter-rater reliability was observed for both the forward span and backward span phases (ICCs = 0.94, ICC =1.00, respectively) in the random reliability sample.

The HSKT test was used to measure children's inhibitory control, where the child had to inhibit their dominant response (Ponitz et al., 2008). The children were asked to play a game where they had to do the opposite of what they are being asked to do. For example, the researcher asked the child to touch their head in which case the child had to touch their toes and vice versa. If the child passed this trial, they moved on to the advanced trial where the knees and shoulders commands were introduced. The outcome variable for this test was a final score that is the sum of the first 6 practice items and 20 test items. Possible scores ranged from 0–52 and a higher score indicates better inhibitory control. High inter-rater reliability (ICC = 0.996) was observed in the random reliability sample.

Language was assessed using the expressive vocabulary test in the iPad-based Early Years Toolkit (Howard & Melhuish, 2017). The children were shown pictures on a slideshow via Zoom. Researchers scored the test using an iPad with the app. Children named as many objects correctly as possible, with the words increasing in complexity as the test progressed. The game ended if the child incorrectly named 6 items in a row. The outcome variable for this test was a final score calculated based on the number of correct responses. Possible scores ranged from 0–45 and a higher score indicates better vocabulary. The expressive vocabulary test from the Early Years Toolkit has previously shown excellent reliability (Cronbach's $\alpha = .92$) and good convergent validity when compared to existing measures (Howard & Melhuish, 2017).

Self-control was assessed using a modified snack delay test in which children had to maintain a fixed posture for four minutes to gain a reward (Wiebe et al., 2011). The child was instructed to "sit still and silent like you're frozen" with their hands placed on the table. The parent then placed six small snacks under a transparent cup or container within reach of the child on the table in front of them. When the researcher rang the bell, the child could eat the snack. Before the actual trial, a practice trial was conducted where the child had to wait 10 seconds before they could eat the snack. Throughout the 4-minute trial, parents and the researcher pretended to be otherwise engaged and executed prompts to distract the child. The outcome variable for this test was a final score based on the time duration until the snack was eaten, how still children kept their hands and bodies, as well as how quiet they were throughout the test. Possible scores ranged from 0–144 and a higher score indicates better self-control. The snack delay has previously shown good test-retest reliability of $r > 0.80$ (Shoemaker et al., 2012) and high inter-rater reliability was observed in our random sample (ICC = 0.96).

Parent-child Interactions

Parent–child interactions were examined during three tasks. Parents and children were instructed to read a storybook (Pete the Cat's First Day of Preschool or Bears and a Birthday), watch a short video (Paw Patrol Mighty Pups: Pups vs. The Super Sonic Sound System or Peppa Pig: The Market) and play an electronic game (Curious George Hide and Seek or peg + cat The

Highlight Zone) via either an iPad, laptop, or computer. Parent–child interactions during these tasks were recorded so that they could be coded afterwards.

The recordings of parent–child interactions were coded using the Parent-Child Interaction System (PARCHISY) (Deater-Deckard, et al., 1997; Deater-Deckard, 2000). The PARCHISY consists of 18 items and uses a combination of codes for parent's behaviour (i.e., positive affect, negative affect, verbalizations etc.), child's behaviour (i.e., noncompliance, autonomy/independence etc.), as well as codes for dyadic interactions (i.e., reciprocity, conflict) (Deater-Deckard, et al., 1997; Deater-Deckard, 2000). The PARCHISY scale was adapted from a 7-point Likert scale to a 5-point Likert scale for this study to allow for more consistency in coding for the specific tasks used in the present study. Possible scores ranged from 0–90 and a higher total score represented better quality parent–child interactions (Deater-Deckard, 2000; Deater-Deckard & Petrill, 2004). For this study, a high inter-rater reliability was observed (Weighted Kappa ≥ 0.84), which is consistent with other reports of high interrater reliability for the PARCHISY (Cronbach's α ≥ 0.80) (Funamoto & Rinaldi, 2015).

Demographic Information

Demographic information from participants was collected using a parent questionnaire. Parents were asked to report their child's sex, race/ethnicity, the number of siblings (including stepsiblings) that live in the home with them, and the number of hours/week their child spent in childcare. Parents also reported their age, sex, gender identity, household income, and education level.

Statistical Analyses

Statistical analyses were conducted using STATA 15 and SAS 9.4 software. Descriptive statistics were calculated for parent and children's demographic characteristics. To address the first objective, descriptive statistics were calculated to determine the total duration and patterns of screen time. To address the second objective, Spearman ρ coefficients were used to determine whether there was an association between each screen time and cognitive development variable because the cognitive development test scores were not normally distributed. Next, partial Spearman ρ correlations were computed, adjusting for child age and parental education. These two variables were selected because they were the only demographic variables significantly correlated with one or more cognitive developmental outcomes. Due to the small sample size, we focused on effect size for interpretation: small, medium, and large effect sizes were defined as $r_s = 0.10$, $r_s = 0.30$ and $r_s = 0.50$, respectively (Cohen, 1992). To address the third objective, means and standard deviations for the quality of parent–child interactions were calculated, and a repeated measures ANOVA was used to determine whether parent–child interaction quality differed based on the type of task. The assumptions of normality and equality of variances were checked for the ANOVA. A Bonferroni post-hoc test was conducted to determine which tasks were significantly different and Cohen's *d* coefficients were calculated to determine the effect size. Small, medium and large effect sizes were defined as $d = 0.20$, $d = 0.50$ and $d = 0.80$, respectively (Cohen, 1992). Finally, sensitivity analyses were conducted to examine patterns of children's screen time use and to examine the association between children's screen time use and cognitive development, when only diary days that parents reported being typical were included. Statistical significance was set at $p < 0.05$ for all statistical tests.

