Dialog, 18(*4*), 111-116

ISSN: 1930-9325

RESEARCH-TO-PRACTICE SUMMARY

Preschooler Digital Usage and Visual Spatial Performance: Implications for the Classroom

Kathleen Keefe-Cooperman

Long Island University Post

This research to practice paper summarizes a study focused on typically developing preschooler's integrated technology usage. Different amounts of usage were found based on parental education, ethnic/racial identity, and SES. Television viewing patterns from a 2010 study were also compared to a 2014 group of children. Preschoolers from the 2014 group were watching similar amounts of television, but also had increased technological device usage. Children had greater total screen time than in the past. Lower maternal education, lower SES, and being from a historically disadvantaged background were associated with greater usage time. Preschoolers with higher reported digital media usage had lower WPPSI-IV Visual Spatial Composite scores and Full Scale IQ scores, on average. Strategies to improve visual spatial skills in the classroom setting are provided.

Keywords: visual spatial functioning; preschooler; screen time; mobile devices; integrated technology

Visual and spatial abilities are progressively mastered as a skill set during childhood, and used in everyday life as an adult. The action of unlocking a door with a key, addressing an envelope, or hanging a picture on a wall are the result of playing with Legos, stacking blocks, or completing puzzles as a child. Thinking spatially allows us to focus on object location, shape, the relation to other objects, and what happens when items move (Newcombe, 2010). Mastery of spatial skills has increasingly been linked to later academic achievement. Science, technology, engineering and math fields (STEM) build upon those early years of motor development (Uttal, Meadow, Tipton, et. al., 2013).

The young children of today have never known a life without mobile devices, computers and television. Digital usage is growing, as noted in the increase of children using a mobile device for media activity from 39% in 2011 to 80% in 2013 (Rideout, 2014). Children who are poorer or of minority status have higher usage rates daily (Rideout, 2013). Preschoolers are digital natives who are drawn to mobile technology and able to easily maneuver through applications (apps). Many benefits are cited in relation to increased access to technology. Chiong and Schuler (2010) note that mobile learning provides a venue for underserved children to be able to access educational material, and that teachable moments can now occur anytime and

I would like to acknowledge the help of Margaret Hoban for her help in entering data.

anyplace. That is correct if digital usage is optimally implemented and the focus is on educational material. As an example of a negative unintended consequence, Radesky et al. (2015) examined the frequency of mobile device usage in low income mother-child interactions, and found fewer interpersonal interactions as use increased. At-risk children already show less optimal sleep health, and related adaptive and cognitive functioning issues (Keefe-Cooperman & Brady-Amoon, 2014). Digital usage provides an additional detraction for already disadvantaged youth, and impedes educational efforts to close the achievement gap.

Understanding how digital usage impacts spatial development is key. Integrated technology usage may be taking up time previously spent building blocks, or stacking pots on a kitchen floor. The way children play with a smart device is different. Touch screen usage involves a physically different manipulation of objects. Fingers are used to move items across the screen in a two dimensional manner. There is no stacking or turning of items physically. In fact, only one hand is typically used to move digital media (Manches, 2011). Puzzles can now be completed on a touch screen without the child ever learning to physically turn the items so as to fit them into a space. Two dimensional media objects lack the perceptual cues of three-dimensional items, and negatively impact future application due to the limited nature of movement (Barr, 2013). Understanding the impact of digital device usage related to visual spatial functioning will set the stage for the development of curricula in the classroom to optimize preschooler educational readiness.

FINDINGS FROM THIS STUDY

Preschoolers from a 2010 study (612 children) were compared to preschoolers from a 2014 study (492 children) because of the digital explosion into everyday life that occurred between the two time periods. Television viewing patterns have remained similar over time, but technological device usage has increased. The 2014 group watched about the same amount of television, and had additional screen time through digital usage. The 2014 preschooler group had higher daily total screen time amounts as a result. Additionally, on average, children who were reported to watch greater amounts of television had higher amounts of technology usage.

European American preschoolers reported statistically significant less digital device time usage than African American participants, but not Latino(a), and Asian participants. See Table 1 for the time usage for each of the 2010 and 2014 racial/ethnic preschool groups. Parents in the "at risk" income level reported statistically significant greater amounts of digital device time usage than those in the lower middle class, middle class, and upper middle class. See Table 2 for the time usage for each of the 2010 and 2014 SES preschool groups. Historically disadvantaged and poorer children are spending more time on digital devices. Maternal education was also related to digital media usage based on differences between group means, but no clear pattern was found. See Table 3 for the time usage for each of the 2010 and 2014 maternal education preschool groups.

