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Designing and Using Digital Books for Learning:
The Informative Case of Young Children and Video

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Abstract

To promote young children's learning from screen-based digital books, parents, educators, researchers, and designers might productively consult research about very young children's learning from another screen-based medium: video. This extensive literature reveals challenges to young children's learning from digital screens that extends from infancy throughout the preschool years. The youngest viewers learn better watching real events "face to face" than they do watching video, and have trouble transferring information from a screen to the real world. Supports for learning include particular experiences, active mediation by social partners, and select built-in features. Each support is reviewed in regard to its potential relevance to digital books.

Keywords: video; e-books; scaffolding; contingency; learning

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Digital books (e-books) hold both promise and challenges as tools for early learning. Screen-based books in electronic format appeal to young children, potentially increasing early exposure to reading [1]. Automatic narration prolongs children's engagement by letting them 'read' by themselves [2], and audiovisual enhancements such as sound effects and animations may promote story comprehension [3,4]. The majority of e-books on touchscreens also include interactive elements such as hotspots or games that make them similar to other apps [5]. However, research indicates that some attractive features of screen technology come at a cost, actually hindering learning [6]. Digital books must be designed and used with care to be optimally beneficial.

In trying to promote young children's learning from e-books, parents, educators, researchers, and designers might look to research about very young children's learning from an earlier digital information source--video. The long history of research on this topic reveals challenges to young children's learning from screen media, as well as supports that can enhance learning. The reasons why very young children do not learn well from video are informative when thinking about promoting early learning from screen-based electronic books, our focus here. This review includes empirical research over the last 20 years from our own and others' labs on learning from video during early childhood, focusing on the years prior to formal school entry (particularly zero to three) when children are first exposed to screen media. This research formed part of the basis for Hirsh-Pasek and colleagues' "four pillars of learning" [7] needed to optimize the educational value of touchscreen apps.

1. Learning from video: Not easy for young viewers

To adults, watching sports or a current event on video is much like really being there [8]. We can learn to make a gourmet dish from watching a cooking show or improve our golf swing via an instructional video. What we see on the screen, we can apply in the real world; that is, adults can *transfer* what they learn from a representation to their own lives [9]. The connection between video and the real world may seem so obvious, we lose sight of the fact that videos (and still pictures) are 2-dimensional representations. The relation between representation and reality (and how the two differ) is something that very young children begin to master during early childhood [10].

Numerous research studies show that infants, toddlers, and very young preschoolers do not learn as well from watching video as they do from watching real events [8,11]. For instance, after 2-year-olds watch through a window as an adult in an adjoining room hides a toy, they typically find the toy. However, if they see the identical live event on video, they usually do not find it [12,13,14]. Similarly, infants and toddlers (between 6 and 30 months) imitate an adult's assembly of a simple toy better after watching a face-to-face demonstration than they do after watching the person give the same demonstration on video [15,16,17]. In each case, to succeed, children must apply what they see on the screen to their own life experience outside the screen (e.g., imitate the adult's actions when they are given the parts of the toy), which is a challenge for very young children [11]. The same pattern of results holds for very young children's language learning from video—better learning from a speaker who is present than from the same person on video [e.g., 18,19].

In the late 1990s, appealing commercial videos were developed that claimed to teach infants language, art, mathematics, and music, turning infants into “baby geniuses.” Parents

snapped up these videos, purchasing an estimated \$200 million worth from the leading company in 2005 [20]. In multiple studies, however, after repeatedly watching one of these popular baby vocabulary videos for 4 to 6 weeks, 8- to 24-month-old infants displayed no more vocabulary growth than did a non-watching control group [21,22,23]. At a follow-up visit 3 months after viewing the video, parents in one of the studies believed that their infants who had watched the video learned more of the words than parents did whose infants had not watched the video. (However, infants' word learning was not tested by the researchers.) In another of the studies, parents who liked the video thought their infants had learned more words, but parent liking was unrelated to children's learning.

In summary, learning from video is challenging for infants and toddlers; direct comparisons indicate that it typically is not as efficient as learning from people face to face. However, as many parents can attest, young children *do* learn from video. In research, toddlers 15 to 30 months of age have shown that, to some extent and under some conditions, they can learn words [24,25,26,27,28,29], baby signs [30], and actions [15,31] from video. Additionally, age matters substantially: 3- and 5-year-olds learned multiple novel words from viewing a 15-minute video twice [32] and 5-year-olds carry out even cognitively challenging imitation tasks equally well from video and a real person [33,34]. By the time children reach the original target age for Sesame Street (3 to 5 years), they have become much better at learning from representational media such as video, although even school-aged children struggle to learn from video in some circumstances [35,36]. Therefore, it is important to keep age in mind when thinking about children's learning from screen media.