3.4 Results

Of the 47 parent–child dyads recruited for this study, two participants withdrew from the study due to technical problems and one did not complete daily diary surveys or Zoom meetings, leaving a sample of 44 parent–child dyads for the analyses addressing objective one. The participant characteristics for parent–child dyads are presented in Table 2. Of the 44 parent–child dyads, two children were excluded from the analyses addressing objective two and three because the children primarily spoke a language other than English resulting in them not being able to complete the cognitive development tests and researchers being unable to code the parent–child interaction tasks. Additionally, children that did not attempt or complete a cognitive development test were excluded from that test. In the final analyses, 40 participants were included in the working memory test, 34 participants were included for the inhibitory control test, 42 participants were included for the vocabulary test and 41 participants were included for the self-control test.

The patterns of children's screen time are presented in Table 3. On average, parents completed 13.5 days (SD = 1.2) of the two-week screen time diary. Children spent on average 103.5 minutes/day (SD = 59.2) engaged in screen time, 24.9 (SD = 29.5) using mobile screen devices, and 48.1 (SD = 30.5) co-using with an adult. The majority of children's screen time during the day was spent watching shows/movies/videos, and the majority of content was for entertainment purposes rather than educational purposes. The sensitivity analysis for total duration and patterns of children's screen time for days parents recorded as typical is presented in Table S1. On average, parents completed 11.5 typical days (SD = 2.2) of the two-week screen time diary. For almost all screen time variables, the mean was slightly lower in comparison to the full dataset.

The correlation coefficients between total duration and screen time patterns and cognitive development are presented in Table 4. Total screen time (r_s = -0.40; p = 0.011) and show/movie/video viewing (r_s= -0.42; p= 0.007) were significantly negatively correlated with working memory. The effect size for these correlation coefficients is considered medium (Cohen, 1992). Additionally, a medium effect size was observed for the negative association between co-use of traditional and mobile screen devices with self-control (r_s=- 0.30; p=0.057). No other statistically significant correlations were observed, and the remaining correlations were all below $r_s = 0.3$ or a medium effect size. After adjusting for child age and parental education, medium effect sizes were observed for total screen time ($r_s = -0.32$, $p = .056$), show/movie/video viewing ($r_s = -0.32$, $p = .056$) and working memory but they were no longer significant. Additionally, educational screen use was significantly positively correlated with vocabulary ($r_s = 0.38$, $p = .018$), while co-use was significantly negatively correlated with self-control ($r_s = -0.32$, $p = .049$). A medium effect size was also observed for the correlation between educational screen use and inhibitory control ($r_s = 0.33$, $p = .074$).

The sensitivity analysis for the correlation coefficients between total duration of screen time, patterns of screen time, and cognitive development on typical days only are presented in Table S2. Similar to the main analysis, medium effect sizes were observed for total screen time and show/movie/video viewing and working memory. However, unlike the main analysis, a medium effect size was not observed for co-use and self-control ($r_s = -0.28$, $p = .092$). After adjusting for child age and parental education, medium effect sizes for total screen time and working memory ($r_s = -0.30$, $p = .073$) and educational screen time and inhibitory control ($r_s = -0.30$, $p = .089$) were observed but they were no longer significant. Additionally, educational screen use was significantly positively correlated with vocabulary ($r_s = 0.32$, $p = .049$). Unlike the main analysis, a medium effect size was not observed for the correlation between show/movie video viewing and working memory.

The summary of the parent–child interaction scores between the three tasks are presented in Table 5. The results showed that there was a statistically significant difference in parent–child interaction quality scores for the three tasks ($p < .001$). The Bonferroni contrast revealed that the parent–child interaction quality significantly differed between the video and storybook reading tasks ($p < .001$, $d = 0.70$), the video and electronic game tasks ($p = .003$, $d = 2.56$), and the storybook reading and electronic game tasks ($p < .001$, $d = 1.48$). Medium and large effect sizes were observed for the difference in parent-child interaction quality between the three tasks. The video viewing task had the lowest parent–child interaction quality average score ($M = 31.70$, $SD = 4.14$) and the electronic game had the highest average score ($M = 43.39$, SD = 4.96).

3.5 Discussion

This pilot study addressed current gaps in the literature to better understand patterns of screen time use and its association with various domains of cognitive development (i.e., memory, executive functioning, and language) among preschool children aged 3 years, as well as whether the quality of parent–child interactions differed between three tasks. Based on parental daily diary reports, show/movie/video viewing, referred to as video viewing hereafter, was the most common type of screen time and parent–child interactions during video viewing were of the lowest quality. In contrast, electronic game use was the least common type of screen time, but it had significantly higher parent–child interaction quality compared to video and storybook reading tasks. Some correlations with medium effect sizes were observed, though the direction of correlations differed based on the screen time variable and the cognitive developmental outcome. Total duration of screen time, video viewing, and co-use were negatively associated with some cognitive developmental measures, whereas educational screen time was positively associated with vocabulary.

