



Personalized interactive characters for toddlers' learning of seriation from a video presentation



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ABSTRACT

Children's media is rooted in relationships with onscreen characters. In this study, 18-month-old toddlers were initially exposed to one of two unfamiliar interactive media characters for 3 months. Conditions varied whether the character was personalized to them or not. At age 21 months, toddlers were tested on a seriation task that was presented onscreen by the character and compared to the performance of a 21-month-old control group who did not view a video demonstration (total $N = 48$). Toddlers learned significantly more from the personalized character, but not from the non-personalized character, when compared to the control group. Children in the personalized condition also increased in parasocial, nurturing behaviors directed at the character during play sessions, and these scores were linked to better seriation performance. The results suggest an important role for social relationships with interactive characters to teach early seriation skills.

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Children's worlds are densely populated with media characters, including interactive toys that can personalize a message and respond contingently to what a child says and does. Previous video demonstrations presented by meaningful characters, such as Elmo, resulted in better toddler learning of an early mathematics concept—in this case seriation of objects—than when the same task was demonstrated by a non-meaningful character that the toddlers did not know (Lauricella, Gola, & Calvert, 2011). In the current study, we examined the role that an interactive toy character, which was programmed to be personalized or not personalized to the child, played in toddlers' subsequent learning of a seriation task that was later presented by that character onscreen. Our main hypothesis was that toddlers would learn best from the personalized character on the subsequent onscreen transfer task involving seriation skills.

Early seriation learning

U.S. children lag behind most of their international peers in learning STEM (science, technology, engineering, and mathematics) concepts, which places the U.S. at a future economic disadvantage in the world economy (U.S. Department of Education, 2011). One way to address this deficiency is to get young children involved in activities that

promote the early skills required to understand more advanced mathematical concepts. Seriation is one such skill (Gola, Richards, Lauricella, & Calvert, 2013; Kirova & Bhargava, 2002; Kroesbergen & Van Luit, 2003; Piaget, 1954; Clements, Sarama & Liu, 2008).

Seriation involves an understanding that number systems have an order that reflects the relative size or amount of objects (Piaget, 1954). A typical seriation task involves the manipulation of actual objects by some dimension in which there are relative differences in attributes, such as ordering a series of sticks from the smallest to the largest (Flavell, 1963).

Because Piagetian seriation tasks are “generative of future learning” of mathematics concepts, the Early Math Assessment Measure includes these tasks as a targeted skill for mastery by preschool-aged children (Clements et al., 2008). Programs such as *Big Math for Little Kids*, which is designed to teach 4- to 5-year-old children deep mathematical concepts, incorporates seriation skills into lesson plans, allowing children to exercise coordination of relative dimensions by one or more attributes (Greenes, Ginsburg, & Balfanz, 2004). Meta-analyses demonstrate that children, such as special needs elementary-aged students, benefit from learning seriation skills as a precursor for more advanced mathematical concept mastery (Kroesbergen & Van Luit, 2003).

As early as age 21 months, some toddlers can seriate simple tasks, such as nesting cups by size, when exposed to a live adult who demonstrates the task (Fragaszy, Galloway, Johnson-Pynn, & Brakke, 2002; Greenfield, Nelson, & Saltzman, 1972). Based on the extant research, seriation skills were targeted as an early mathematics skill for our study, in this instance having toddlers nest cups by size as the transfer task to be taught by onscreen characters.

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Learning from socially relevant video characters

Favorite teachers have always been a source of inspiration to their students, motivating them to perform their very best. The social and emotional relationships that children form with adults, such as their teachers, can influence learning, as can the social relationships that children have formed with onscreen media characters (Richert, Robb, & Smith, 2011). Indeed, children learn best from media that is *socially relevant* to them (Troseth, Saylor, & Archer, 2006). In recent years, the concept of social relevancy has been broken into two distinct theoretical parts (Krcmar, 2010): 1) social meaningfulness and 2) social contingency. Social meaningfulness was subsequently linked to emotional, *parasocial relationships*, whereas the perception of social contingency was linked to *parasocial interactions* (see Bond & Calvert, 2014; Calvert & Richards, 2014).

Parasocial relationships

Meaningful social relationships with onscreen personalities are defined as parasocial relationships (Calvert & Richards, 2014). More specifically, parasocial relationships involve a one-sided, emotionally tinged relationship with a media character or onscreen person that lasts over time (Hoffner, 2008).¹ In other words, parasocial relationships are ongoing affective bonds with media characters (Bond & Calvert, 2014).

Toddlers who have meaningful relationships with characters learn well when those characters present content onscreen. For example, 21-month-olds performed better on a seriation task demonstrated by the popular Elmo character than when children viewed a Taiwanese character named DoDo, who is unknown to U.S. children, demonstrate the exact same task with the same Elmo-like voice. Furthermore, only children who viewed the Elmo demonstration performed significantly better on the seriation task when compared to another group of children who saw no video demonstration at all (Lauricella et al., 2011).