Emerging research indicates that learning from touchscreens is similarly hard for young children. As with video, children may fail to connect information from touchscreens with the

relevant real-life situations [11,37,38]. Thus, considering what factors support learning from screens is important going forward as new screen-based technologies are introduced into children's lives.

2. Experiences that promote learning

Thinking about the experience that young children have with video, it may not be so strange that they do not reliably use it as an information source. On the screen, animals talk and wear clothes, and objects violate the law of gravity--in other words, the world on the screen does not reflect the aspects of real life that infants are beginning to form concepts about [39]. For this reason, the youngest viewers may be conservative about learning from video [40]. If this is so, giving children experience with video that clearly reflected reality might change their learning from the medium. In one study, infants (9 and 11 months) selectively looked at a video depicting a toy they had played with, rather than video of a novel toy, showing that they noticed the connection between 2-dimensional video and their own experience [41]. In a study with 2-year-olds, parents connected their video cameras to their TV sets, and children got to watch themselves "live" on the screen. Parents were encouraged to do everything they could to help their children see the connection between video and reality. After about an hour's cumulative experience with this new kind of video at home, children successfully used information from video in the lab to solve a problem [40]. In correlational research, 2-year-old children's exposure to live video of themselves on the reversible LCD screens of their parents' video cameras or on security monitors in stores predicted their success at learning from video in the lab [42]. These results underscore that 2-dimensional representations are not necessarily "transparent" to the youngest viewers, and that they may need support to understand the information contained therein and how it relates to the real world.

Thinking about children's typical experiences with touchscreen devices, what prediction could we make about whether such experiences support children's learning? Many children probably use touchscreens to play games, often fantasy games that are distinct from real life. We would predict that this use of touchscreens would not prompt very young children to connect content on screen with real life. On the other hand, experience Skyping with familiar people and looking at home videos and family pictures on smartphone and tablet computer screens might make it easier for children to learn from touchscreens, especially if parents draw explicit connections between events on the screen and the real world (see Sections 3 and 6 below). That is not to say that children should never play games on touchscreens, but that other activities are more likely to clarify that images on smartphones and tablet screens relate to reality. Making such connections would promote the "meaningfulness" [7] or relevance [26,38] of digital content for very young users.

3. Social support increases attentiveness and learning

The previous paragraph alludes to another important factor that helps young viewers learn from video: social support. Even simple scaffolds by adults can support learning: 2-year-olds learned a new word from a video when their parents provided two one-sentence scaffolds linking the objects on screen with the real objects in the room [26]. Children who watched without parent support showed no evidence of applying the label to the objects.

Three possible mechanisms through which parent interaction may promote children's learning are: 1) helping children *focus attention* on the screen, 2) providing *cognitive supports* (e.g., practice recalling words), and 3) offering *responsive feedback* that changes as children's knowledge grows [43]. An intervention utilizing all three mechanisms of support was particularly powerful. In a study using lightly animated video storybooks, parents engaged in co-

viewing the videos with their preschoolers (age 3.5 years). They paused the video story and asked questions that got more complex over repeated viewings (dialogic questioning) [44]. Even without support, children of this age learned from the video; however, children whose parents used dialogic questioning learned significantly more words from the story and had better story comprehension than children whose parents provided no scaffolds [43]. Notably, children whose parents provided these supports also learned more than children whose parents simply paused the video and commented on the events on screen, indicating that directing attention to content alone was not as effective as the adaptive and socially responsive intervention.

The same type of parent scaffolding is likely to be effective when co-playing a game with children or co-reading a book on a touchscreen [45]. Compared to videos, touchscreen apps and e-books have the advantage of containing natural pause points, or places where the user needs to interact to move on. This gives parents and children natural points to interact with each other without worrying about missing important content.