A novel aspect of the present study was examining the patterns of preschool children's screen time measured via a daily diary design. Previous studies have primarily relied on the use of parent questionnaires to measure children's screen time habits, typically by focusing on the total duration and/or frequency of children's screen time (Byrne et al., 2021). Only one recent study to our knowledge used a daily screen time diary to examine children's media quantity, content, and context in Saudi children aged 1 to 3 years (Alroqi et al., 2021). Our finding regarding the high prevalence of watching videos on traditional or mobile screen devices for entertainment purposes is consistent with the findings of this study. Specifically, children spent the majority of screen time watching child-directed non-educational content on all screens (Alroqi et al., 2021). These findings suggest that while mobile media devices can be interactive and used for a variety of activities, it appears young children may primarily use these screen devices passively. This finding may be the result of parents using screens to entertain or occupy children while they complete other tasks as interactive screen time may require more parental engagement and support (Blum-Ross & Livingston, 2016). Thus, future research should capture parent's intent for each screen time session.

It is important to note that some content categorized as entertainment in the present study was marketed as educational. This is in line with a recent study that found 58% of apps labeled as educational for young children were low-quality on a coding scheme assessing active learning, engagement in learning, meaningful learning, and social interaction (Meyer et al., 2021). One study examining parent perceptions of the risks and benefits of screen time found that 82% of parents believed that screen time provided opportunities for learning and education (Hinkley & McCann, 2018). Therefore, there may be a disconnection between what parents perceive as educational, potentially due to marketing, and what programs and apps are actually of high-quality for educational or learning outcomes.

The present study found that educational screen time, as defined by researchers, was significantly positively correlated with vocabulary, even after adjustment of covariates and the removal of non-typical diary days. This finding is consistent with a recent meta-analysis that found educational TV programs were significantly associated with stronger language skills in children 12 years and younger (Madigan et al., 2020). Unique to the present study was the inclusion of electronic games in addition to videos in the educational screen time variable. Our findings for total screen time, video viewing, and working memory align with the findings from a large systematic review that found primarily null or detrimental effects of screen time on various domains of cognitive development (Carson et al., 2015). Since findings of the current study suggest associations with screen time may differ across these domains, future studies should examine the associations between screen time and cognitive development across language, memory, and executive function domains in larger more generalizable samples Additionally, future studies should consider the patterns of screen time, not just the total duration, to better understand the impacts of screen time on these domains of cognitive development.

One potential mechanism to explain why excessive screen time may be negatively associated with children's cognitive development is through the displacement of interactions with caregivers, such as displacing non-screen-based language and play based interactions with screen time (Radesky et al., 2015). High-quality parent–child interactions are important for optimal growth and development in early childhood. Co-use of screen devices may mitigate some of the negative impacts of screen time by providing opportunities for parent–child interactions, scaffolding, and feedback (Meyers et al., 2018; Strouse et al., 2018). However, in the present study co-use was negatively associated with self-control. This may be explained by the fact that video viewing was the most prevalent type of screen time, and video viewing had the lowest quality of parent–child interactions. In contrast, co-use of electronic games had the highest quality of parent–child interactions, but this type of screen time was not prevalent among young children. Taken together, these findings suggest that the quality of parent–child interactions during co-use may be more important than the quantity of co-use.

One major strength of this study was the use of the daily screen time diary to measure the patterns of children's screen time. Screen time daily diaries allow for more a comprehensive measure of children's screen time (Byrne et al., 2021). One limitation is the small sample size, given this was a pilot study. Therefore, the results may not be generalizable to all children aged 3 years in Canada. Additionally, residual confounding may have occurred due to unmeasured variables (e.g., parent availability, parental stress). Finally, it is important to note that the cognitive development tests used in this study were validated for in-person assessments not virtual assessments, however the data for this study were collected virtually due to the COVID-19 pandemic.

3.6 Conclusion

Overall, the findings of this study suggest that excessive screen time may be detrimental for some domains of cognitive development, but the type, content, and context is important to consider in future studies with daily diaries. In particular, high-quality educational screen use may have some cognitive development benefits, especially for language development, but it may be difficult for parents to identify high-quality versus low-quality programming and electronic games. Additionally, while interactive activities, such as playing electronic games and reading storybooks had higher quality parent–child interactions in comparison to TV viewing, children primarily use traditional and mobile screen devices for show/movie/video viewing. Given the small sample size of this study, future studies should be conducted with larger, more generalizable samples to confirm these findings.