Greater daily digital usage was associated with lower visual spatial performance. Spending even small amounts of time daily with integrated technology was associated with lower WPPSI-IV overall intelligence test scores, and visual spatial scores. Those with the least amount of resources are at the most risk for lower visual spatial abilities.

TABLE 2
Television Viewing Times, Smart Device Usage, and Total Screen Time in Minutes for Socioeconomic Groups from the 2010 and 2014 Preschooler Groups

SES Group	*n*	Television Time	Digital Device Time	Total Screen Time	WPPSI-IV VS M (SD)
At Risk/Lowest Income					
2010	59	2 – 3 hrs		2 – 3 hrs	
2014	53	2 – 3 hrs	45 – 60 min	> 3 hrs	90.11 (10.36)
Lower Middle class					
2010 (Combined with Middle Class)					
2014	74	1 – 2 hrs	15 – 30 min	2 – 3 hrs	95.12 (10.60)
Middle Class					
2010	625	1 – 2 hrs		2 – 3 hrs	
2014	204	1 – 2 hrs	15 – 30 min	2 – 3 hrs	95.94 (11.32)
Upper Middle Class					
2010	141	1 – 2 hrs		1 – 2 hrs	
2014	121	1 – 2 hrs	15 – 30 min	1 – 2 hrs	98.23 (11.10)
Total					
2010	847	1 – 2 hrs		1 – 2 hrs	
2014	452	1 – 2 hrs	15 – 30 min	2 – 3 hrs	95.66 (11.22)

Note. WPPSI-IV Visual Spatial (VS) Composite Score is derived from the Block Design and Object Assembly Subtest Scores; M = 100, SD = 15. [a]Television and total screen usage time have been collapsed into time categories: 1 – 2 hours; 2 – 3 hours; > 3 hours. [b]Digital device usage time has been collapsed into categories: 15 – 30 minutes; 30 – 45 minutes; 45 – 60 minutes.

TABLE 3
Television Viewing Times, Smart Device Usage, and Total Screen Time in Minutes for Maternal Education Groups from the 2010 and 2014 Preschooler Groups

Maternal Education	*n*	Television Time	Digital Device Time	Total Screen Time	WPPSI-IV VS M (SD)
Did Graduate High School					
2010	10	1 – 2 hrs		1 – 2 hrs	
2014	9	1 – 2 hrs	30 – 45 min	2 – 3 hrs	92.13 (9.32)
High School Graduate					
2010	51	1 – 2 hrs		1 – 2 hrs	
2014	22	2 – 3 hrs	15 – 30 min	2 – 3 hrs	86.4 (13.43)
Some College					
2010	103	2 – 3 hrs		2 – 3 hrs	
2014	63	2 – 3 hrs	30 – 45 min	2 – 3 hrs	91.39 (9.63)
College Degree or Higher					
2010	477	1 – 2 hrs		1 – 2 hrs	
2014	352	1 – 2 hrs	15 – 30 min	1 – 2 hrs	97.11 (11.12)
Total					
2010	641	1 – 2 hrs		1 – 2 hrs	
2014	446	1 – 2 hrs	15 – 30 min	2 – 3 hrs	95.64 (11.33)

Note. WPPSI-IV Visual Spatial (VS) Composite Score is derived from the Block Design and Object Assembly Subtest Scores; M = 100, SD = 15. [a]Television and total screen usage time have been collapsed into time categories: < 1 hour; 1 – 2 hours; 2 – 3 hours; > 3 hours. [b]Digital device usage time has been collapsed into categories: 15 – 30 minutes; 30 – 45 minutes; 45 – 60 minutes.

IMPLICATIONS FOR PRACTICE

There are several implications for practice which emerged from the results of the study. The first is that parents from lower SES backgrounds, having less maternal education, or from a historically disadvantaged racial/ethnic identity need to be informed about integrated technology and visual spatial functioning. The second is that including more fine motor and visual spatial play activities into the ongoing curriculum may improve overall abilities and lead to greater STEM success in later grades.