4. Repetition of content

Besides helpful external supports from people and the environment, some support for learning can be built into the digital product itself. Since representations such as video images (or pictures on touchscreens) are 2-dimensional and difficult for children to connect to the real world, young children may need longer to process the information. Brain-imaging research with event-related potentials (ERPs) indicates that during the attention process, toddlers (18-month-olds) recognize a 2-dimensional image of an object more slowly than they recognize the actual 3-dimensional object [46]. This might affect the formation of a robust memory for what they see on screen. In earlier experiments, *repetition* of a demonstration on video helped 12- to 24-month-old children to imitate novel behaviors [16,47,48,49], perhaps by making up for slower

processing. In correlational research, 30-month-old toddlers who watched episodes of *Sesame Street* over and over (on DVDs or videotapes) had better language outcomes than those who watched the televised broadcast (i.e., saw each episode only once) [50]. Preschoolers (age 3 to 6) paid more attention to and better understood the content of educational television programs and the storyline of animated children's movies after watching them repeatedly [51,52,53]. Repeated exposure to the same content gives children multiple opportunities to learn the new information, notice and store more details, and make connections to what they already know. Repetition is also part of dialogic questioning, the social support method that helped 3-year-old children learn from video in Strouse and colleagues' study [43].

Touchscreen games and e-books can easily build in repetition. Additionally, they can adapt to the child's expertise level, providing repetition when needed but moving on once a child demonstrates mastery. The ability to modify a response based on what a child does is a major strength of current digital technology.

5. Parasocial relationships

One effect of children's repeated exposure to educational programming has been the development of what are called *parasocial relationships*: "emotionally tinged relationships with media characters that parallel real social relationships" [54, p.1]. According to the research of Calvert and her colleagues, these enduring attachments stem from repeated interactions with a media character that acts social by asking questions and pausing for a response, along with parent encouragement and engagement with toy character replicas. In one study, 21-month-old American children viewed a televised demonstration of how to seriate (or nest) cups of various sizes together, performed either by the familiar character Elmo or by DoDo (an unfamiliar Taiwanese TV character who, like Elmo, used child-directed speech) [55]. Those who viewed

Elmo smiled more during the demonstration, used his name more, and were better able to repeat the process of nesting the cups than children who viewed DoDo's demonstration or no demonstration at all. In another study, children were familiarized with Dodo over a 3-month period (from 18 to 21 months of age) through videos and being given a Dodo doll [56].

Researchers made 3 home visits in which they observed children playing with and watching DoDo. Those children who carried out more "nurturing behaviors" where the doll was treated as a human (such as sharing juice with Dodo or giving Dodo a bath) also learned to nest more cups from a video demonstration given by Dodo. Knowing children's tendency to form parasocial relationships with familiar characters, the developers of e-books might strategically use the interactive and adaptive qualities of current and future technology (including artificial intelligence) to build such relationships between book characters and readers [57].

6. Contingent responsiveness

True responsiveness with an on-screen person is possible when using a recently developed technology: video chat. Children between 1 and 5 years of age played and interacted with their parent on a video feed in the same way they did when the parent was physically present and seemed to draw comfort from their parent's "presence" via video feed [58,59]. In other research, children learned better from video when a researcher on screen offered live, contingent responses (e.g., played "Simon Says" with children and conversed with co-viewing parents) for a few minutes via a closed-circuit video feed [60,61] or Skype video link [62]. After this brief interaction, 24- to 30-month-old children more readily used information provided by the person on video to solve real-world tasks (imitation, object retrieval, and verb learning) compared to children who watched the researcher on pre-taped video. In a recent study, 12- to 25-month-old children experienced multiple sessions of video chat at home via FaceTime; in the

lab, they learned from, preferred, and recognized the on-screen person, and anticipated phrases she had used during the live-feed sessions, more than those who saw the sessions pre-recorded [63]. In all of these studies, the on-screen person's responsiveness may have indicated to children that she was a social partner—when she offered information, they listened. Additionally, by conversing with the person on the screen, parents may have helped children to view on-screen information as meaningful [7].

One possibility common to both video and electronic books is building in a virtual social partner. Strouse and colleagues [43] explored whether a dialogic questioner could be effectively built into a video story. One version of a storybook DVD would pause on some pages, and “Miss Sue” (a kindly teacher in a picture-in-picture frame in the corner of the page) would ask questions relevant to the story, pausing for a response *à la* Dora the Explorer. Three-year-olds who watched the on-screen questioner learned more words and understood the story better than those who watched without questioning, but learned less than those whose parents were trained to ask questions and provide responsive feedback. Miss Sue could not respond to children, nor time her speech and pauses to correspond to children's actions and comments. Thus, her presence provided only some of the cognitive benefits of parent questioning, without the social feedback involved in truly contingent interactions.