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Table 1
Children's screen time content definitions

Definition
Education preschool-aged • Coherent and integrative narrative (show/movie/video only) • Language/topic appropriate for preschool-aged child • Labelling or finding objects and/or speaks directly to the child throughout the program • May provide opportunities to respond verbally • May be labelled as a show/game for preschool-aged children
Education school-aged • Coherent and integrative narrative (show/movie/video only) • Language/topic appropriate for school-aged children • May be labelled as a show/game for school-aged children
Entertainment • Non-adult content that does not involve labelling or finding objects and/or speaks directly to child • May not have a coherent and integrative narrative • Does not provide opportunities to respond verbally
Adult • Adult appropriate language and topics, including sports • May be labelled as a show/game for adults
Other • Non-adult content that does not involve labelling or finding objects and/or speaks directly to child throughout programming • Not enough detail provided by parent (e.g., only station/network provided) • Activity based programming (e.g., yoga)

Table 2

Participant Characteristics

Children's Demographics	**Mean/Category (SD/Percent) n=44**
Child Age (years)	3.5 (± 0.3)
Sex	
Male	20 (45.5%)
Female	24 (54.6%)
Siblings	
0	6 (13.6%)
1	23 (52.3%)
2+	15 (34.1%)
Race/Ethnicity	
Caucasian	30 (68.2%)
Non-Caucasian	14 (31.8%)
Children's Cognitive Development	
Working memory (Range: 0-5; n=40)	0.9 (± 0.4)
Inhibitory control (Range: 0-52; n=34)	16.6 (±15.0)
Vocabulary (Range: 0-45; n=42)	25.3 (± 6.0)
Self-control (Range: 0-144; n=41)	75.8 (±31.9)
Parental Demographics	
Relationship to Child	
Mother	43 (97.7%)
Father	1 (2.3%)
Parental Age (years)	35.2 (± 3.4)
Parental Education	
High school diploma or college/ trade certificate	8 (18.2%)
Bachelor's degree	23 (52.3%)
Post-graduate	13 (29.6%)
Household income	
<$100 000	8 (18.2%)
$100 001 - $150 000	25 (56.8%)
>$150 000	11 (25.0%)
Non-parental care (hours/week)	15.2 (± 17.5)

Table 3

Patterns of Children's Screen Time

	Mean (SD) (n= 44)
Total screen time (min/day)	103.5 (± 59.2)
Type	
Show/movie/video (min/day)	88.7 (± 56.8)
Electronic game (min/day)	7.3 (±18.9)
Content	
Educational screen time (min/day)	14.2 (±15.6)
Device	
Mobile device screen time (min/day)	24.9 (±29.5)
Context	
Co-use (min/day)	48.1 (± 30.5)

Table 4

Spearman Rho coefficients between diary-measures of screen time and cognitive development

	Total screen time (min/day)	Show/movie/ video(min/day)	Electronic game (min/day)	Educational screen use (min/day)	Mobile screen device use (min/day)	Co-use (min/day)
Bivariate Correlations						
Working memory (n=40)	**r_s = -0.40*** **p = 0.011**	**r_s = -0.42*** **p = 0.007**	r_s =-0.28† p = 0.078	r_s = -0.09 p = 0.573	r_s = -0.05 p = 0.739	r_s= -0.19 p = 0.249
Inhibitory control (n=34)	r_s = -0.16 p = 0.370	r_s = -0.28 p = 0.109	r_s = -0.06 p = 0.743	r_s = 0.15 p = 0.382	r_s = 0.23 p = 0.189	r_s = -0.18 p = 0.299
Vocabulary (n=42)	r_s = -0.21 p = 0.189	r_s = -0.29† p = 0.066	r_s = 0.22 p = 0.166	r_s = 0.24 p = 0.121	r_s = 0.20 p = 0.214	r_s = 0.02 p = 0.901
Self-control (n=41)	r_s = 0.03 p = 0.867	r_s = -0.03 p = 0.867	r_s = 0.06 p = 0.723	r_s = 0.07 p = 0.678	r_s = 0.15 p = 0.341	r_s = -0.30 p = 0.057†
Partial Correlations[a]						
Working memory (n=40)	r_s=-0.32 p =0.056†	r_s=-0.32 p = 0.056†	r_s=-0.26 p = 0.125	r_s=0.10 p = 0.574	r_s= -0.03 p = 0.876	r_s=-0.14 p = 0.410
Inhibitory control (n=34)	r_s=-0.13 p = 0.496	r_s=-0.20 p = 0.276	r_s= -0.13 p = 0.499	r_s=0.33 p = 0.074†	r_s=0.26 p = 0.155	r_s=-0.19 p = 0.304
Vocabulary (n=42)	r_s=-0.20 p = 0.213	r_s=-0.27 p = 0.102	r_s = 0.23 p = 0.156	**r_s=0.38*** **p = 0.018**	r_s=0.21 p = 0.204	r_s=0.08 p = 0.644
Self-control (n=41)	r_s=0.04 p = 0.815	r_s=0.01 p = 0.948	r_s=0.05 p = 0.746	r_s=0.16 p = 0.349	r_s=0.19 p = 0.265	**r_s=-0.32*** **p = 0.049**

***p<0.05**; †p<0.10

Note: [a] Partial correlations are adjusted for child age and parental education

Table 5
Summary of parent-child interaction quality scores

Task	N	Mean[a]	SD
Video	42	31.70	4.14
Electronic game	42	43.39	4.96
Storybook reading	42	35.30	5.92

Note. SD represents standard deviation
[a] The scores for all three tasks were significantly different.

