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SCREEN TIME AND ATTENTION IN PRESCHOOL CHILDREN: EXPLORING SEX DIFFERENCES

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ABSTRACT

Screen-based activities have become part of everyday life for many preschool children. Smartphones and tablets are used for entertainment, games, educational activities, and, in some situations, to keep children occupied or calm. This growing exposure has raised questions about its relationship with attention and self-regulation during a period when these abilities are still developing. Research to date has not produced a consistent answer. Some studies have linked greater or persistent screen exposure with problematic digital-media use and difficulties in executive functioning, whereas others have found little or no relationship between total screen time and executive function. Differences between boys and girls may partly explain this variation. Boys have been reported in some studies to spend more time with mobile devices and to show greater interest in certain types of games, while girls have performed better on some measures of response inhibition. These differences, however, vary across studies and do not indicate that either sex is generally more susceptible to attention difficulties associated with screen use. The relationship is likely influenced by several factors, including the type and purpose of screen activity, executive functioning, emotional regulation, and the family environment. This review examines the relationship between screen exposure and attention in preschool children and considers whether sex differences may shape this association. More longitudinal research involving children aged 3–6 years is needed to clarify the direction and strength of these relationships.

Keywords: Screen Time; Attention; Sex Differences; Preschool Children; Digital Media; Executive Function

1 INTRODUCTION

Digital devices are no longer unusual in the lives of young children. Smartphones and tablets are used to watch videos, play games, draw, access educational applications, and engage with other forms of digital content. For preschool children, screen exposure can occur in a variety of circumstances. A device may be used during leisure time, while travelling, during meals, or simply when a caregiver needs a child to remain occupied. Because of this widespread use, the possible relationship between screen exposure and children's attention has become an increasingly relevant developmental issue.

The preschool years are also a period of rapid development in attention and executive functioning. Between approximately 3 and 6 years of age, children become progressively better at maintaining attention, resisting distractions, inhibiting inappropriate responses, and moving from one task to another. These abilities are still developing, however, and are influenced by both the child's characteristics and the environment in which development takes place.

It is useful to distinguish ordinary screen exposure from problematic digital use. Screen time generally refers to the amount of time spent using screen-based media, while problematic smartphone or media use involves difficulty controlling use or experiencing negative consequences from it. The two concepts overlap but are not interchangeable. A child who spends a considerable amount of time watching an educational program, for example, cannot automatically be considered to have problematic digital use. Conversely, a child may have difficulty stopping device use even when total exposure is relatively limited. The circumstances surrounding screen use may therefore matter as much as the number of hours involved. What children watch or play, why they use the device, when they use it, and whether the activity is passive or interactive can all change the nature of the experience.

The association with attention is similarly difficult to interpret as a simple cause and effect relationship. Children who already have difficulties with attention or self-regulation may be particularly drawn to stimulating digital activities. Parents may also rely on smartphones or tablets to occupy or calm children who are difficult to settle. At the same time, frequent engagement with highly stimulating digital content may reduce the amount of time children spend practicing sustained attention and self-regulation through other activities.

Sex differences provide another possible explanation for variation between children. Boys and girls may differ in the amount of time they spend using digital devices, the activities they choose, and their performance on particular aspects of executive function. Such differences do not necessarily mean that one sex is more vulnerable than the other. They may instead influence the way children interact with digital media and respond to the demands of different screen activities. This review examines the relationship between screen time and attention in preschool children, with sex differences considered as a possible factor influencing this relationship. Findings related to executive function, visual attention, gaming, emotional regulation, and parenting are included where they help explain the main association.

2 REVIEW CONTENT

2.1 Screen Time and Attention in Preschool Children

The nature of screen exposure has changed considerably with the widespread availability of portable devices. Television generally provides a relatively fixed viewing experience, whereas smartphones and tablets allow children to choose content, interact with applications, receive immediate feedback, and move quickly between activities. These features can make digital activities highly engaging, but their developmental implications depend on how they are used. Park and Park studied 1,378 preschool children in Korea and found that 17% met the criteria for problematic smartphone use used in their study. Frequent smartphone use and exposure of more than two hours per day were associated with higher odds of problematic smartphone use. Entertainment-oriented television and video use were also associated with problematic smartphone use, while gaming was not independently associated after adjustment. [1] The findings indicate that duration and type of use both deserve attention, rather than treating all forms of screen exposure as equivalent.

