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Screen Time and Children: The Relationship between Preschool Children's Household Screen Media Experience and Executive Functioning

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Abstract

Technology is inescapable in homes with young children. The main goal of this study is to investigate what aspects of children's EF are influenced by Household Screen Media Experience (HSME). A total of 1014 parents of 3- to 6-year-old children (M = 5.07, SD = 0.89, 497 females) were recruited to participate in this study. The children's screen media experiences, including time management, life conflict, emotional experience, and parental behavior, were assessed. Children's EF was assessed via the Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P). For demographic information, children's age, gender, and SES information were collected. The results showed that there was a significant positive correlation between HSME and children's EF. Time control and emotional experience predicted the Inhibitory Self-Control Index (ISCI), the Flexibility Index (FI), and the Emergent Metacognition Index (EMI), while parental behavior predicted the ISCI and EMI and life conflict predicted the FI. In sum, the excessive use of screen media during the preschool period was connected with negative outcomes for EF. Different aspects of HSME moderated the influence of HSME on children's EF.

Keywords

Executive Functions, Screen Time, Preschool Children, Child Development, Family Education

1. Introduction

Smartphones and tablet computers are known to be the most commonly used technological devices. The data shows a significant increase in the screen media experience during early childhood. The number of 2-year-old children using screen media rose from 10% to 38% from 2011 to 2013. Moreover, half of the children aged 0 - 8 years are reported as screen media users (Bozzola et al., 2018). Kabali et al. (2015) reported that before reaching the age of 4 years, three-quarter of children possess their own mobile media devices. The main goal of this study was to investigate the relationship between preschool children's household screen media experience and their executive functions.

Some researchers have provided significant evidence that the screen media use affects various aspects of child development. For example, Lin et al. (2017) explored the influence of touchscreen on children's fine motor development. In the pretest, there was no group difference. However, in the post-testing children who did not use touchscreens performed comparatively better fine motor skills than the children who use touchscreens. By reviewing the effects of screen time on children's physiological and psychological development, Domingues-Montanari (2017) found that uncontrolled use of screen time was harmful for children's cognitive development. It contributed to a series of problems, such as obesity, sleep issues, depression, and anxiety. Wan et al. (2021) found that greater screen media use was linked to limitations in social-emotional functioning of infants aged 6 - 24 months.

Recently, many studies have focused on the relationship between household screen media experience HSME and the development of executive functions in preschool children. Executive functions (EF) is a set of cognitive processes associated with higher-level thought processing and behaviors that support the reflective, top-down coordination and control of other brain functions (Diamond, 2013; Doebel, 2020; Harvey & Miller, 2017; Netelenbos et al., 2018; Slot et al., 2017; Zelazo, 2015; Zelazo, 2020). Most researchers agree that EF consists of at least three dimensions: inhibitory control, cognitive flexibility, and working memory (Gioia et al., 2000; Harvey & Miller, 2017; Netelenbos et al., 2018; Rosen et al., 2019; Rosen et al., 2020). Studies have shown that the development of EF in childhood is closely related to a child's academic achievement such as arithmetic, literacy, and reading, even when a variety of potential confounding factors were controlled (Cirino et al., 2019; Eaton & Ratner, 2016; Harvey & Miller, 2017; Lawson & Farah, 2017; Montoya et al., 2018; Netelenbos et al., 2018; Prager et al., 2016; Sabbagh et al., 2006; Zelazo, 2015; Zelazo et al., 2016).

Some researchers have reported that the excessive use of screen media shows a negative impact on the development of children's EF (Antrilli & Wang, 2018; Canadian Paediatric Society, Digital Health Task Force, Ottawa, Ontario, 2017; Jusienė et al., 2020; Supanitayanon et al., 2020; Yang et al., 2017). Antrilli and Wang (2018) explored the impact of touchscreen and physical activity on the cognitive flexibility of 2.5-year-old children, they found that children engaged in physical activity performed better in the sorting tasks than those who used touchscreen. Li et al. (2020) also suggested that children viewing fanciful events scored lower on the behavioral EF tasks than the control group. Both psychophysiological and neurobehavioral evidence indicated that the high frequency group use more cognitive resources than the control group.

