CHAPTER 5

Parasocial Relationships With Media Characters: Imaginary Companions for Young Children's Social and Cognitive Development

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Early childhood is a time when imagination develops (Singer & Singer, 2005), as do first friendships (Hartup, 1989). When these two processes meet in the information age, parasocial relationships, which are emotionally tinged one-way relationships with media personae, including media characters (Bond & Calvert, 2014a; Horton & Wohl, 1956), can emerge. Put another way, children's close relationships with media characters are in essence their imaginary friends, which are not real, but are treated by children as such (Gleason, 2013). This bending of reality can serve children's social and cognitive development (Richert, Robb, & Smith, 2011).

In this chapter, I explore early parasocial relationships that children develop with media characters in a world that increasingly blurs the line between what is real and what is pretend, particularly when interactive media provide contingent replies to children's behaviors (Brunick, Putnam, Richards, McGarry, & Calvert, 2016). Just as young children's real relationships with people provide a basis for social and cognitive advancements, so too can parasocial relationships provide a network of symbolic experiences that can be beneficial for their development (Calvert, 2015; Calvert & Richards, 2014).

WHAT ARE PARASOCIAL RELATIONSHIPS?

Early social skills unfold in close emotional relationships; they initially emerge in vertical relationships, such as from parent to child, and are later refined in horizontal relationships with peers (Hartup, 1989). It is in these

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horizontal relationships that early friendships with peers first develop in about their third year of life (Hartup, 1989). These early friendships often involve play with someone who is located in physical proximity, and can be trusted to be available for support when needed (Furman & Rose, 2015).

Children do not limit their social relationships to real people. Pretend friends, for instance, are common among young children (Singer & Singer, 2005). Pretense provides a forum for learning about others—about their thoughts, feelings, likes, and dislikes (Singer & Singer, 2005). Children talk to and anthropomorphize their imaginary friends, including those who come from their media experiences (Calvert & Richards, 2014).

Why do young children often treat these imaginary characters as if they are real? Better yet, why wouldn't they? Media characters stand on two legs, whether they are a person, an animal, or an object (Calvert & Richards, 2014). They do what children do: they have birthday parties, jump in puddles, eat breakfast, and play with their friends (Calvert & Richards, 2014). By treating the characters "as if" they are real, children suspend reality, such as it is in early childhood, entering into an imaginary world where animals can talk, trains can smile to express their feelings, and robots can fly. This animistic approach to reality is both engaging, as well as potentially informative, to young children (Calvert & Richards, 2014). This approach is also found among adolescents who suspend reality and act "as if" the characters that they see in media are actually real (Giles & Maltby, 2004).

Many of the characters in children's programs talk to their young audiences using parasocial interaction techniques. For instance, characters often ask children to help them solve problems in simulated conversations, thereby prompting interactive exchanges with their audiences. A prototypical example is as follows: the character raises a query, pauses for a reply, and then acts as if they have heard what the child said (Lauricella, Gola, & Calvert, 2011). Indeed, many children do reply to the characters, acting as if the characters can hear what they are saying (Anderson et al., 2000; Calvert, Strong, Jacobs, & Conger, 2007; Calvert et al., 2016). These kinds of conversations are a facet of interactivity (Rafaeli, 1988), and they are linked to better story comprehension and problem solving skills (Calvert et al., 2007).

MEASURING EARLY PARASOCIAL RELATIONSHIPS AND PARASOCIAL INTERACTIONS

What exactly is a parasocial relationship for a young child? To answer this question, Bond and Calvert (2014a) began with the premise, as other scholars have (e.g., Wilson & Drogos, 2007), that favorite characters would be most likely to enjoy the status of an emotionally close relationship with children. Therefore, we had parents answer an online survey that initially asked them to identify who they thought their child's favorite media character was, followed by numerous questions about their child's favorite media character.

Using factor analysis of parent reports, we identified three distinct categories that comprised children's parasocial relationships: character personification (treating a character as if they were a person), attachment (feeling close to and using the character for contact comfort, e.g., holding a soft plush toy of their favorite character when upset), and social realism (e.g., believing the character was real or pretend) (see Fig. 1). Table 1 presents the questions that emerged in the factor analysis of the parent assessment of their children's parasocial relationships with a favorite media character (Bond & Calvert, 2014a).

In a subsequent study, we collected parent data about a character that their 24- and 32-month-old child knew, Elmo the Muppet from *Sesame Street*, even though he may not have been their child's favorite character (Richards & Calvert, 2015). Results indicated that the internal consistency (Cronbach's alpha) for the three parent subscales of children's parasocial relationship with Elmo was good to excellent for the character personification and attachment subscales in three related experiments, and they were acceptable or good for social realism in two of those three experiments. Thus, the parent measure of children's parasocial relationships yields consistent, reliable findings for two factors across studies whether it is a favorite and/or

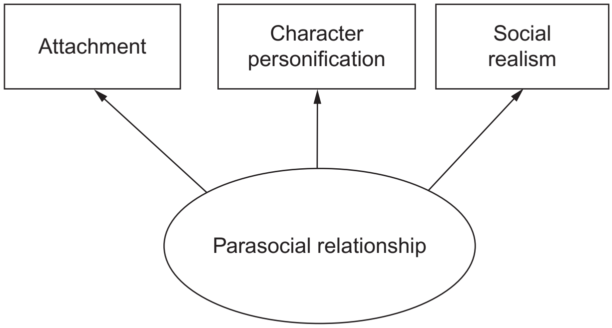

Fig. 1 Components of parasocial relationships. *(From Bond, B. J., & Calvert, S. L. (2014a). A model and measure of U.S. parents' perceptions of young children's parasocial relationships.* Journal of Children and Media, 8*, 286–304. http://dx.doi.org/10.1080/17482798.2014.890948.)*