Evidence concerning executive function is less uniform. In a meta-analysis involving 6,922 children younger than six years, Bustamante et al. found no statistically significant overall association between total screen time and executive function. [2] This result is important because it suggests that the amount of time spent in front of a screen does not, on its own, explain differences in children's executive abilities. Variation in study methods, the type of content assessed, and the context of use may contribute to the inconsistent findings.

There is nevertheless evidence that sustained patterns of screen exposure may be related to problematic media use. Fitzpatrick et al. followed 315 children from approximately 3.5 to 5.5 years of age and found that children with a high

screen-use trajectory had more symptoms of problematic media use at 5.5 years. [3] Because the study followed children over time, it provides stronger evidence of temporal association than a purely cross-sectional study, although it still cannot establish that screen exposure itself caused the later difficulties.

The direction of the association becomes particularly relevant when attention and executive function are considered. Danet et al. found that 3–4-year-old children with weaker overall executive functioning were more likely to be given mobile devices for calming purposes. [4] In this situation, increased screen exposure among children may be partly a consequence of a child's existing regulatory difficulties.

Radesky et al. reported a related pattern in a longitudinal study of 422 children aged 3–5 years. Mobile-device use for calming was associated over time with emotional reactivity and executive functioning, with evidence of bidirectional relationships. [5] In other words, children's regulatory difficulties and their use of mobile devices may influence each other rather than occurring in a simple sequence.

These findings make a direct explanation based only on screen duration difficult to sustain. Two children may spend the same amount of time using a device but have very different experiences depending on the content, purpose, and circumstances of use. The child's existing ability to regulate attention and behavior may be part of the explanation as well.

2.2 Sex Differences in Children's Digital Use Patterns

Research has identified some differences between boys and girls in digital-media use, although the pattern is far from consistent. In a systematic review and meta-analysis of 39 studies involving 32,927 children aged six years or younger, de Azevedo et al. found a small positive association between male sex and smartphone-use duration. The same analysis did not find a significant overall association between sex and problematic smartphone use. [6]

The distinction between duration and problematic use is important. Spending somewhat more time with a smartphone does not necessarily mean that a child has greater difficulty controlling its use. A difference in duration may instead reflect differences in the activities children choose.

This possibility is supported by research examining digital preferences. Chichinina et al. studied children aged 6-7 years and found that boys more frequently selected video games as their preferred digital activity, while girls reported a wider range of uses, including drawing, communication, and photography. [7] Although these children were slightly older than the preschool population considered in this review, the findings provide an indication that boys and girls may engage with digital devices in different ways.

Plotnikova et al. reported similar differences in preferred game types among 6–7-year-old childre. Boys more often preferred quick-reaction and strategic games, whereas girls more often selected logic, educational, drawing, and simulation activities. The authors also found relationships between preferred game types and selected executive-function measures. [8] Because the study was correlational, however, it cannot establish that playing a particular type of game caused differences in executive function.

The broader literature on problematic smartphone use also remains inconsistent. Fischer-Grote et al. reviewed 38 studies involving children and adolescents and found conflicting evidence concerning sex. Some studies reported higher problematic smartphone use among girls, while others reported higher use among boys or no significant difference. Differences in age, definitions of problematic use, and measurement methods were among the factors that complicated comparisons between studies. [9]

Visual attention offers another perspective on smartphone use. In an earlier study of television viewing, Alvarez et al. found greater visual attention to animated content among boys in some age groups. [10] However, the study examined television rather than smartphones, and greater visual attention did not necessarily translate into better comprehension. More recent eye-tracking research involving preschool children has shown that children's attention to on-screen characters varies according to age and the characteristics of the material presented. [11]

Taken together, these findings point toward differences in how boys and girls may use digital media rather than a clear difference in overall vulnerability. The available evidence does not justify describing boys as inherently more attracted to screens or girls as inherently less affected by them.