Table S1

Patterns of children's screen time with typical days only

	Mean (SD) (n= 44)
Total screen time (min/day)	99 (± 60.7)
Type	
Show/movie/video (min/day)	85.2 (± 59.0)
Electronic game (min/day)	7.3 (±18.9)
Content	
Educational screen time (min/day)	13.9 (±16.1)
Device	
Mobile device screen time (min/day)	24.7 (±31.5)
Context	
Co-use (min/day)	45.6 (± 31.6)

Table S2
Spearman Rho coefficients between diary-measures of screen time for typical days only and cognitive development

	Total screen time (min/day)	Show/movie/Video (min/day)	Electronic game (min/day)	Educational screen use (min/day)	Mobile screen device use (min/day)	Co-use (min/day)
Bivariate Correlations						
Working memory (n=40)	**r_s =-0.39*** **p = 0.013**	**r_s = -0.40*** **p = 0.012**	r_s = -0.26 p = 0.108	r_s = -0.04 p = 0.810	r_s = 0.00 p = 0.989	r_s = -0.22 p = 0.178
Inhibitory control (n=34)	r_s = -0.15 p = 0.389	r_s = -0.24 p = 0.168	r_s = -0.03 p = 0.859	r_s = 0.22 p = 0.213	r_s = 0.28 p = 0.110	r_s = -0.05 p = 0.775
Vocabulary (n=42)	r_s = -0.16 p = 0.317	r_s = -0.25 p = 0.118	r_s = 0.19 p = 0.234	r_s = 0.23 p = 0.142	r_s = 0.25 p = 0.105	r_s = -0.01 p = 0.947
Self-control (n=41)	r_s = 0.04 p = 0.785	r_s = -0.02 p = 0.913	r_s = 0.02 p = 0.908	r_s = 0.12 p = 0.439	r_s = 0.20 p = 0.214	r_s = -0.24 p = 0.134
Partial Correlations[a]						
Working memory (n=40)	r_s=-0.30 p = 0.073†	r_s=-0.28 p = 0.089†	r_s=-0.28 p = 0.098	r_s=0.079 p = 0.644	r_s= -0.035 p = 0.983	r_s=-0.19 p = 0.254
Inhibitory control (n=34)	r_s=-0.10 p = 0.608	r_s=-0.14 p = 0.462	r_s= -0.09 p = 0.627	r_s=0.30 p = 0.097	r_s=0.29 p = 0.114	r_s=-0.08 p = 0.680
Vocabulary (n=42)	r_s=-0.12 p = 0.457	r_s=-0.21 p = 0.201	r_s = 0.17 p = 0.297	**r_s=0.32*** **p = 0.049**	r_s=0.24 p = 0.137	r_s=0.02 p = 0.889
Self-control (n=41)	r_s=0.07 p = 0.658	r_s=0.04 p = 0.831	r_s=-0.01 p = 0.976	r_s=0.17 p = 0.310	r_s=0.21 p = 0.206	r_s=-0.28 p = 0.092†

***p<0.05**; †p<0.10
Note: [a] Partial correlations are adjusted for child age and parental education

Chapter 4: Conclusion

The first 5 years of life are characterized by rapid growth and development, especially in the cognitive domains of language, memory and executive functioning (Bauer et al., 2010; Carson et al., 2015; Garon et al., 2008; Radesky & Christakis, 2016; Tomasello, 2011). Due to advancing technology, screen time is highly prevalent, and the majority of Canadian preschool children fail to meet the screen time recommendations (Chaput et al., 2017; Lee et al., 2017). Therefore, it is important to understand the role children's screen time plays in their cognitive development. While previous literature has examined children's screen time largely in the context of TV viewing, video game and/or computer use, few studies have examined mobile screen devices and the patterns of children's screen time (e.g., content, context). Furthermore, though the importance of parent-child interactions in children's cognitive development has been previously established, little research exists on parent-child interactions that occur during children's screen use. This thesis addressed these evidence gaps.

One objective of this thesis was to examine the patterns of children's screen time use (i.e., type, device, content, context). Findings from this study suggest that children primarily use traditional and mobile screen devices passively (e.g., to watch shows, movies and videos) for entertainment purposes. Additionally, this study found that there are some discrepancies between what programs and apps met our definition of high quality for education or learning outcomes and what programs and apps were marketed to parents as parents as educational. Previous literature on children's educational TV programming found that educational TV programming encouraging direct participation (e.g., Dora the Explorer, Blue's Clues, Arthur, Clifford) facilitated greater vocabulary compared to TV programming that used poor or nonsensical language (e.g., Teletubbies) (Linebarger & Walker, 2005). However, as children's screen time has evolved beyond TV programming to include streaming and gaming research has not kept up with changes in technology. Only one recent study examined educational apps for preschool children and found that the majority of apps marketed as educational were low quality (Meyer et al., 2021). Therefore, this study filled important gaps in the literature by considering patterns of screen time.

With regards to the second objective of this thesis, some associations were observed between children's screen time and some domains of cognitive development. It was hypothesized (thesis hypothesis 1) that the associations between children's screen time and cognitive development would depend on total duration and the patterns of screen time use, with increased total duration being negatively associated with cognitive development and educational screen time and co-use being positively associated. Findings partially supported this hypothesis as total duration of screen time was significantly negatively correlated with working memory and educational screen time was significantly positively correlated with suppressive vocabulary. In rejection of this hypothesis, co-use was significantly negatively associated with children's self-control. These trends remained similar after adjusting for child age and parental education. It is important to note that these findings were not consistent across all domains of cognitive development. This finding highlights the importance of considering multiple domains of cognitive development when examining associations with patterns of screen time, representing another strength of the present study.