Table 1 Parasocial relationship items: parent questions & factors assessing child's favorite character (Bond & Calvert, 2014a)

Character personification	[Child] thinks that [character] has thoughts and emotions
	[Child] gets sad when [character] gets sad or makes a mistake
	[Child] trusts [character]
	[Child] treats [character] as a friend
	[Child] believes that [character] has needs
	[Child] believes that [character] has wants
Social realism	[Child] knows that [character] is imaginary[a]
	When [character] acts out a behavior on screen (like dancing, singing, or playing a game), [child] believes that [character] is performing the behavior in real life
	[Child] believes that [character] is real
Attachment	[Character] makes [child] feel comfortable
	[Character] makes [child] feel safe
	The voice of [character] soothes [child]

Note: Each item is rated 1–5 on a 5-point Likert scale. The child's name and the favorite character are imputed into this online survey.
[a]The item is reverse coded.

a popular character. The exception was social realism, which was a bit weaker on internal consistency when a popular rather than the favorite child character was the focus.

Parent data from Bond and Calvert (2014a) were also used to create a path analysis to describe how parasocial relationships with media characters develop. As seen in Fig. 2, we discovered that parent encouragement, engagement with toy replicas that resembled the character, repeated exposure to the character across platforms, and parasocial interaction predicted parasocial relationships. Parent encouragement, toy play, and parasocial interaction were directly linked to the development of parasocial relationships. Indirect links occurred through parasocial interactions to parasocial relationship development for parent encouragement, toy play, and also repeated exposure to the character across media platforms. These results suggested that parasocial interactions with favorite media characters created a potential trajectory for the development of parasocial relationships, with toy play and parent encouragement also having their own independent links to these relationships.

Based on this initial study (Bond & Calvert, 2014a), we developed a child measure of parasocial relationships and sampled different parents and their children (Richards & Calvert, 2016a). We examined preschool-aged children's choices of favorite characters, compared them to what their parents said, and asked both the child and the parent samples the questions that had

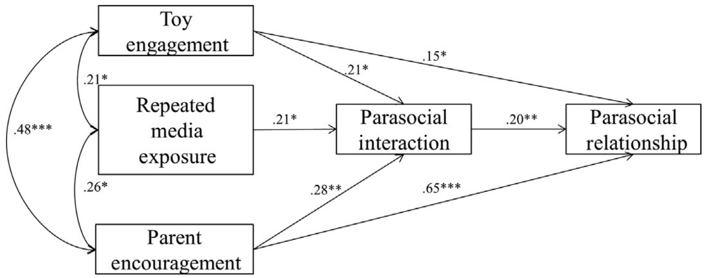

Fig. 2 Parasocial relationship development model. *(Adapted from Bond, B. J., & Calvert, S. L. (2014a). A model and measure of U.S. parents' perceptions of young children's parasocial relationships.* Journal of Children and Media, 8*, 286–304. http://dx.doi.org/10.1080/17482798.2014.890948.)*

comprised children's parasocial relationships via parent report in the original Bond and Calvert (2014a) study. We simplified the children's questions, and also dropped questions that were too abstract for them to understand. We used a 5-point smiley face Likert scale to make response choices easier for children.

Using factor analysis, Richards and Calvert (2016a) found consistent but somewhat different clusters of features that defined parasocial relationships when compared to the original factor analysis by Bond and Calvert (2014a). Specifically, the factors that described children's parasocial relationships with their favorite characters, via the child smiley face scale, were attachment and friendship, human needs, and social realism. Similar factors—attachment and character personification, human needs, and social realism—were found in analyzing the data from the parents of those children via the parent survey. See Tables 2 and 3, respectively, for the questions and factors derived for the Child Parasocial Relationship and the Parent Parasocial Relationship measure in the Richards and Calvert (2016a) study.

The new human needs factor included questions about the character getting hungry, sleepy, or feeling sad when the character made a mistake. Interestingly, caring for a character's human needs also emerged in behavioral studies of parasocial relationships (see Calvert, Richards, & Kent, 2014; Gola, Richards, Lauricella, & Calvert, 2013), providing evidence of construct validity. These findings are consistent with kindergartners' beliefs that a mouse's mind continues to exist, in terms of being hungry or feeling sad, even after death (Bering & Bjorklund, 2004).