However, some other studies have shown that using screen media is a good choice to improve children's EF (Bell, 2014; Huber et al., 2018). Huber et al. (2018) found that 2- and 3-year-old children showed better delayed gratification after using an educational app than after viewing a cartoon. More interestingly, their results showed that children's working memory improved after using an educational app. Their findings further indicate that the content of screen media mediates the relationships between HSME and children's (Huber et al., 2018). Specifically, some educational content which contains social interactions decreases the negative effect of screen time on children's EF. To sum up, even though the effects of HSME on children's EF have been previously discussed, the results are contentious. In addition, no study has explored the relationships between HSME and each of the three core components of EF. Therefore, our study intends to explore the links between HSME and three executive function abilities (e.g., ISCI, FI, and CMI) in preschool children.

The preschool period is one of the most important periods for studying EF (Bettencourt, 2018; Crivello et al., 2016; Daneri, Blair, & Kuhn, 2018; Mcharg et al., 2020; Netelenbos et al., 2018; Sasser et al., 2017; Scionti et al., 2020; Zelazo et al., 2018). The previous studies showed that parental behavior is related to the development of preschool children's EF (Bernier, Carlson, & Whipple, 2010). Hammond et al. (2012) found that parental scaffolding at age 3 influences EF at age 4. Furthermore, parental scaffolding at age 2 had an indirect effect on EF at age 4. Meuwissen and Carlson (2015) revealed that there was a significant positive correlation between a fathers' authoritative parenting and 3-year-old children's EF. The impact of parental behavior on child's EF may be produced by the different social environment provided by the parents and how different parents provide support for their children

Additionally, a number of studies have shown that interventions for EF are highly operative during the preschool period (Ackerman & Friedman-Krauss, 2017; Diamond & Lee, 2011; Hammond et al., 2012; Meuwissen & Carlson, 2015; Sasser et al., 2017; Scionti et al., 2020; Zelazo, 2020; Zelazo et al., 2018). Previous studies showed that physical exercise could facilitate children's EF, both aerobic and chronic exercise (see Best's review, 2010). Some other studies pointed out that physical activity is just as beneficial for the EF of children with learning disabilities, such as ADHD (Ziereis & Jansen, 2015). Best (2010) proposed that the effort to execute the complex motor activity when participate exercise could enhance the neural circuitry which related to child's EF. Similarly, in a functional magnetic resonance imaging (fMRI) study, Davis et al. (2011) showed that both the planning aspects of executive function was improved and the activation of bilateral prefrontal cortex was enhanced during a long-term exercise.

In addition, many factors affect the development of children's EF, among which the socioeconomic status (SES) is most closely related (Corso et al., 2016; Feola, 2017; Last et al., 2018; Lawson & Farah, 2017; Merz et al., 2019; Rosen et al., 2019). Last et al. (2018), for example, found that a positive correlation exists between SES and children's EF and that this relationship was too stable to change with age. Lawson and Farah (2017) conducted a meta-analysis from 25 independent samples with 8760 children aged 2 - 18 years. Therefore, children's SES is considered as a control variable in our study. Additionally, researches state that children at different ages perform differently on EF (Esteraich, 2018; Fang et al., 2017; Feola, 2017; Jusienė et al., 2020; Khodarahimi, 2018; Prager et al., 2016; Willoughby et al., 2017). Likewise, some previous studies found that gender also influences the EF of preschool children (Esteraich, 2018; White et al., 2017; Yamamoto & Imai-Matsumura, 2017). Thus, age and gender were taken as control variables in our study.

Much of the existing research has begun to focus on the relationship between HSME and the development of children's EF. But it is still unclear which specific aspect of children's EF is affected by HSME. Additionally, a large number of previous studies have relied on smaller samples. Thus, with a large sample (N = 1014), our study therefore focused on two questions: 1) how does HSME affect different aspects of children's EF (e.g., cognitive flexibility, working memory)? 2) If the HSME affects all aspects of children's EF, which dimension contributes the most in our model? A standard regression method has been conducted to test the relationships between children's HSME and each of the three core components of EF. We used a multiple regression method by taking the ISCI, FI and EMI into consideration to conduct a comprehensive analysis on the basis of partial correlation test to analyze the hypotheses. Specifically, we developed a multiple regression model by taking ISCI, FI and EMI into consideration to conduct a comprehensive analysis. Moreover, gender, age, and SES were analyzed as control variables.