Young children may be able to learn from traditional or mobile screen devices through parent-child interactions while co-using (Radesky & Christakis, 2016). However, children's ability to benefit from parent-child interactions during screen use may depend on the quality of interactions occurring, not the quantity (Ewin et al., 2020). With regards to the third objective of this thesis, it was hypothesized (thesis hypothesis 2) that the quality of parent-child interactions would differ based on the task, specifically that storybook reading would have the highest quality parent-child interactions followed by the electronic game and video tasks, respectively. In contrast to the hypothesis, the electronic game task had the highest quality parent-child interactions while in support of the hypothesis, the video viewing task had the lowest quality parent-child interactions. However, the findings of this study suggest that preschool children primarily use traditional and mobile screen devices for entertainment purposes. Therefore, co-using occurs most frequently for this type of screen time, which is characterized by low quality parent-child interactions. It is also important to note that co-using occurred less than half of the total time children used screens in this sample. There is a variety of reasons families may use screen time (Blum-Ross & Livingston, 2016), including occupying children while parents work or do chores, such as cooking dinner, where it may not be possible for parents to co-use and engage in high quality interactions with children. These practical considerations should be considered in future interventions and initiatives targeting preschool children's screen time.

Due to the novel research of this thesis and the small sample size of this pilot study, future research should confirm these findings in larger, more generalizable samples. Additionally, findings from this study can inform future research that builds on these findings. For instance, in terms of the findings regarding the total duration of screen time, future research should examine strategies to support families in limiting preschool children's total duration of screen time. Some studies have shown interventions focused on reducing both children's and parent's screen time have had success (Maniccia et al., 2011; Wu et al., 2016). However, the majority of these studies have focused on children aged 5 and older so future work should consider children under the age of 5 years. In regard to our findings for educational screen time, future studies should determine if educational content can be developed to impact multiple domains of cognitive development. Furthermore, research on how to support parents in evaluating the programming and games that are of higher educational quality is needed. In relation to the findings on parent-child interactions, future research should examine whether increasing the proportion of high-quality parent-child interactions during co-use could benefit children's cognitive development. Finally, parental factors that this thesis did not address, such as parental attitudes and rules regarding children's screen time, parental availability, and parental stress should be considered in future research in this area. The body of work described in the section could help in the development of more nuanced screen time recommendations. For example, while the overall message is still to limit children's screen time, it may be possible to add recommendations regarding the content and context of screen time when children do engage in this behaviour. This information may be helpful for caregivers and educators across home, childcare, and school settings.

In conclusion, given mobile and traditional screen devices are ubiquitous in today's society and very few preschool children meet national and international screen time recommendations (Atkin et al., 2014; Chaput et al., 2017; Hinkley et al., 2012; Lee et al., 2017), it is important to examine the patterns of children's screen time and their associations with children's cognitive development. This thesis contributed novel research in this area of preschool children's screen time and the findings highlight the importance of considering not only the duration of screen time but the content and context. The future research informed by the findings of this thesis may be useful for guideline updates and interventions targeting children's screen time.

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Appendix I: Letter of Information and Consent Form

INFORMATION LETTER

Screen technology, parent-child interactions, and neurocognitive development in early childhood

Principal Investigators:
Dr. Valerie Carson, 1-151 Van Vliet Centre, University of Alberta, Edmonton, AB, T6G 2H9
Dr. Sandra Wiebe, P243 Biological Sciences Building, University of Alberta, Edmonton, AB, T6G 2E9

Dear Parent/Guardian,

This research is being led by Dr. Valerie Carson and Dr. Sandra Wiebe from the University of Alberta. We are asking for you and your child to participate in this important new research study.

What is this study about? The purpose of this study is to help us better understand the association between children's screen time and their neurocognitive development. This study is funded by the Women and Children's Health Research Institute (WCHRI).

What will participation entail? 1) Completion of an online questionnaire. 2) A trained research staff will conduct 2 to 3 virtual meetings with you and your child. 3) You will record your child's screen time in a daily diary for 14 consecutive days.

1) Prior to the first meeting, we will ask you to complete a short questionnaire online regarding your child's everyday behaviour, home environment, your parenting practices, and family background. The questionnaire should take about 15 minutes to complete.

2) During the first virtual meeting, you and your child will complete three tasks together, including watching a brief television show, playing a computer game, and reading an electronic storybook. At the second virtual meeting, your child will complete a series of four tasks to assess aspects of their neurocognitive development such as working memory, impulse control, vocabulary, and language. For one of the tasks, you will be asked to provide a novel snack for your child. If needed, a third meeting can be arranged to allow your child to complete any remaining tasks. All virtual meetings will be recorded for later analysis and you will remain in the room with your child throughout the sessions. The virtual meetings will last about 30 minutes each.

3) After the first virtual meeting, you will be asked to complete a daily diary measuring your child's screen time patterns for 14 consecutive days. Diaries include reporting the time(s) your

child engaged in screen time (e.g., 9:00-9:30 am), the device that was used (e.g., iPad, TV), type of screen time (e.g., movie, game), content (e.g., program name) and context (e.g., watched with Mom). The daily diaries will be completed online or on paper, if preferred. The diaries should take approximately 5 minutes/day to complete.