There were two main caveats for the findings of the Richards and Calvert (2016a) study. One was that only about 30% of parents agreed with their child about who the child's favorite character was. The other was that the parasocial relationship subscales on the parent parasocial relationship measure were internally consistent, but the child measure reached acceptable

Table 2 Parasocial relationship items: child questions & factors assessing child's favorite character (Richards & Calvert, 2016a)

Attachment & friendship	How safe does [character] make you feel when you are scared? Really safe, safe, kind of safe, a little bit safe, or not safe at all? Is [character] your best friend, your good friend, kind of a good friend, a little bit of a friend, or not your friend at all? Is [character] really cute, kind of cute, a little bit cute, or not cute at all?" Does [character] have a whole lot of feelings, a lot of feelings, kind of has feelings, a little bit of feelings, or no feelings at all?
Social realism	Is the character totally real, mostly real, kind of real, mostly pretend, or totally pretend?[a] Is [character] totally pretend, mostly pretend, kind of pretend, mostly real, or totally real?
Human-like needs	Does [character] get really hungry, hungry, kind of hungry, a little bit hungry, or not hungry at all? Does [character] get really sleepy, sleepy, kind of sleepy, a little bit sleepy, or not sleepy at all? How do you feel when [character] makes a mistake? Really sad, sad, kind of sad, a little bit sad, not sad at all

Note: Each item is rated 1–5 on a 5-point Likert smiley face scale. The child's favorite character is imputed into this oral survey.
[a]The item is reverse coded.

Table 3 Parasocial relationship items: parent questions & factors assessing child's favorite character (Richards & Calvert, 2016a)

Attachment & character personification	[Child] thinks that [character] has thoughts and emotions [Character] makes [child] feel safe [Child] trusts [character] The voice of [character] soothes the child [Character] makes child feel comfortable
Social realism	[Child] knows that [character] is imaginary[a] When [character] acts out a behavior on screen (like dancing, singing, or playing a game), [child] believes that [character] is performing the behavior in real life [Child] believes that [character] is real
Human-like needs	Child] believes that [character] has needs [Child] believes that [character] has wants

Note: Each item is rated 1–5 on a 5-point Likert scale. The child's name and the favorite character are imputed into this online survey.
[a]The item is reverse coded.

levels of internal consistency only for the attachment and friendship subscale. The fantasy/reality subscale may have been particularly difficult for the children, as the lines between what is pretend and what is real are often blurred for young children (Singer & Singer, 2005), but internal consistency improved on that measure for older children in the sample (Richards & Calvert, 2017). Complicating matters is the reality that children sometimes reported seeing embodied characters like Mickey Mouse and the Disney princesses walking around at theme parks like Disney Land (Richards & Calvert, 2016a). The internal consistency of the human needs subcategory of parasocial relationship via children's self-reports was not in the acceptable range either and did not improve for older children (Richards & Calvert, 2017), but that dimension had been found and validated through behavioral data in other empirical studies (Calvert et al., 2014; Gola et al., 2013).

One possible solution to the child parasocial relationship measurement problem is to merge the responses of the child and adult parasocial relationship scales, with the child's favorite character being imputed into the parent online survey. If the scores of parents and children are highly positively correlated, the internal consistency measures of the parent measure could be used to bolster the child measure. Another option is to use the parent measure alone, particularly when assessing the parasocial relationship with a character who is not necessarily the child's favorite, since it has demonstrated high internal consistency for items in subscales for three studies, including favorite characters and a popular, nonfavorite character (Bond & Calvert, 2014a; Richards & Calvert, 2015, 2016a). The problem with this approach is that parents often do not reply to the online survey, making it necessary to increase the sample size of children substantially to get enough parent responses. A third option is to focus primarily on the attachment and friendship child subscale, as it demonstrates sufficient internal consistency for use as a measure of parasocial relationships (Richards & Calvert, 2017). A final option is to use individual items from the measure. Trust is one such option as discussed below.

MEANINGFUL PARASOCIAL RELATIONSHIPS FOR EARLY STEM LEARNING

Trust is a facet of onscreen relationships that is linked to credibility decisions by young children. For instance, Corriveau and Harris (2009) showed

3- to 5-year-old children two onscreen teachers, one of whom the child knew and the other who was unknown to them. Next, they varied how accurate each teacher was in naming familiar objects to the children after which each teacher named novel objects. For the novel words, the younger 3-year-old children selected the familiar teacher as the most trustworthy to them, even if she had previously made mistakes in labeling the familiar objects. In essence, they forgave their teacher for her previous errors. By contrast, the older 4- and 5-year-old children chose the teacher who had previously named the familiar objects accurately when faced with the uncertainty of naming novel objects. Harris and Corriveau (2011) described children's decisions as evolutionary advantageous: that is, children trust those who are familiar to them at very young ages given the evolutionary advantage of attachment biases. This early attachment preference then shifts with age to finding the accurate person, regardless of personal closeness to them, as accuracy becomes more important for survival.

Building on this line of research, Richards and Calvert (2015) varied the familiarity and accuracy of a media character, in this case the popular US character Elmo versus DoDo, a popular character from Taiwan that was unknown to US children. Using an iPad interface, 32-month-old children interacted with a game in which they had to choose the character who labeled novel foods correctly after having experienced the two characters naming familiar foods correctly or incorrectly. Interestingly, 32-month-old children selected the accurate novel character over the inaccurate familiar, meaningful character for the novel food names if the unfamiliar character had previously labeled the familiar foods correctly. This effect occurred regardless of whether the child received feedback about their choices in the familiar food trials. Even 24-month-old toddlers selected the unfamiliar character for the novel food names when the familiar character had previously labeled familiar foods incorrectly. Put simply, their trust was reserved for the credible character. Our results differed from those of Corriveau and Harris (2009), we think, partly because they observed real people on video whereas our study used puppets with interactive apps that elicited responses from children (Richards & Calvert, 2015).