In ongoing research, we are applying this idea by incorporating a virtual partner in an e-book. Using a touchscreen tablet computer for the e-book gives us the opportunity to build contingency and feedback into the platform that is truly responsive to children's input. Future applications could use advanced AI technologies to create e-books even more adaptive to children's individual responses [45,57], although it would take truly impressive technology to

completely mimic the responsiveness and personalized situational knowledge of a human who shares prior experiences with the child.

6. Attention-directing versus attention-distracting features

As interactivity is built into e-books, giving thought to the *kind* of interactivity is vital. According to previous research, the enhancements included in an e-book may determine the extent to which it promotes or distracts from learning. Research with video has shown that preschool children orient their attention to the screen following sound effects and character vocalizations [64]. Placing attention-grabbing auditory features just before important content helped 4-year-olds attend to and understand educational TV messages [65,66,67,68]. In a similar way, strategically placed multimedia (animated pictures and sounds to highlight story elements) may direct children's attention, aiding comprehension [3,6,69,70,71,72]. However, encouraging the child to touch the screen had a different outcome: Takacs and colleagues [6] found that when hotspots or embedded games were added along with multimedia, this combination was particularly detrimental for preschool and elementary-school children from less advantaged families, perhaps because these interactive features distracted children from educational content. Thus, the electronic features to incorporate in an e-book should be chosen and tested to avoid common problems with interactive media while leveraging their benefits [7].

7. Conclusion

For very young children, learning from digital media holds both challenges and promise. Research indicates that young children sometimes find it difficult to learn from video and touchscreens. Experiences that clarify the relation between screen and reality, social scaffolding, repetition of content, encouraging parasocial relationships, contingent responsiveness from individuals on the screen, and attention-directing audio and video features all support learning.

Built-in supports and those offered by caregivers might be additive in promoting children's learning from screen media. However, adults often view digital media (including e-books) as child-only activities, and place faith in those designing "educational" media to have optimized their products in an age-appropriate manner. Thus, a paradigm shift is needed in parents' and teachers' attitudes regarding the use of digital media, including videos and e-books. Adults need to keep an eye on the design of media that they offer their children and to recognize the value of giving children experiences and scaffolds that support their learning. Even when aspects of prompting and feedback are built into a product, it is important to educate adults regarding the added benefit that results from active social support.

References

- [1] C. Chiong, J. Ree, L. Takeuchi, I. Erickson, Print books vs e-books. Comparing parent-child co-reading on print, basic and enhanced e-book platforms.
http://www.joanganzcooneycenter.org/wpcontent/uploads/2012/07/jgcc_ebooks_quickreport.pdf, 2012 (accessed 16.07.02)
- [2] A. Biemiller, Teaching vocabulary in primary grades: Vocabulary instruction needed. in E.J. Baumann, J.F. Kame'enui (Eds.), *Vocabulary instruction: Research to practice*, Guilford, New York, 2004, pp. 28-40.
- [3] A.G. Bus, Z.K. Takacs, C.A. Kegel, Affordances and limitations of electronic storybooks for young children's emergent literacy, *Dev. Rev.* 35 (2015) 79-97.
- [4] O. Korat, A. Shamir, Do Hebrew electronic books differ from Dutch electronic books? A replication of a Dutch content analysis, *J. of Comput. Assist. Learn.* 20 (2004) 257–268.
- [5] L. Guernsey, M. Levine, C. Chiong, M. Severns, Pioneering literacy in the digital wild west: Empowering parents and educators.
http://www.joanganzcooneycenter.org/wpcontent/uploads/2012/12/GLR_TechnologyGuide_final.Pdf, 2012 (accessed 16.07.02).
- [6] Z.K. Takacs, E.K. Swart, A.G. Bus, Benefits and pitfalls of multimedia and interactive features in technology-enhanced storybooks: A meta-analysis, *Rev. of Educ. Res.* 85 (2015) 698-739.
- [7] H. Hirsh-Pasek, J.M. Zosh, R.M. Golinkoff, J.H. Gray, M.B. Robb, J. Kaufman. Putting education in “educational” apps: Lessons from the science of learning. *Psych. Sci. in Pub. Int.* 16 (2015) 3-34.