2. Method

2.1. Participants

Participants were 1014 parents (either father or mother) of 3- to 6-year-old children (M = 5.07, SD = 0.89, 497 females) from Jiangsu, China. They were recruited through voluntary participation in the network platform questionnaire. The research was approved by the Ethics Committee of [blinded] University. We got written informed consent before participation in the study from all participating parents. Fortunately, all participants (100%) provided valid responses and contributed to the data analysis.

2.2. Measures

2.2.1. Questionnaire on the SES of Families

We used Xu et al.'s (2006) questionnaire to ask for the highest education level and occupation type for both mother and father. It has seven education levels available for parents to choose, from the lowest of "not having attended school" to the highest of "master's degree or higher". Scores ranged from 1 to 7. On the other side, the occupation categorized 5 types was arranged on the basis of 5 levels from "temporary workers" to "senior professionals". Scores ranged from 1 to 5. The total score of this measure was calculated by summing up points of these two questions of both mother and father, thus, the total possible score ranges from 4 to 24 points. Hence, higher the total score, the higher the family SES.

2.2.2. Questionnaire on HSME for Children

We modified previous questionnaires on preschoolers' computer usage to assess media experience with any forms of digital screens (e.g. smart-phones, iPad, televisions or computers) which had been used in our previous study (Xie, Wang, Yu, & Fong, 2020). This measure consisted of four subscales: time management, life conflict, emotional experience and parental behavior. Time management consisted of 2 items to measure the weekly frequency (from "0 - 5 times a week" to "more than 16 times a week") and each-time duration of usage to screen media (from "within half an hour" to "one and a half hours to more than 2 hours") respectively, participants could choose the most accurate description out of all options, and the total score ranged from 2 to 9. The higher total score indicated the more frequency of HSME. Life conflict consisted of 3 items and assessed the influence of screen exposure on children's behavior, including "Does your child use screen media while having a meal?" Emotional experience assessed preschoolers' emotional expressions related to screen media and 3 items were included such as "Will your child throw tantrums or engage in conflicts with others if their screen exposure was interrupted?" The last subscale assessed the parents' behavior with 3 items, including "Will you give your child a smartphone or iPad to smooth their mood?" The three remaining subscales were measured on a 4-point Likert scale from 1 (always) - 4 (never). Cautiously, we needed to mark the reverse scoring in "Does the child stop immediately when you let your child stop playing with your cell phone and iPad?" The sum of all responses provided the total score of this measure, which had a potential range of 11 - 44. The higher total score indicates higher frequency of child's HSME. The internal consistency of the scale was 0.73.

2.2.3. EF Questionnaire

We used Gioia et al.'s (2000) questionnaire (Behavior Rating Scale of EF-Preschool Version, BRIEF-P) to analyze child's EF development. The BRIEF-P consists of a single rating form, designed to be completed by child's parent, with 63 items in five non-overlapping scales. The Inhibitory Self-Control Index (ISCI) is composed of the Inhibit and Emotional Control scales (including 26 items, scores range 26 - 78), the Flexibility Index (FI) is composed of the Shift and Emotional Control scales (including 20 items, scores range 20 - 60), and the Emergent Metacognition Index (EMI) is composed of Working Memory and Plan/Organize scales (including 27 items, scores range 27 - 81). Each item scores range from 1 (never) to 3 (often); the higher total score indicates the more serious the individual EF damage. The internal consistency of each factor was 0.9, 0.78, 0.84, 0.88, 0.78, and that of the total scale was 0.95.

2.3. Data Analysis Plan

First, we used the Harman single factor test method, which analyzed all items by exploratory factor analysis (EFA) to test whether there was a common method variance in this study. The results showed that 13 characteristic roots were greater than 1, and the first common factor explains 17.54% of the total variation, which was less than 40% of the critical value. Therefore, it did not have serious common method variance in this study.

Second, we used SPSS 26.0 to analyze the basic statistics of the collected data (Mean, *SD*, Minimum, Maximum). By viewing gender, age and SES as control variables, we investigated the relationship between HSME and each dimension of EF by the Person correlation analysis. The results suggested a significant correlation between HSME and EFs after excluding the interference of SES and basic statistics. Above all, we established the multivariate linear regression function model and adopted the Entered method to get the best model.

3. Results

Table 1 for descriptive statistics of all variables shows that the average SES of 1014 samples was at the middle level, children's performance in HSME was at the moderate level and children's EF was also at a moderate level.