In a video study assessing early acquisition of math skills, Lauricella et al. (2011) compared 21-month-old toddlers' performances on a seriation task in which they nested cups after viewing the meaningful Elmo character versus the unknown DoDo character demonstrate the task. There was also a no exposure control group who were simply given the cups. In this instance, children who viewed Elmo perform the task onscreen subsequently outperformed those who viewed DoDo sequencing the items. Those who viewed Elmo demonstrate the task also performed significantly better on the seriation task than the control group; by contrast, those who viewed DoDo demonstrate the task did not perform significantly better than the control group (Lauricella et al., 2011).

We then decided to build parasocial relationships between toddlers and the unfamiliar DoDo character. In this study, Gola et al. (2013) had one group of toddlers play with DoDo toys in their homes from ages 18–21 months before viewing DoDo perform the seriation task onscreen. Another group viewed the onscreen DoDo character demonstration only at age 21 months without any prior toy play with DoDo. There was also a no exposure control group. The toddlers who had played with DoDo for 3 months and then viewed DoDo performing the seriation task at age 21 months performed significantly better on the sequencing task than the no exposure control group. By contrast, those who were exposed to DoDo only when he performed the onscreen seriation task did not perform significantly better than the control group. More importantly, the more that toddlers in the play experience condition nurtured DoDo by pretending to feed the character or put him down for a nap, the better they performed on the subsequent seriation task. Given that parasocial relationships are emotionally tinged relationships, we concluded that nurturing the character by taking care of its needs was a behavioral measure of parasocial relationships (Gola et al., 2013). These findings dovetail nicely with the results of the factor analyses of both parent and child report in which human needs (e.g., feeding the character and putting it to sleep) were a component of parasocial relationships (Richards & Calvert, 2016a).

In the final study in this series, Calvert et al. (2014) used interactive characters, the Leapfrog puppies Scout and Violet, to teach the seriation task. Scout, the boy character, had bright green markings, and Violet, the girl character, had soft lavender markings. Both had the same child-like voice. These characters were programmed so that they were or were not personalized to be like the 18-month-old child. In particular, the personalized character was programmed to know the toddler's name, gender, and share the same favorites, such as the child's preferred songs and foods. By contrast, the nonpersonalized character called the toddler by the generic name "Pal," was the opposite gender, and had different favorites from the child. Once again, we observed the toddler playing with the toys with a caregiver over a 3-month period. Then we had them view their character onscreen performing the seriation task. There was also a no exposure control group.

After viewing the character demonstrate the seriation task, the children who had been in the personalized condition performed significantly better on that task than those in the no exposure control condition. However, those in the nonpersonalized condition did not perform the seriation task significantly better than the control group. Toddlers who had personalized characters also increased in parasocial, nurturing behaviors over time during their play sessions, unlike those with nonpersonalized characters. The more that toddlers increased in nurturing, parasocial behaviors with the toys, the better they did on the seriation task; that outcome was only true, however, for those who had the personalized character (Calvert et al., 2014).

Taken together, these studies demonstrate that emotionally close relationships with toy replicas of media characters can result in better performance when children observe onscreen cognitive tasks demonstrated by those characters. Nurturing the character during play, be it a traditional puppet or an interactive toy, is the key for developing this close relationship at young ages. For interactive toys, the character assists subsequent transfer tasks when it is personalized to the child; that is, it is made to be "like" the child. This kind of homophily in real-life relationships as well as with these toy media characters is a component of friendships and reinforces the premise that children treat their imaginary friends just as they do their real-life friends (Bond & Calvert, 2014a). However, if those characters have been previously wrong, young children will select an unfamiliar character that labels novel objects over a familiar character's incorrect labels (Richards & Calvert, 2015). These findings indicate that parasocial relationships are beneficial for early cognitive outcomes, but only if the character is credible and worthy of their trust.

PARASOCIAL BREAKUPS

Just as is found in relationships with real people, children eventually break up with their favorite media characters. In early childhood, parasocial relationships last about 2.4 years (Brunick & Calvert, 2016).

The reasons that children break up with media characters are varied, but one is key. While children's media characters are often ageless, remaining much the same in terms of age and behaviors, the child is growing up with new social and cognitive needs emerging. According to the survey by Bond and Calvert (2014b), which used parent report, the main reasons for parasocial break up include outgrowing the character, growing tired of the character, or finding a new favorite. During the preschool years, peer pressure also emerges for children to give up the neotenous, baby-like favorite characters of early childhood in favor of those who look and act in more mature ways (Brunick & Calvert, 2016). Indeed, children often prefer older characters to younger ones (Calvert & Kotler, 2003).

One reason that babyish characters may be left behind involves an increasing preference for gender-stereotyped characters as children age. Compared to earlier parasocial relationships with favorite characters, new favorites tend to be more gender stereotyped in terms of masculine and feminine attributes (Bond & Calvert, 2014b; Brunick & Calvert, 2016). For instance, one boy switched his favorite character to the rough and tumble superhero male character Buzz Lightyear from his previous favorite, the more benign babyish looking Caillou. Similarly, a girl changed her favorite character to the more physically attractive Disney Tinkerbell character from her previous favorite, the inquisitive Sesame Street Muppet Abby Cadabby (Bond & Calvert, 2014b). The colors of favorite characters also become more gender stereotyped as children age. In particular, girls prefer their characters to be softer feminine lighter colors, whereas boys prefer their characters to be darker, masculine colors (Brunick & Calvert, 2016). These findings suggest that by the preschool years, favorite characters increasingly reflect children's growing understanding of what is traditionally gender appropriate for girls and boys, a pattern that is consistent with more general patterns of traditional gender stereotypes (Huston, 1983).