- [8] G.L. Troseth, Is it life or is it Memorex? Video as a representation of reality, *Dev. Rev.* 30 (2010) 155-175.
- [9] S.M. Barnett, S.J. Ceci, When and where do we apply what we learn?: A taxonomy for far transfer, *Psych. Bull.* 128 (2002) 612-637.
- [10] G.L. Troseth, S.L. Pierroutsakos, J.S. DeLoache, From the innocent to the intelligent eye: The early development of pictorial competence, in: R. Kail (Ed.), *Advances in Child Development and Behavior* Vol. 32, Academic Press, New York, 2010, pp. 1-35.
- [11] R. Barr, Transfer of learning between 2D and 3D sources during infancy: Informing theory and practice, *Dev. Rev.* 30 (2010) 128-154.
- [12] K. Schmitt, D.R. Anderson, Television and reality: Toddlers' use of visual information from video to guide behavior, *Media Psychol.* 4 (2002) 51-76.
- [13] G.L. Troseth, J.S. DeLoache, The medium can obscure the message: Young children's understanding of video, *Child Dev.* 69 (1998) 950-965.
- [14] J.A. Deocampo, J.A. Hudson, When seeing is not believing: Two-year-olds' use of video representations to find a hidden toy, *J. of Cogn. and Dev.* 6 (2005) 229-260.
- [15] R. Barr, H. Hayne, Developmental changes in imitation from television during infancy, *Child Dev.* 70 (1999) 1067-1081.
- [16] R. Barr, P. Muentener, A. Garcia, Age-related changes in deferred imitation from television by 6- to 18-month-olds, *Dev. Sci.* 10 (2007) 910-921.
- [17] R.B. McCall, R.D. Parke, R.D. Kavanaugh, Imitation of live and televised models by children one to three years of age, *Monogr. of the Soc. for Res. in Child Dev.* 42 (1977).

- [18] P.K. Kuhl, F.M. Tsao, H.M. Liu, Foreign-language experience in infancy: Effects of short-term exposure and social interaction of phonetic learning. *Proc. of the Natl. Acad. of Sci.* 100 (2003) 9096-9101.
- [19] S. Roseberry, K. Hirsh-Pasek, J. Parish-Morris, R.M. Golinkoff, Live action: Can young children learn verbs from video? *Child Dev.* 80 (2009) 1360-1375.
- [20] P. Bronson, A. Merryman, Baby Einstein vs. Barbie.
<http://www.time.com/time/nation/article/0,8599,1538507,00.html>, 2006 (accessed 16.12.11)
- [21] J.S. DeLoache, C. Chiong, M. Vanderborcht, K. Sherman, N. Islam, G.L. Troseth, G.A. Strouse, K.D. O'Doherty, Do babies learn from baby media? *Psychol. Sci.* 21 (2010) 1570-1574.
- [22] M.B. Robb, R.A. Richert, E.A. Wartella, Just a talking book? Word learning from watching baby videos, *Br. J. of Dev. Psychol.* 27 (2009) 27-45.
- [23] E.A. Vandewater, Infant word learning from commercially available video in the US, *J. of Child. and Media* 5 (2011) 248-266.
- [24] M. Krcmar, B.G. Grela, Y.-J. Lin, Can toddlers learn vocabulary from television? An experimental approach, *Media Psychol.* 10 (2007) 41-63.
- [25] D.L. Linebarger, D. Walker, Infants' and toddlers' television viewing and language outcomes, *Am. Behav. Sci.* 48 (2005) 624-645.
- [26] G.A. Strouse, G.L. Troseth, Supporting toddlers' transfer of word learning from video, *Cogn. Dev.* 30 (2014) 47-64.
- [27] K.D. O'Doherty, G.L. Troseth, P. Shimpi, E. Goldenberg, N. Akhtar, M.M. Saylor, Third-party social interaction and word learning from video, *Child Dev.* 82 (2011) 902-915.
- [28] J. Scofield, A. Williams, D.A. Behrend, Word learning in the absence of a speaker, *First Lang.* 27 (2007) 297-311.