In a follow-up study, one group of toddlers was familiarized with the DoDo character through play sessions with a puppet version of him and exposure to videos of him doing everyday activities, like eating breakfast. This familiarized condition also learned the seriation task better from his video demonstration than a control group who had no prior exposure to the character before viewing the video demonstration. By contrast, toddlers who only viewed DoDo perform the seriation task onscreen with no other exposure to the character performed no better than the control group on the seriation task. Within the familiarized condition, those who nurtured the puppet character during play sessions by feeding him and putting him to bed—a behavioral indicator of a parasocial relationship—performed better on the seriation task than those who did not nurture the character during play sessions (Gola et al., 2013).

Parasocial interactions

In children's media, parasocial interactions involve a production practice that simulates the perception of social contingency (Calvert & Richards, 2014). This perception is created by having a media character such as Dora the Explorer speak to the audience, pause for a reply during which the child ostensibly says or does something requested by the character, and then act as if the child actually did respond (Lauricella et al., 2011). These kinds of pseudo-interactions can get children actively involved with the program content, with children often responding to and interacting with the characters (Anderson et al., 2000), and can lead to better comprehension of plot-relevant content when these interactive prompts are included versus excluded (Calvert, Strong, Jacobs, & Conger, 2007). The production practice of creating the illusion of a social

interaction is now very common in children's television programming (Calvert & Wartella, 2014). Nevertheless, characters who speak to children and wait for a reply to create the illusion of an interaction do not necessarily facilitate improved learning (Lauricella et al., 2011).

Children can have a parasocial relationship with a character without these kinds of pseudo-interaction programming practices taking place. That is, children can observe and learn from onscreen characters whose experiences only involve other characters, with the characters saying nothing to the audience (O'Doherty et al., 2011). In these situations, children can become emotionally invested in the characters and create parasocial relationships through observational learning, i.e., social cognitive theory (Bandura, 1986).

Parasocial interactions, then, can occur without a character being meaningful to a child, but sometimes those characters are meaningful to them. Similarly, a child can develop a parasocial relationship with a media character, regardless of whether or not production practices are used that can create the illusion of a two-way interaction. In other words, children can have both parasocial relationships and parasocial interactions with a media character, or only one of these kinds of parasocial experiences.

Implications for learning

We believe parasocial relationships are at the heart of children's learning from media characters, as it indicates an emotional investment in a character, which should increase engagement and potentially learning. For instance, parasocial interaction production practices were used in the DoDo seriation video, but only those who had been familiarized with DoDo performed better than the control group; by contrast, those who had no prior relationship with DoDo did not perform any better than the control group (Gola et al., 2013). Therefore, even after holding levels of parasocial interaction production practices in the DVD constant, parasocial relationships still emerged as a significant influence in children's learning from onscreen presentations.

Taken together, these findings suggest that very young children act as if their favorite media characters are alive, forming parasocial relationships with them and treating them as humans. Indeed, Piaget (1954) and Piaget, Tomilson, and Tomilson (2007) long held that children in the preoperational stage of development believed in animism, giving human attributes to non-human objects. For example, young children sometimes believe that their stuffed toys and dolls are alive, talk to them, and treat them as friends. In a similar way, children may 'breathe life' into their favorite characters with whom they have formed parasocial relationships. Although these relationships with onscreen characters are unidirectional, from the child to a character, the fact that media characters walk, talk, have friends, and look like other people may overpower the fact that the character is not actually real (Calvert & Richards, 2014).

Learning from interactive characters

Interactive characters can personalize their responses to young children, perhaps further blurring the line between what is real and what is pretense. The largest difference between programmable, interactive characters and those that are observed in television or film presentations may be that interactive characters can be more responsive than television characters can be. When programmed, interactive characters can say a child's name, share their favorite activities, engage the child in a socially contingent conversation, and create the illusion that the character is child-like. These properties parallel the ways that children develop preferences for peers (Bond & Calvert, 2014).

Although children do not typically define their own gender prior to age 2 (Kohlberg, 1966), toddlers prefer toys that are the same gender as they are as early as age 18 months (Serbin, Poulin-Dubois, Colburne, Sen, & Eichstedt, 2001). Moreover, children prefer to play with a puppet that has the same physical appearance and favorite food as they do (Fawcett & Markson, 2010). This personal resemblance, in turn, influences learning. That is, children learn more from characters that closely

¹ Note that the terms parasocial relationship and parasocial interaction were originally used interchangeably (Horton & Wohl, 1956). The terms have now been separated conceptually (Schramm & Hartmann, 2008) and will be discussed as distinct concepts in this article.

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