2.3 Sex Differences in Attention and Executive Function

Attention is not a single ability. Staying focused on a task, selecting relevant information, suppressing an inappropriate response, and holding information in mind involve overlapping but distinct processes. For this reason, differences

between boys and girls may appear on one measure of attention or executive function without being present across all measures.

Mileva-Seitz et al. examined 752 preschool children and found that boys made more commission errors than girls during a Go/No-Go task and performed less well on a forward short-term memory measure. The researchers did not, however, find sex differences in omission errors or backward working memory. [12] The pattern therefore does not indicate a general difference in executive functioning; rather, it points to differences in particular components of cognitive control.

Ribeiro et al. found a comparable task-specific pattern in 160 children aged 4–6 years. Girls performed better than boys on a Go/No-Go response-inhibition task, but the difference was not observed on the Shape School task. [13] Usai's review similarly concluded that reported sex differences in inhibitory abilities depend on the task and the demands placed on the child. [14]

These findings become relevant when considering digital activities. Many games and applications require children to maintain attention, respond quickly, inhibit competing responses, and eventually stop an activity. A child who has difficulty with response inhibition may consequently find it harder to disengage from a highly rewarding digital activity. This possibility, however, should not be interpreted as evidence that sex differences in inhibition directly cause screen-related attention problems.

The emotional role of digital devices may also differ between children. In the study by Radesky et al., associations between mobile-device use for calming and emotional reactivity were stronger among boys in some analyses. [5] This finding raises the possibility that the relationship between screen use and emotional regulation may not be identical for boys and girls. It does not, however, establish an inherent biological susceptibility among boys.

Sex differences in attention and executive function are therefore best understood as selective and dependent on context. They may contribute to different responses to digital activities, but they cannot independently explain the relationship between screen exposure and attention.

2.4 Sex Differences in the Screen Time–Attention Relationship

Considering screen time and attention separately does not fully capture the question of whether boys and girls may respond differently to digital exposure. The more relevant issue is whether sex changes the way screen exposure is related to attention and self-regulation.

Some evidence points toward differences in digital-use patterns. Boys have been reported to spend slightly more time using mobile devices and to show greater preference for certain interactive or game-based activities. [6, 7, 8] Such activities may involve rapid feedback, competition, rewards, and frequent changes in stimuli. For a child who already finds it difficult to inhibit responses, leaving an engaging activity may be particularly challenging.

This does not mean that gaming itself produces attention problems. In the preschool study by Park and Park, gaming was not independently associated with problematic smartphone use after adjustment. [1] Game characteristics also differ substantially, and some games require planning, working memory, or inhibitory control. The meaning of gaming therefore depends on the type of activity rather than on the label “gaming” alone.

Girls have performed better than boys on some response-inhibition tasks, although the difference has not appeared consistently across measures. [12, 14] One possible interpretation is that differences in specific executive processes could influence how children manage highly engaging digital activities. At present, however, few preschool studies have directly tested whether these differences explain the association between screen exposure and attention.

The purpose of screen use may be equally important. When a device is given to calm a child, the screen becomes part of the child's emotional-regulation strategy rather than simply a source of entertainment. Children with weaker executive functioning may be more likely to receive devices in these situations. [4, 5] Repeated use for calming could then make transitions away from the device more difficult.

The family environment adds another layer to this relationship. de Azevedo et al. found an association between parental device use and children's mobile-device duration. [6] Young children have limited control over their own access to digital media, so their screen habits are closely connected to the routines and practices established by caregivers.

Sex may therefore influence some parts of the pathway without being the main determinant. Differences in preferred activities, inhibitory control, or emotional responses could change how children interact with screens, while executive function and parenting may influence whether that exposure becomes problematic.