- [29] S. Yuan, C. Fisher, "Really? She blicked the baby?" Two-year-olds learn combinatorial facts about verbs by listening, *Psych. Sci.* 20 (2009) 619-626.
- [30] S. Dayanim, L.L. Namy, Infants learn baby signs from video, *Child Dev.* 86 (2015) 800-811.
- [31] H. Hayne, J. Herbert, G. Simcock, Imitation from television by 24- and 30-month-olds, *Dev. Sci.* 6 (2003) 254-261.
- [32] M.L. Rice, L. Woodsmall, Lessons from television: Children's word learning when viewing, *Child Dev.* 59 (1988) 420-429.
- [33] E. Flynn, A. Whiten, Imitation of hierarchical structure versus component details of complex actions by 3- and 5-year-olds, *J. of Exp. Child Psychol.* 101 (2008) 228–240.
- [34] N. McGuigan, A. Whiten, E. Flynn, V. Horner, Imitation of causally-opaque versus causally-transparent tool use by 3-and 5-year-old children, *Cogn. Dev.* 22 (2007) 353–364.
- [35] J.L. Bates, L.A. Ricciardelli, V.A. Clarke, The effects of participation and presentation media on the eyewitness memory of children, *Aust. J. of Psychol.* 51 (1999) 71-76.
- [36] D.D. Kerkman, M.F. Piñon, J.C. Wright, A.C. Huston, Children's reasoning about video and real balance-scale problems, *Early Educ. and Dev.* 7 (1996) 237-252.
- [37] E. Zack, R. Barr, P. Gerhardstein, K. Dickerson, A.N. Meltzoff, Infant imitation from television using novel touch screen technology, *Br. J. of Dev. Psychol.* 27 (2009) 13-26.
- [38] G.A. Strouse, P.A. Ganea, Toddlers' word learning and transfer from electronic and print books, *J. of Exp. Child Psychol.* (in press)
- [39] R. Baillargeon, A. Needham, J. deVos, The development of young infants' intuitions about support, *Early Dev. and Parent.* 1 (1992) 69-78.
- [40] G.L. Troseth, TV Guide: Two-year-old children learn to use video as a source of

information. *Dev. Psychol.* 39 (2003) 140-150.

[41] P. Hauf, G. Aschersleben, W. Prinz, Baby do baby see!: How action production influences action perception in infants, *Cogn. Dev.* 22 (2007) 16-32.

[42] G.L. Troseth, A.M. Casey, K.A. Lawver, J.M.T. Walker, D.A. Cole, Naturalistic experience and the early use of symbolic artifacts, *J. of Cogn. and Dev.* 8 (2007) 309-331.

[43] G.A. Strouse, K.D. O'Doherty, G.L. Troseth, Effective covieing: Preschoolers' learning from video after a dialogic questioning intervention, *Dev. Psychol.* 49 (2013) 2368-2382.

[44] G.J. Whitehurst, F.L. Falco, C.J. Lonigan, J.E. Fischel, B.D. DeBaryshe, M.C. Valdez-Menchaca, M. Caulfield, Accelerating language development through picture book reading, *Dev. Psychol.* 24 (1988) 552-559.

[45] G.L. Troseth, C.E. Russo, G.A. Strouse, What's next for research on young children's interactive media? *J. of Child. and Media* 10 (2016) 54-62.

[46] L.J. Carver, A.N. Meltzoff, G. Dawson, Event-related potential (ERP) indices of infants' recognition of familiar and unfamiliar objects in two and three dimensions, *Dev. Sci.* 9 (2006) 51-62.

[47] R. Barr, P. Muentener, A. Garcia, M. Fujimoto, V. Chávez, The effect of repetition on imitation from television during infancy, *Dev. Psychol.* 49 (2007) 186-207.

[48] R. Barr, N. Wyss, Reenactment of televised content by 2-year-olds: Toddlers use language learned from television to solve a difficult imitation problem, *Infant Behav. and Dev.* 31 (2008) 696-703.

[49] G.A. Strouse, G.L. Troseth, "Don't try this at home": Toddlers' imitation of new skills from people on video, *J. of Exp. Child Psychol.* 101 (2008) 262-280.