Table 1. Descriptive statistics of all variables ($N = 1014$).

	M	*SD*	Min.	Max.	Cronbach's α
Age	5.07	0.89	3	6	-
SES	12.38	3.14	6	22	-
HSME	18.22	3.81	11	39	0.73
EF	196.96	22.16	166	266	0.95
Time management	3.04	1.15	2	9	0.71
Life conflict	4.80	1.48	3	12	0.8
Emotional experience	4.87	1.49	3	10	0.7
Parental behavior	5.50	1.34	3	12	0.73
ISCI	91.31	8.06	81	119	-
FI	27.52	6.41	20	45	-
EMI	78.13	8.77	65	109	-
Inhibit	-	-	-	-	0.9
Shift	-	-	-	-	0.78
Emotional control	-	-	-	-	0.84
Working memory	-	-	-	-	0.88
Plan/organize	-	-	-	-	0.78

In Table 2, when SES, gender, and age were managed as control variables, the HSME is significantly positively correlated with EF ($p < 0.001$), and the fractal dimensions used by HSME were also significantly positively correlated with the fractal dimensions of EF ($p < 0.001$). It showed that more screen media usage leads to worsened child EF.

By using a multiple regression method to test hypotheses, we put all four fractal dimensions of the HSME into the regression model to test the hypothesis models and regression coefficient. The results are explained in Table 3.

With taking ISCI, FI and EMI of EF as dependent variables in model 1, model 2, and model 3, R^2 values for each stage of analysis regression model are 0.116 ($F = 18.861$, $p < 0.001$), 0.093 ($F = 14.726$, $p < 0.001$) and 0.124 ($F = 20.271$, $p < 0.001$), which means that the influencing factors explain 11.6%, 9.3%, and 12.4% of the variance in each model. Standard multiple regression also provides an adjusted R^2 value. The adjusted R^2 value in these models were 0.11, 0.087, and 0.118, indicating a good fitness of these three models. ANOVA was used to assess the statistical significance of the result. The result in Table 3 demonstrates that the R^2 was statistically significant in model 1, model 2, and model 3, with $F_{model1} = 18.861$ ($p < 0.001$), $F_{model2} = 14.726$ ($p < 0.001$), $F_{model3} = 20.271$ ($p < 0.001$).

Table 2. Correlation test between HSME and EF.

controlled variable		1	2	3	4	5	6	7	8	9
SES & age & gen	1. HSME	1								
	2. EF	0.325***	1							
	3. Time management	0.650***	0.213***	1						
	4. Life conflict	0.760***	0.205***	0.315***	1					
	5. Emotional experience	0.725***	0.291***	0.307***	0.424***	1				
	6. Parental behavior	0.660***	0.198***	0.309***	0.326***	0.236***	1			
	7. ISCI	0.318***	0.977***	0.205***	0.198***	0.289***	0.196***	1		
	8. FI	0.281***	0.934***	0.173***	0.200***	0.256***	0.152***	0.910***	1	
	9. EMI	0.324***	0.947***	0.223***	0.190***	0.284***	0.210***	0.885***	0.792***	1

***: $p < 0.001$.

Table 3. Parameter test of regression model of HSME and execution function.

Model	R	R^2	$Adj\text{-}R^2$	SE	F	p
controlled variable	0.078	0.006	0.003	0.310	2.064	0.103
Model 1	0.341	0.116	0.110	0.293	18.861	0.000
controlled variable	0.094	0.009	0.006	0.320	2.990	0.030
Model 2	0.305	0.093	0.087	0.306	14.726	0.000
controlled variable	0.101	0.010	0.007	0.323	3.466	0.016
Model 3	0.352	0.124	0.118	0.305	20.271	0.000

Note: the dependent variable of model 1 is ISCI, the dependent variable of model 2 is FI, and the dependent variable of model 3 is CMI.

We used VIF to examine the multicollinearity between the independent variables. The result in Table 4 indicates that multicollinearity does not exist for any independent variable because the Tolerance values are more than 0.10 and VIF values are less than 0.10. The result suggests that the current study does not have any problem with multicollinearity and this allows for standard interpretation of the regression coefficients.