Educating Parents

The preschool setting can be a key place for facilitating positive visual spatial growth and informing parents. Of particular importance to this issue, Head Start classrooms were developed to lessen socio-economic disparities so as to improve school readiness (USDHHS, 2005). Children who are poorer, have mothers/female caregivers with less education, or are of historically disadvantaged minority/ethnic status are on technological devices more than their peers, and are missing opportunities for developmental growth. The Head Start programs, and other programs that provide schooling for underserved children, can make a difference in improving future STEM readiness. In addition to the ongoing daily curriculum, Head Start parent information meetings are often held to improve parent knowledge on a variety of subjects. The teacher also has ongoing contact and input with the parent. This can empower the teacher to be an agent of change for the parents.

Head Start works on the premise that there is a partnership between parents and the school in facilitating their children's education. The data from this study can be used to provide parents with the information that can guide integrated technology usage in the home. Parents turn to teachers for help related to families and parenting. Teaching parents about the importance of spatial development in preparation for school readiness is key (Verdine, Golinkoff, Hirsh-Pasek & Newcombe, 2014). Showing parents that there is data associating digital device usage with lower visual spatial functioning is a form of empowerment. Informed parents are more likely to develop daily routines and schedules that will support optimal development for their children and lead to greater educational success.

Incorporating Visual Spatial Play in the Classroom Curriculum

The preschool classroom setting typically contains several play areas where preschoolers can go to play with blocks, Legos or other three dimensional building toys. Integrating spatial education as more of a key part of the curriculum will result in gains in the STEM related fields (Verdine et al., 2014). Implementing a spatial education as part of the ongoing daily curriculum will identify at risk children and improve overall abilities. A way to successfully achieve spatial education is to move blocks, puzzles and shapes from activity areas to part of the curriculum. The preschool setting can be a place of compensation for increased digital usage in daily life.

The findings from this study showing the association between lower visual spatial functioning and digital device usage emphasize the need to proactively compensate with the use of structured spatial lessons. Head Start teachers are skilled educators who can improve visual spatial functioning and resultant school readiness skills.

REFERENCES

Barr, R. (2013). Memory constraints on infant learning from picture books, television, and touchscreens. *Child Development Perspectives*, *7*(4), 205-210.

Chiong, C., & Shuler, C. (2010). Learning: Is there an app for that. *Investigations of young children's usage and learning with mobile devices and apps. New York: The Joan Ganz Cooney Center at Sesame Workshop*.

Keefe-Cooperman, K., & Brady-Amoon, P. (2014). Preschooler Sleep Patterns Related to Cognitive and Adaptive Functioning. *Early Education and Development*, *25*(6), 859-874.

Manches, A. (2011). Digital manipulatives: tools to transform early learning experiences. *International Journal of Technology Enhanced Learning*, *3*(6), 608-626.

Newcombe, N. S. (2010). Picture This: Increasing Math and Science Learning by Improving Spatial Thinking. *American Educator*, *34*(2), 29.

Radesky, J., Miller, A. L., Rosenblum, K. L., Appugliese, D., Kaciroti, N., & Lumeng, J. C. (2015). Maternal Mobile Device Use During a Structured Parent–Child Interaction Task. *Academic pediatrics*, *15*(2), 238-244.

Rideout, V. J. (2013). *Zero to eight: Children's media use in America 2013: A Common Sense Media Research Study*. New York: The Joan Ganz Cooney Center at Sesame Workshop.

Rideout, V. J. (2014). *Learning at home: Families' educational media use in America. A report of the Families and Media Project.* New York: The Joan Ganz Cooney Center at Sesame Workshop.

U. S. Department of Health & Human Services. Head Start Impact Study: First Year Findings. Washington, DC: 2005. http://www.acf.hhs.gov/programs/opre/hs/impact_study/reports/

Uttal, D. H., Meadow, N. G., Tipton, E., Hand, L. L., Alden, A. R., Warren, C., & Newcombe, N. S. (2013). The malleability of spatial skills: a meta-analysis of training studies. *Psychological bulletin*, *139*, 352-402. doi:10.1037/a0028446

Verdine, B. N., Golinkoff, R. M., Hirsh-Pasek, K., Newcombe, N. S., Filipowicz, A. T., & Chang, A. (2014). Deconstructing building blocks: Preschoolers' spatial assembly performance relates to early mathematical skills. *Child Development*, *85*(3), 1062-1076.