INTELLIGENT CHARACTERS

Observational media rely heavily on children's imagination to create pseudo interactions with characters. Newer media, by contrast, allow contingent replies to children's actions, potentially providing an avenue to channel their love of media characters into more advanced types of learning. Notably, animated intelligent characters do not fall prey to the "uncanny valley," in which more realistic animated characters look "creepy" (Mori, MacDorman, & Kageki, 2012), as was the case of the animated but too realistic-looking characters in the movie *The Polar Express* (Noë, 2012). This familiarity and attachment to animated characters makes them ideal as potential playmates and teachers in this emerging and interactive world of intelligent characters (Brunick et al., 2016).

Based on this idea, we created an intelligent character prototype using Dora from the children's program *Dora the Explorer* to teach an early math skill, the add-one-concept (Calvert et al., 2016). The add-one concept involves automatically understanding that adding one to a number advances the sum by one unit (e.g., 3 + 1 is 4) rather than counting one by one on one's fingers, as often occurs during early childhood (Baroody, 1987). The development of the add-one concept allows children to free up cognitive resources to compute higher order math skills (Baroody, Eiland, Purpura, & Reid, 2012).

In our game prototype, children solve 16 math problems to help Dora from the children's animated program *Dora the Explorer* count supplies that come down a grocery store conveyor belt for her cousin Diego's birthday party. There are four rounds increasing in the level of difficulty, as regulated by the speed and whether the math problems are presented in canonical or random order. If children miss a problem or fail to reply before the object disappears into a grocery bag at the end of the conveyor belt, the character Swiper the fox steals the bag. Two levels of scaffolding, which include having Dora's sidekick monkey Boots assist children, are built into the game if they have difficulty solving the addition problems.

The interface verbally engages children in *parasocial interaction techniques*. Specifically, Dora asks children questions, pauses for a reply, and responds contingently to children's answers via a second, hidden experimenter, the Wizard, who remotely controls the game from behind a screen, just as the Wizard from *The Wizard of Oz* did from behind his curtain. In our case, the Wizard of Oz paradigm allows an experimenter to deliver accurate, contingent responses to each child.

The parasocial interaction techniques include *small talk* to build repertoire (e.g., "Have you ever had a birthday party?") and *add-one math problems* (e.g., "What is 3 + 1?"; Calvert et al., 2016). Small talk allows children to avoid face threat (Cassell, 2016), as they become comfortable "talking" to a character, and do not have to respond only to an addition question that may be difficult for them to answer. Visual attention was recorded via a camera as children played the game beside an experimenter. We also assessed how emotionally close children felt to Dora via the attachment and friendship subscale of the child parasocial relationship measure (see Richards & Calvert, 2017).

Our initial results suggest that the prototype was engaging and effective. Overall, 90% of preschool-aged children completed the add-one game, with an average completion time of about 13 min. Children answered an average of 12.95 problems correctly on their first attempts, needing an average of 1.28 first level scaffolds and about one second level scaffold per game. Older children answered more problems correctly on the first try and more quickly than younger children. Children looked at the game about 88% of the time, looked at the first experimenter beside them about 5% of the time, and looked elsewhere about 7% of the time. The verbal parasocial interaction interface was effective, with children responding on average to 84% of small talk prompts and 94% of number prompts. Children who felt more emotionally close to Dora answered more small talk prompts, thereby providing a link between parasocial relationships and parasocial interactions (see Calvert et al., 2016). Our initial findings suggest that popular media characters demonstrate promise as intelligent characters who can contingently interact with children in academic settings, potentially providing pathways for the development of the fundamental mathematical skills necessary for future scholastic success.

In a follow-up study, we are currently comparing the Dora intelligent character prototype game with a no character control that only depicts the game in the grocery store setting. The no character control has an adult female voice present the same script that is used in the Dora game with the same grocery store check-out line background. In this study, we added questions to ask children if they thought that Dora could see them or hear them after they had interacted with the game. Thus far, their reply is overwhelmingly "yes" to Dora hearing them. One boy in the Dora condition elaborated by saying "because it kept answering me!" During actual game play, one girl also looked at the experimenter and excitedly commented, "She's talking to me!" The majority of children in the Dora condition also thought that she could see them, probably because she was physically present on the screen. Children in the no character condition also thought that they could be heard by the game, and interestingly, also believed that they could be seen when no character was present. Given that the contingency of replies in this game are built upon verbal spoken parasocial interaction techniques, the finding that children think that they can be heard suggests that the interface is believable to them. These findings are consistent with research demonstrating that contingency is a trigger for the belief of a human mind (Waytz, Klein, & Epley, 2013).

Both the Dora and the no character game versions get children to reply to questions through parasocial interaction techniques, thereby engaging them with an onscreen or an offscreen character who has a voice, and both versions result in accurate performance on add-one-concept problems. If the character serves to motivate children through parasocial relationships, as we think is the case, then faster response times on the transfer task should take place in the character than in the no character condition, which was in fact the case (Calvert et al., 2017).

Personalized intelligent character interfaces are also emerging to teach older minority children STEM skills. For instance, Cassell (2016) built an animated, intelligent virtual peer to teach science concepts through language that mapped into the child's dialect. The basic premise is that minority children, who tend to lag behind others in STEM skills, are disadvantaged in part because African American Vernacular English is not the same as the Standard American English that is typically used in school systems. Hence, there are minimal links between who the child is and what the learning setting demands. It is, if you will, like asking children to speak in a foreign language.