Furthermore, Table 4 presents that the constant terms in the three models were significantly correlated with dependent variables ($p < 0.001$), indicating that all the models should consist of the constant. After taking ISCI as a dependent variable (see model 1), there was a significant positive correlation ($p < 0.01$) except for life conflict ($t = 1.235$, $p = 0.217$) in model 1 and the common expression of the regression equation as follows:

Table 4. Executive function multiple linear regression analysis test.

Model	predictive variable	Unstandardized coefficient		*t*	*p*	*B* 95.0% confidence intervals		Collinearity statistics	
		B	*SE*			Lower limit	Top limit	Tolerance	VIF
Model 1	(constants)	3.129	0.091	34.464	0.000	2.951	3.307	—	—
	SES	−0.026	0.012	−2.155	0.031	−0.050	−0.002	0.946	1.058
	Age	−0.001	0.011	−0.111	0.912	−0.022	0.020	0.952	1.050
	Gender	−0.004	0.018	−0.192	0.848	−0.040	0.033	0.991	1.009
	Time management	0.050	0.018	2.841	0.005	0.016	0.085	0.818	1.223
	Life conflict	0.027	0.022	1.235	0.217	−0.016	0.069	0.744	1.344
	Emotional experience	0.138	0.021	6.493	0.000	0.096	0.180	0.762	1.313
	Parental behavior	0.071	0.023	3.154	0.002	0.027	0.116	0.830	1.204
Model 2	(constants)	0.999	0.095	10.506	0.000	0.813	1.186	—	—
	SES	−0.031	0.013	−2.438	0.015	−0.055	−0.006	0.946	1.058
	Age	0.000	0.011	−0.032	0.975	−0.022	0.022	0.952	1.050
	Gender	0.036	0.019	1.881	0.060	−0.002	0.074	0.991	1.009
	Time management	0.040	0.019	2.178	0.030	0.004	0.077	0.818	1.223
	Life conflict	0.051	0.023	2.257	0.024	0.007	0.096	0.744	1.344
	Emotional experience	0.122	0.022	5.461	0.000	0.078	0.165	0.762	1.313
	Parental behavior	0.043	0.024	1.810	0.071	−0.004	0.089	0.830	1.204
Model 3	(constants)	2.447	0.095	25.857	0.000	2.262	2.633	—	—
	SES	−0.041	0.013	−3.262	0.001	−0.066	−0.016	0.946	1.058
	Age	0.011	0.011	1.005	0.315	−0.011	0.033	0.952	1.050
	Gender	0.006	0.019	0.313	0.754	−0.032	0.044	0.991	1.009
	Time management	0.065	0.018	3.503	0.000	0.028	0.101	0.818	1.223
	Life conflict	0.018	0.023	0.797	0.426	−0.026	0.062	0.744	1.344
	Emotional experience	0.138	0.022	6.249	0.000	0.095	0.182	0.762	1.313
	Parental behavior	0.085	0.024	3.593	0.000	0.038	0.131	0.830	1.204

$$y(\text{ISCI}) = 3.129 - 0.026x_1 + 0.05x_4 + 0.138x_6 + 0.071x_7 \quad (1)$$

With FI as dependent variable (see model 2), there was a significant positive correlation ($p < 0.05$) except parental behavior ($t = 1.81$, $p = 0.071$) in model 2 and the common expression of the regression equation is stated as follows:

$$y(\text{FI}) = 0.999 - 0.031x_1+0.04x_4+0.051x_5+0.122x_6 \quad (2)$$

With CMI as dependent variable (see model 3), except for life conflict ($t = 0.797$, $p = 0.426$), there was a significant positive correlation ($p < 0.001$) in model 3 and the common expression of the regression equation is stated as follows:

$$y(\text{CMI}) = 2.447 - 0.041x_1 + 0.065x_4 + 0.138x_6 + 0.085x_7 \quad (3)$$

Note: x_1 = SES, x_2 = age, x_3 = gender, x_4 = time management, x_5 = life conflict, x_6 = emotional experience, x_7 = parental behavior.

4. Discussion

In this study, gender, age, and SES were taken into account as the control variables, and the partial correlation analysis found that there was a significant correlation between HSME and children's EF. By further investigating the effect of HSME on different aspects of children's EF, we found that emotional experience, parental behavior, and time management positively predicted ISCI and CMI; however, life conflict did not predict ISCI and CMI. Additionally, emotional experience, life conflict, and time management positively predicted FI.