- [50] D.L. Linebarger, S.E. Vaala, Screen media and language development in infants and toddlers: An ecological perspective, *Dev. Rev.* 30 (2010) 176-202.
- [51] A.M. Crawley, D.R. Anderson, A. Wilder, M. Williams, A. Santomero, Effects of repeated exposures to a single episode of the television program Blue's Clues on the viewing behaviors and comprehension of preschool children, *J. of Educ. Psychol.* 91 (1999) 630–637.
- [52] M.A. Sell, G.E. Ray, L. Lovelace, Preschool children's comprehension of a Sesame Street video tape: The effects of repeated viewing and previewing instructions, *Educ. Technol. Res. and Dev.* 43 (1995) 49–60.
- [53] H. Skouteris, L. Kelly, Repeated-viewing and coviewing of an animated video: An examination of factors that impact on young children's comprehension of video content, *Aust. J. of Early Child.* 31 (2006) 22–30.
- [54] B.J. Bond, S.L. Calvert, A model and measure of US parents' perceptions of young children's parasocial relationships, *J. of Child. and Media* 8 (2014) 286-304.
- [55] A.R. Lauricella, A.A. Howard Gola, S.L. Calvert, Toddlers' learning from socially meaningful video characters, *Media Psychol.* 14 (2011) 216-232.
- [56] A.A. Howard Gola, M.N. Richards, A.R. Lauricella, S.L. Calvert, Building meaningful parasocial relationships between toddlers and media characters to teach early mathematical skills, *Media Psychol.* 16 (2013) 390-411.
- [57] K.L. Brunick, M.M. Putnam, L.E. McGarry, M.N. Richards, S.L. Calvert, Children's future parasocial relationships with media characters: The age of intelligent characters, *J. of Child. and Media* 10 (2016) 181-190.
- [58] J. Tarasuik, R. Galligan, J. Kaufman, Seeing is believing but is hearing? Comparing audio and video communication for young children, *Frontiers in Psychol.* 4 (2013).

- [59] J. Tarasuik, R. Galligan, J. Kaufman, Almost being there: Video communication with young children. <http://dx.doi.org/10.1371/journal.pone.0017129>, 2011 (accessed 16.11.12)
- [60] M. Nielsen, G. Simcock, L. Jenkins, The effect of social engagement on 24-month-olds' imitation from live and televised models, *Dev. Sci.* 11 (2008) 722-731.
- [61] G.L. Troseth, M.M. Saylor, A.H. Archer, Young children's use of video as a source of socially relevant information, *Child Dev.* 77 (2006) 786-799.
- [62] S. Roseberry, K. Hirsh-Pasek, R.M. Golinkoff, Skype me! Socially contingent interactions help toddlers learn language, *Child Dev.* 85 (2014) 956-970.
- [63] L.J. Myers, R.B. LeWitt, R.E. Gallo, N.M. Maselli, Baby Facetime: Can toddlers learn from online video chat? *Dev. Sci.* (in press)
- [64] D.R. Anderson, S.R. Levin, Young children's attention to "Sesame Street," *Child Dev.* 47 (1976) 806-811.
- [65] S.L. Calvert, A.C. Huston, B.A. Watkins, J.C. Wright, The relation between selective attention to television forms and children's comprehension of content, *Child Dev.* 53 (1982) 601-610.
- [66] S.L. Calvert, M.C. Scott, Sound effects for children's temporal integration of fast-paced television content, *J. of Broadcast. and Electron. Media* 33 (1989) 233-246.
- [67] A.C. Huston-Stein, J.C. Wright, Children and television: Effects of the medium, its content, and its form, *J. of Res. and Dev. in Educ.* 13 (1979) 20-31.
- [68] E. P. Lorch, D.R. Anderson, S.R. Levin, The relationship between visual attention and children's comprehension of television, *Child Dev.* 50 (1979) 722-727.

- [69] G.A. Strouse, P.A. Ganea, Do contingent hotspots support or distract infants from learning a new word from an electronic book? Poster presented at the biennial meeting of the International Congress of Infant Studies, <https://osf.io/h5xug/>, 2016 (accessed 16.07.02).
- [70] D.J.H. Smeets, A.G. Bus, The interactive animated e-book as a word learning device for kindergartners, *Appl. Psycholinguistic*. 36 (2015) 899-920.
- [71] M.J.A.J. Verhallen, A.G. Bus, Low-income immigrant pupils learning vocabulary through digital picture storybooks, *J. of Educ. Psychol.* 102 (2010) 54–61.
- [72] M.J.A.J. Verhallen, A.G. Bus, M.T. de Jong, The promise of multimedia stories for kindergarten children at risk, *J. of Educ. Psychol.* 98 (2006) 410–419.