To address this issue, Cassell (2016) created an African American virtual character named Alex who spoke to third grade children in one of three ways: Standard American English only, African American Vernacular English only, or a mixture of African American Vernacular English and Standard American English (i.e., code switching). Alex's African American Vernacular English language patterns are based on 8- to 10-year-old African American children's verbal and nonverbal patterns. In the Standard American English condition, the character only interacts in Standard American English with the child. In the African American Vernacular English condition, the character speaks only in African American dialect. In the code switching condition, the character switches between African American Vernacular English and Standard American English. Specifically, repertoire building is done in African American Vernacular English in which the child chats about everyday events with the character. Then the character uses "school talk" of the sort that is typically used in classrooms to do the science problems. The character looks like a middle schooler who is racially ambiguous.

The study is conducted using *the Wizard of Oz* paradigm in which a hidden experimenter responds to the child from behind a screen. Results indicated that African American children presented stronger science arguments in the African American Vernacular English speaking condition than when the virtual peer exclusively spoke Standard American English (Cassell, 2016). In a longitudinal 6-week long follow-up study, students in the code switching condition discussed more science concepts than those who were exposed to the virtual peer who only spoke Standard American English. Student engagement increased, as indicated by the use of more pitch fluctuations, louder voices, and faster speaking patterns, by children in the code switching than in the Standard American English speaking condition. Finally, children themselves used more code switching in their subsequent conversations with teachers in a learning context, revealing transfer effects.

Overall, Cassell's (2016) argument is that social connectedness is facilitated by tasks that support who the child is than those that attempt to make a child fit in with a dominant culture. This sense of social connectedness, comprising trust, rapport, and perceptions of sameness, in turn, then improves student learning of science concepts. This link to trust is consistent with our work on close, emotional parasocial relationships as a key to learning math concepts from the media characters who are their trusted friends (Calvert et al., 2014; Gola et al., 2013).

THE CREATION OF ENGAGING MEDIA CHARACTERS IN EDUCATIONAL PRODUCTIONS

Certainly children use educational materials in formal school settings, but the key to success is getting them to engage in scientific concepts at home as well (Brunick et al., 2016). If children do not voluntarily spend time with educational content, then the opportunities to learn from media characters are limited. What kinds of qualities create engaging media characters? How do the production features that present and represent content influence children's engagement, learning, and cognitive skill development? These questions are addressed next.

The character. One mystery of creating educational content for children is making characters that engage them, that spark their curiosity, that make them want to watch them and/or interact with them. What are the optimal ways to design and present media characters? How should they look, and how should they act?

One dimension of interest is whether the characters are animated or live. In the United States, the majority of the characters and educational programs designed for children are animated (Calvert & Kotler, 2003). There are numerous reasons for this decision, many of which are financial. Live child actors have contracts with limits on how much time they can work. Further complications are that the characters grow up, and may tire of the program they are doing. By contrast, animated characters are properties. Their images are controlled by their creators. They can be bought and sold to market products. They can work morning, noon, and night. Animated characters easily traverse cultural boundaries as dubbing languages onto them for a native dialect is far easier than dubbing a different language onto a real person whose lips more closely match the words being said, and their voices can be made to sound child-like. Animated characters are, in essence, cost effective.

Puppets and Muppets are also a relatively cost effective way to develop characters, as they have adult puppeteers who have fewer limits than child actors do in terms of work schedules. Adult Muppeteers can also follow directions much easier than a young child actor. While some argue that children's media should return to the day of live characters (Kleeman, 2016), that day has passed into one in which the characters are human-like, but animated or puppets/Muppets. This approach dovetails nicely with the imaginary capabilities of their young viewers (Valkenburg & Calvert, 2012).

Animated characters have key features that make them who they are. They are embodied; they have an age and a gender; they have nonverbal behaviors and voices that are characteristic of who they are; and they have characteristic ways of acting, including personality attributes (Calvert & Richards, 2014). For very young children, neotenous features are appealing to them (Brunick & Calvert, 2016) as are child-like voices (Anderson & Kirkorian, 2015). These qualities parallel the kinds of properties that appeal to babies, such as the high-pitched voices used in infant directed speech (Fernald, 1985). The *Sesame Street* Muppet character Elmo is a perfect example of a popular character that appeals to very young children. He has a large round face and big eyes, a bright red furry body, and a high-pitched voice. His very persona is perceptually salient, filled with high contrast (his dark eyes on white irises with his bright red body), incongruity (his voice), and his prototypical 2-year-old child personality filled with surprise and wonder. Elmo is also everywhere—in children's television programs, in their games, as toys, on their clothes, and on the foods that they purchase at the supermarket (Richards & Calvert, 2017. All of these personal qualities coupled with ubiquitous access make him appealing to children, and it is difficult though not impossible to duplicate this formula.

As children grow older and move into the preschool years, their developmental needs shift. For instance, children develop their first real friends (Hartup, 1989). They prefer characters that continue to reflect who they are. Throughout the world, their identity, and hence their friends, increasingly involve their gender (Huston, 1983; Maccoby, 1999). Knowing that you a boy or a girl is a watershed moment in the life of a child. The world becomes black and white, or perhaps better said, blue and pink. Categories are constructed about what you should like (and not like), about what you should (and should not do), about who your friends should be. With development, real friends tend to be of the same gender as the child (Huston, 1983), as are the imaginary media friends of their lives (Richards & Calvert, 2016b). Rough and tumble play, which reflects the aggressive reality of young male culture, becomes the preferred mode of interaction for many boys, and playing with dolls is often enjoyed in the social world of girls (Huston, 1983). The imaginations of children flourish at this time in development (Singer & Singer, 2005), and how they express those fantasies reflects who they are.