Is my participation voluntary? Yes, you and your child are under no obligation to participate in this study. You should not feel obliged to answer any survey questions you do not wish to. Even if you agree to participate, you and your child may withdraw from the study **at any time** without any penalty. Within one month of completing the virtual meetings and daily screen time diaries you can ask to have any collected data withdrawn and not included in the study. If your child does not want to participate in the study tasks they do not have to.

Are there any benefits or risks by participating? There are no anticipated risks. All tasks have been used in previous research with young children. You and your child may not directly benefit from participating in the study. However, the findings from the study will have important implications on screen-time guideline updates, health promotion initiatives and campaigns, and future interventions.

What will happen to the information collected? All data collected will be kept confidential. Only the research team will have access to it. The study data will be kept in a secure place for a minimum of ten years. If the data is to be used for other studies, ethics approval will be obtained. The data may also be published in professional journals or presented at scientific conferences, but any such presentations will be of general (group-level) findings and will never breach individual confidentiality. Should you be interested, you are entitled to a copy of the findings.

Will there be any compensation for my participation? Parents will receive an electronic gift card up to $48 after they are done participating in the study. Specifically, parents will receive $20 for the 2-3 virtual meetings and a maximum of $28 ($2 per daily entry) for the 2 week daily diaries.

What if I have questions or concerns? If you have any questions or concerns regarding this study, please contact the principal investigators, Dr. Valerie Carson (780-492-1004; vlcarson@ualberta.ca) or Dr. Sandra Wiebe (780-492-2237; sandra.wiebe@ualberta.ca) or the research coordinator Madison Predy (780-995-9143; perbel@ualberta.ca). The plan for this study has been reviewed for its adherence to ethical guidelines by a Research Ethics Board at the University of Alberta. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office (780-492-2615). This office has no direct involvement with this project.

CONSENT FORM

Screen technology, parent-child interactions, and neurocognitive development in early childhood

I have read the letter of information, have had the nature of the study explained to me, and I agree to have my child participate. All questions have been answered to my satisfaction.

Signed in _________________________ (city) this ________ day of _____________, 20_____.

Name of child participant (please print): ____

Birth date of child (please print): ____

(MM/DD/YYYY)

Name of parent/guardian (please print): ____

Signature of parent/guardian: ____

Appendix II: Parent Questionnaire

Technology and Development in Early Childhood

Parent Questionnaire

<u>Instructions:</u> Please take your time and read each question carefully. Choose the answer that best describes you and your child by placing an (⍰) in the box provided or writing in the space provided. There are no right or wrong responses. If there is a question that you do not want to answer, you do not have to. **Your responses will be kept confidential.**

Part A: Demographic Characteristics of Your Child

1. Is your child male or female? ☐ Male ☐ Female

2. Please select your child's race/ethnicity (check all that apply):
   - Aboriginal person, that is First Nations, Métis, or Inuk (Inuit)
   - White
   - South Asian (e.g., East Indian, Pakistani, Sri Lankan)
   - Chinese
   - Black
   - Filipino
   - Latin American
   - Arab
   - Southeast Asian (e.g., Vietnamese, Cambodian, Malaysian, Laotian)
   - West Asian (e.g., Iranian, Afghan)
   - Korean
   - Japanese
   - Other (please specify): ___________________________

3. Typically, how many **hours per week** does your child spend in care other than yours (or the child's parents)? _________

   If applicable, check all that apply and fill in number of <u>hours per week</u>:
   - Daycare centre _________
   - Home daycare _________
   - Another adult (e.g., friend, relative, nanny, babysitter) **in your home** _________
   - Another adult (e.g., friend, relative, nanny, babysitter) **outside your home** _________
   - Other (specify: _________________________) __________

4. How many siblings (brothers or sisters) does your child have **that live in the same home**, including step-brothers and step-sisters? If applicable, what are the sibling(s)' ages (please specify age in months or years)?

Younger siblings: ☐ 0 ☐ 1 ☐ 2 ☐ 3 or more, and if applicable their age(s): ___________

Older siblings: ☐ 0 ☐ 1 ☐ 2 ☐ 3 or more, and if applicable their age(s): ___________

Part B: Your Child's Screen Time

Note: Screen time includes any time spent watching shows or playing games on a screen. Screens can include televisions, computers, laptops, tablets, smart phones, etc.

5. On average, how much time **per day** does your child watch television, videos, or DVDs **on** a television, computer, or portable device?

   Weekdays **(per day)** _______ Hours AND _______ Minutes

   Weekend **(per day)** _______ Hours AND _______ Minutes

6. On average, how much time **per day** does your child play video/computer games **on** devices such as a learning laptop, leapfrog leapster, computer, laptop, tablet, cell phone, PlayStation, or XBOX?