Our study found that time management predicts all three dimensions of EF. This result is consistent with a series of previous studies (Canadian Paediatric Society, Digital Health Task Force, Ottawa, Ontario, 2017; Supanitayanon et al., 2020; Wan et al., 2021; Yang et al., 2017). First, screen time usage is linked to the development of EF-related areas of the brain. Kühn et al. (2014) found that, compared to infrequent game players, individuals who play video games for 9 hours per week show larger volumes in areas of the brain such as the nucleus accumbens, linked to reward processing, as well as displaying increased cortical thickness in the prefrontal cortex, which is responsible for executive control. Second, some research has indicated that excessive HSME will take the place of precious cognitive activities that can actively promote the development of children's EF, such as book reading (Anderson & Subrahmanyam, 2017). This can also explain why children's EF is poor when they spend excessive time on screen media.

In addition, the results showed that emotional experience could also predict all three dimensions of EF. It is reasonable that children will display negative emotions when parents or caregivers do not satisfy their desires for HSME. Some studies have shown that negative emotions do affect children's EF (Chen et al., 2013; Chen et al., 2014). Chen et al. (2013) compared the difference in EF between distinct negative emotion groups. The results showed that low negative emotion patients performed better than high negative emotion patients. During the investigation for the current study, we also observed that some parents simply try to prevent their children from using screen media by taking away their screen media compulsively. In this situation, children can feel stressed and will protest by crying. Feola (2017) found that higher stress affects the performance of child's PFC, which is a major region supporting EF. Thus, we speculate that the conflict between children and parents puts pressure on children and causes them to feel negative emotions, which further impacts their EF.

Parental behavior will also affect the development of child's EF. It can significantly predict ISCI and CMI. It should be noted that parents' behavior sets an example for their children (Lauricella et al., 2015; Rahman & Farzana, 2019). For example, Kim et al. (2021) reported that mothers' smartphone addiction has an important influence on children's smartphone usage. Compared with the children in the low-risk group, the children in the high-risk group were exposed to smartphones earlier. This indicates that children have more chances to be exposed to screen media when parents use screen media excessively. In addition, parent-child interaction in HSME can also influence children's EF (Hammond et al., 2012; Huber et al., 2018; Meuwissen & Carlson, 2015; Nikken & Opree, 2018; Schoeppe et al., 2016; Yang et al., 2017). Some parents, especially parents with low SES, view screen media as an alternative reward for children when they are crying. This may impair child's EF because of the lack of parent-child interaction.

The implications of these findings are below. First, children's time spent on HSME should be strictly controlled. The guidelines of the American Academy of Pediatrics (AAP) recommend that children strictly observe corresponding media usage times at different ages. Parents and other caregivers of children can make a scientific time schedule for children. Parents should restrict screen media usage time for children, including in public places or at meals. In addition, parents can encourage children to participate in various outdoor activities. Fostering more activities that do not involve screens can effectively reduce children's HSME time.

Secondly, parents and other caregivers, as the closest people to the children, should be the role models of screen use for their children. A study shows that children will imitate the parents' behavior to gain attention (Canadian Paediatric Society, Digital Health Task Force, Ottawa, Ontario, 2017). This reminds parents to pay more attention to the impact of parental behavior. To some degree, they should avoid using or use less screen media in front of children. Moreover, parental scaffolding should be given to children. For example, parents can select high-quality and educational content for children to efficiently keep the children from viewing unsuitable information.

Finally, parents should create chances for children to interact with others in daily life without letting them use screen media alone. First, parents can accompany children when they use screen media and can talk about the content of the screen media with children. Second, parents should encourage children to play with their peers. Children will have fun with their peers when the parents create more opportunities for them to play. Lastly, it is meaningful for parents to combine HSME with creative and active play and participate in the activities. Children will get more chances for interaction when their parents are involved in their play.

5. Limitations

There are some limitations in this study. First, this study mainly discussed the relationship between child's experience with HSME (including time spent in it and child's relationships with the people around him, etc.) and his EF. We did not consider any differences between different types of media or the influence of media content on children's EF. Future research can explore the different media and media content into the scope of investigation. Second, this study did not discuss mechanisms that moderate the relationship between HSME and children's EF. For example, HSME also affects the development of children's language function, and the delay of children's language development will lead to EF damage (Netelenbos et al., 2018). In the future, we can use the structural equation model to further investigate the mechanism through which HSME can affect children's EF.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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