By middle childhood, virtual characters are sometimes created based on prototypical children, as is the case of the virtual character, Alex (Cassell, 2016). Alex's body was made to appear neutral in terms of race and gender, reflecting perhaps, a perspective that emphasizes gender neutrality over a traditional gender-stereotyped worldview. Nevertheless, what Alex says and does is modeled after 8- to 10-year-old African American children, again making it clear that we have certain ways about us that fit our identity as we search for characters who are like us. Put another way, there is an element of truth, an element of authenticity, in who Alex is. He resonates with the ways that African American children talk to one another, and children like him. They talk to him, they laugh with him, and they learn from him. Unlike typical animation in children's television programs, Alex is not moving around the screen. Although movement about the speed of a walk is highly comprehensible for children (Calvert, Huston, Watkins, & Wright, 1982), it is more difficult to program than having a stationary character. The use of movement will come more often in the interactive technologies of our future as interfaces such as virtual reality become more common.

Beliefs in animism and anthropomorphism remain with us, even as our understanding of what is real and what is pretend becomes clearer (Waytz et al., 2013). We give virtual animals "human-like" personalities, such as Silas the virtual dog that gets thirsty and drinks (human-like needs; Richards & Calvert, 2016a), who likes to play ball (attachment and friendship; Richards & Calvert, 2016a), and who feels complex emotions like jealousy and sadness (character personification; Bond & Calvert, 2014a). Students who are exposed to artificial agents that display emotion and are responsive to children's emotions are more motivated and they learn more (Woolf et al., 2009), a finding that is consistent with our work on parasocial relationships (Calvert et al., 2014).

What of the robots that are increasingly part of children's lives? Interestingly, we treat them as if they are real, too. For instance, children who were ages 3–6 gave life-like qualities to robotic dogs more so than to traditional stuffed animals, expecting the robotic dog to respond contingently to them (Kahn, Friedman, Perez-Granados, & Freier, 2006). From ages 7 to 15, children think that robotic dogs can be their friends, providing social companionship (Melson et al., 2009). When a robot named Robovie told children from ages 9 to 16 that he was scared of the dark and did not want to be put in a closet, most children thought that it was not fair to put him there (Kahn et al., 2012). Similarly, adults who were shown a video of a robot who cried when he was tortured felt pity for the robot and anger towards his tormentor (Rosenthal-von der Putten, Kramer, Hoffmann, Sobieraj, & Eimler, 2013). Taken together, these findings suggest that animism continues to color our perceptions of nonliving entities, regardless of our age.

Faces, human-like movements, and contingent replies trigger perceptions of similarity by children and adults, increasing the likelihood that life-like qualities will be attributed to that entity (Waytz et al., 2013). Not surprisingly, we often make robots with a face that has eyes and ears, and bodies with arms and legs that move. Indeed, 3- and 4-year-old children's decisions about whether an object should have a name, which included a robot dog, depended on whether it had a face (Jipson & Gelman, 2007). When military robots are created with only the bottom half of a torso, attached to legs and feet that run through battlefields, they fall into the uncanny valley (Mori et al., 2012), potentially creating a sense of unease and creepiness because they lack a face. But a voice is human and can be personified without a body, as was done in the movie *Her*, in which a computer was but an intelligent voice, but became a voice that was conscious of herself and of her own unique identity.

The backstory is also essential in bringing a media character to life. Who are these characters? What are their relationships to others? What do they like to do? Are they like us? Can children play with them when they are young? What are their hopes and dreams? What are their challenges? Much of this information is transmitted in dialogue, but much is also communicated by how characters dress, speak, move, and relate to others. Their eyes are windows into making them look alive, and considerable time is spent getting animated characters' eyes to look right, down to their very blinks.

Finally, engaging characters must meet the developmental needs of the children that use them to become and to remain a part of their lives. For very young children, their needs involve succorance and attachments to those who can care for them when they need assistance. As they grow older, they seek playmates who entertain them and can be trusted.

Production features. The way that programs are presented to children also influences their engagement with the character and the program content. Production features of children's preschool television programs targeted at boys include rapid action, rapid pacing, loud music, and frequent sound effects to convey the content—features that reflect a traditionally bold masculine image (Huston et al., 1981). By contrast, the production features of girls' programs have dreamy dissolves, more dialogue, and soft music, conveying a stereotypical feminine world in which girls often live (Huston et al., 1981). Certainly there are exceptions to these rules of thumb, but they are exceptions to the highly gendered worlds of children, which is reflected, in part, by their own choice of favorite characters that are the same gender as the child viewer (Bond & Calvert, 2014b; Brunick & Calvert, 2016; Richards & Calvert, 2016a).