   Weekdays **(per day)** _______ Hours AND _______ Minutes

   Weekend **(per day)** _______ Hours AND _______ Minutes

7. At what age did your child start engaging in screen time?
   - ☐ Under 1 year old
   - ☐ 1-2 years old
   - ☐ Above 2 years old
8. How often did your child engage in screen time when they were **under 2 years old**?
   - ☐ Almost never
   - ☐ Occasionally
   - ☐ Frequently
   - ☐ Almost everyday
9. How often did your child engage in **more than 1 hour of screen time per day** when they were **2 years old**?
   - ☐ Almost never
   - ☐ Occasionally
   - ☐ Frequently
   - ☐ Almost everyday
10. Since your child first started engaging in screen time, has the amount changed over time?
    - ☐ Increased
    - ☐ Relatively stable
    - ☐ Decreased

Part C: Parenting Practices

11. Choose the rating that best reflects how often you exhibit this behavior with your child.

	Never	Once in a While	About Half of the Time	Very Often	Always
1) I am responsive to our child's feelings and needs.	1	2	3	4	5
2) I use physical punishment as a way of disciplining our child.	1	2	3	4	5
3) I take our child's desires into account before asking the child to do something.	1	2	3	4	5
4) When our child asks why he/she has to conform, I state: because I said so, or I am your parent and I want you to.	1	2	3	4	5
5) I explain to our child how we feel about the child's good and bad behavior.	1	2	3	4	5
6) I spank when our child is disobedient.	1	2	3	4	5
7) I encourage our child to talk about his/her troubles.	1	2	3	4	5
8) I find it difficult to discipline our child.	1	2	3	4	5
9) I encourage our child to freely express himself/herself even when disagreeing with parents.	1	2	3	4	5
10) I punish by taking privileges (toys, activities) away from our child with little if any explanations.	1	2	3	4	5
11) I emphasize the reasons for rules.	1	2	3	4	5
12) I give comfort and understanding when our child is upset.	1	2	3	4	5
13) I yell or shout when our child misbehaves.	1	2	3	4	5
14) I give praise when our child is good.	1	2	3	4	5
15) I give into our child when the child causes a commotion about something.	1	2	3	4	5
16) I explode in anger towards our child.	1	2	3	4	5
17) I threaten our child with punishment more often than actually giving it.	1	2	3	4	5
18) I take into account our child's preferences in making plans for the family.	1	2	3	4	5
19) I grab our child when being disobedient.	1	2	3	4	5
20) I state punishments to our child and does not actually do them.	1	2	3	4	5
21) I show respect for our child's opinions or involvement by encouraging our child to express them.	1	2	3	4	5
22) I allow our child to give input into family rules.	1	2	3	4	5
23) I scold and criticize to make our child improve.	1	2	3	4	5
24) I spoil our child.	1	2	3	4	5
25) I give our child reasons why rules should be obeyed.	1	2	3	4	5

26) I use threats as punishment with little or no justification.	1	2	3	4	5
27) I have warm and intimate times together with our child.	1	2	3	4	5
28) I punish by putting our child off somewhere alone with little if any explanations.	1	2	3	4	5
29) I help our child to understand the impact of behavior by encouraging our child to talk about the consequences of his/her own actions.	1	2	3	4	5
30) I scold or criticize when our child's behavior doesn't meet our expectations.	1	2	3	4	5
31) I explain the consequences of the child's behavior.	1	2	3	4	5
32) I slap our child when the child misbehaves.	1	2	3	4	5

Part D: Your Information

12. What month and year were you born? ___ ___ / ___ ___ ___ ___
M M Y Y Y Y

13. What sex were you assigned at birth, meaning on your original birth certificate?
    - ☐ Male
    - ☐ Female

14. What is your current gender identity?
    - ☐ Male
    - ☐ Female
    - ☐ Trans male/ Trans man
    - ☐ Trans female/ Trans woman
    - ☐ Genderqueer/ Gender non-conforming
    - ☐ Different identity (please state) ____________________________

15. What is your marital status?
    - Married
    - Living common-law
    - Widowed
    - Separated/Divorced
    - Single, never married

16. Were you born in Canada? • Yes • No

    <u>If no</u>, what <u>year</u> did you first come to Canada to live? ______________

17. What is your best estimate of your total household income received by all household members, from all sources, before taxes and deductions, during the year ending December 31, 2019?
   - ☐ Less than $25,000
   - ☐ $25,000 to $50,000
   - ☐ $50,001 to $75,000
   - ☐ $75,001 to $100,000
   - ☐ $100,001 to $125,000
   - ☐ $ 125,001 to $150,000
   - ☐ $150,001 to $175,000
   - ☐ $175,001 to $200,000
   - ☐ More than $200,000
   - ☐ Do not know

18. What is the highest grade or level of education you have ever completed?
   - ☐ Less than high school diploma
   - ☐ High school diploma
   - ☐ College or trade certificate or diploma
   - ☐ Bachelor's degree (e.g., B.A., B.Sc., LL.B.)
   - ☐ University certificate, diploma or degree above the bachelor's level

19. On a typical day, about how many times do the following devices interrupt a conversation or activity you are engaged in with your child?

	None	Once	2 to 3 times	4 to 5 times	6 to 10 times	11 to 20 times	More than 20 times
a) Cell phone/Smartphone	0	1	2	3	4	5	6
b) Television	0	1	2	3	4	5	6
c) Computer	0	1	2	3	4	5	6
d) Tablet (e.g., iPad, Kindle, etc)	0	1	2	3	4	5	6
e) iPod or other music player	0	1	2	3	4	5	6
f) Video game on console	0	1	2	3	4	5	6

This is the end of the survey. Thank you very much for your participation!