2.5 Visual Attention, Gaming, and Neural Findings

Visual attention is particularly relevant to digital media because screens are designed to attract children's attention through movement, sound, color, characters, and rapid changes in information. Earlier television research found greater attention to animated content among boys in some groups, but these findings cannot be directly applied to smartphone use. [10]

Research using eye-tracking methods has provided a more detailed picture. Choi et al. studied preschool children and found that attention to on-screen characters differed according to age and the characteristics of the material presented. [11] This supports the idea that the design of digital content can influence children's visual engagement. Sex may be one factor, but it is unlikely to be the only or even the dominant explanation.

Gaming deserves similar caution. Boys have more frequently reported preferences for quick-reaction and strategic games in some studies, while girls have shown greater interest in several other types of digital activities. [7, 8] These differences may influence the attentional demands children encounter, but they do not establish that one type of activity is inherently harmful.

Some evidence has also begun to examine neural responses. Ding et al. studied 517 children aged 3–7 years and found an interaction between problematic media use and sex in prefrontal activation during a working-memory task. [15] The findings suggest that boys and girls may show different patterns of functional neural activity in the context of problematic media use.

The interpretation of these findings requires caution. The study was cross-sectional and did not demonstrate that media exposure caused changes in brain development. The observed differences should therefore be described as differences in neural activation or processing, rather than as evidence of brain damage.

These findings are useful for understanding possible mechanisms, but they remain supporting evidence. The central question of this review remains the relationship between screen exposure, attention, and sex during early childhood.

2.6 Parenting and the Direction of the Association

The way children use digital devices is closely tied to their family environment. Preschool children generally depend on caregivers for access to smartphones and tablets, which means that parents influence not only how much children use screens but also when and why devices are provided.

One particularly important situation occurs when a device is used to manage difficult behavior. Danet et al. found that children with weaker executive functioning were more likely to be given mobile devices for calming. [4] This raises a problem when interpreting studies that find an association between screen exposure and attention or behavioral difficulties. The child may have been using the device more frequently because difficulties were already present.

Radesky et al. provided further evidence for this possibility through longitudinal findings linking device use for calming with emotional reactivity and executive functioning. [5] Their findings are consistent with a reciprocal process in which children's regulatory difficulties influence device use while patterns of device use may also be related to later regulatory behavior.

Parents' own digital habits may contribute as well. The association between parental and child mobile-device use reported by de Azevedo et al. suggests that children's exposure takes place within a broader family media environment. [6]

This has practical implications. Managing screen use in preschool children may require more than simply setting a daily time limit. The reasons for using the device, the type of content provided, the way transitions are handled, and the opportunities children have to regulate emotions without a screen may all be relevant.

3 CONCLUSION

The available evidence indicates that sex-related differences may exist in digital-use patterns and selected attention-related abilities among preschool children. However, these differences do not indicate that boys or girls are universally more susceptible to attention difficulties associated with screen exposure. Instead, the relationship between screen exposure and attention appears to be influenced by multiple factors, including executive function, emotional regulation, preferred digital activities, visual engagement, and family environment.

The direction of this relationship should also be considered, as children with pre-existing attention or emotional regulation difficulties may be more likely to engage in screen use, particularly when digital devices are used to calm or occupy them. Therefore, screen exposure may reflect both a response to existing difficulties and a factor associated with subsequent self-regulation patterns.

Overall, sex may modify aspects of the relationship between digital media use and attention, but it should be considered together with the child's developmental characteristics and the context in which screen exposure occurs. Longitudinal research involving children aged 3–6 years is needed to further clarify how sex, screen exposure, executive function, emotional regulation, and family practices interact during this important period of cognitive and behavioral development.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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All authors declare that they have no conflicts of interest related to this review, its findings, or the publication of this manuscript.

Statement of Ethical Approval

Ethical approval was not required for this review because it was based on previously published literature and did not involve human participants or the collection of primary data.

Statement of Informed Consent

Informed consent was not applicable because this study did not involve human participants or the collection of individual-level data.

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