Educational techniques include reflective production features such as moderate levels of action at about the speed of a walk, long slow zooms that provide focus, and singing (Huston et al., 1981). When characters move at about the speed of a walk, they often provide dual visual and verbal modes to represent content that is particularly beneficial to young children (Calvert et al., 1982). Singing elicits an automatic rehearsal option for children as songs replay in our heads (Calvert & Tart, 1993), although recall is often more of a superficial verbatim memory of content rather than a deeper understanding of the material (Calvert, 2001). Moving in a way that represents the meaning of song lyrics, such as making downward motions of your hands to represent "washing the spider out" in the song the *Itsy Bitsy Spider*, however, can improve the memorability of the meaning of those lyrics (Calvert & Goodman, 1999). Characters also have a theme song that represents them and their program which provides an introduction, thematic integration at key points throughout the story, and which draws the action to a conclusion. The theme song of Dora the Explorer is one such example, and we used it to introduce our intelligent character math game (Calvert et al., 2016).

Visual production features such as long slow zooms supplant the cognitive skill of going from a part to a whole whereas a cut activates that cognitive skill; in the latter instance, the viewer has to perform that representational skill without a production feature to provide a scaffold to guide them (Salomon, 1972). Similarly, dissolves provide a slow way of transiting between major shifts in time and place whereas cuts, once again, activate cognitive skills and require viewers to fill in that gap (Calvert, 1988). Reflective features are ideal for younger audiences who need more scaffolds to aid their learning; by middle childhood, there is a shift to presentations that require more mental effort as they challenge the child to think (Salomon, 1972).

When playing video games, the player creates their own character (Calvert & Valkenburg, 2013). That character can be a visual icon that the player manipulates onscreen with some kind of joystick or player movement, with the player generally taking some role in creating an identity for their character (e.g., name, costume, physical attributes). Another option is for the player to be literally embedded within the point of view of the character, which is called a first-person perspective (O'Keefe & Zehnder, 2004). In both instances, the player has control over what their character does, which provides opportunities for the player to develop various cognitive skills.

Video game use, particularly with games that involve the production feature of action, has been linked to the cultivation of attentional skills, visual spatial skills, and iconic representational skills (Subrahmanyam & Greenfield, 2006). The development of these kinds of cognitive skills is a requirement of multitasking and provides a foundation for the development of STEM professions such as engineering.

In the attentional domain, college students who were expert video game players were better than novices at dividing their attention when objects were presented on a screen. Thus, these skills can be developed by playing action video games, and the attentional skills that were developed through video game play transfer to other contexts (Green & Bavalier, 2003; Greenfield, deWinstanley, Kilpatrick, & Kaye, 1994).

Spatial skills include mental rotation of objects, judging speeds and distances, and visualizing two-dimensional depictions in three-dimensional spaces (Subrahmanyam & Greenfield, 2006). Training visual spatial skills via a computer game improved 10- to 11-year-old children's skills at visualizing paths of objects in a game (Subrahmanyam & Greenfield, 1994); adolescents' and college students' mental rotation and visualization skills have also been linked to video game use (Greenfield, Brannon, & Lohr, 1994; Okagaki & Frensch, 1994).

Because most video games involve visual action, gaming also requires players to read the grammar of visual icons (Subrahmanyam & Greenfield, 2006). College students who had prior experiences with video games were more skilled at understanding iconic representations, and those who played the game on a computer represented their learning in visual, iconic forms more so that those who played the game on a board (Greenfield, Camaioni, et al., 1994).

More recent video games, called exergames, require players to engage in gross motor movement during game play (Staiano & Calvert, 2011). This kind of game play over a period of several months resulted in increased executive function skills, which involve cognitive skills such as planning, in a sample of low-income youth (Staiano, Abraham, & Calvert, 2012). Recent developments in gaming, such as *Pokémon Go*, require players to move through space in augmented reality to capture characters. These kinds of games also have the potential to influence players' cognitive skills by increasing their physical movement, and potentially, their skills to deploy attention and spatial skills to move to specific locations to capture Pokémon who are located in their environments.

CONCLUSIONS

In conclusion, to engage children—to be invited into their everyday worlds—is a necessity before one can teach children cognitive lessons. Media characters are a ubiquitous presence in children's lives with vast untapped potential to educate children in informal settings. To accomplish that goal, characters must meet the developmental needs of the children who use them to become and to remain a part of their lives. Those needs change over time, and can be addressed, in part, through emotional, parasocial relationships that children develop with their favorite media characters.

Children who pay attention to a character that conveys educational content, who come back for more from their favorite media friend, are ideally situated to move forward to master the scientific knowledge that they need to succeed in our 21st century educational and work environments. Gaming experiences provide numerous opportunities for the player to be the character, resulting in the development of cognitive skills that involve attentional deployment, visual spatial and iconic representations, and executive function skills.

At an applied level, education now takes place in informal as well as formal contexts, and much informal learning now occurs in front of a screen. As a culture we have not developed a smooth transition for our children between in-classroom and out-of-classroom learning at this point in time. Approaches that maximize the use of these informal contexts to teach young children STEM concepts have the potential for educational innovation. Media characters can become teachers' allies in sustaining interest and in teaching fundamental STEM concepts to young children, which will get them off to the right start when they formally enter school to maximize their ongoing scholastic success.

Close relationships with media characters also have implications for the creation of supplemental learning materials as young children may be more attentive to materials that feature media characters with whom they have a parasocial relationship than with materials that use generic characters. Just as children learn more from their favorite teachers at school, in part because they trust them (see Harris & Corriveau, 2011), children also learn better from their favorite onscreen media characters, but only if they are accurate and credible. Thus, teachers could utilize existing and also develop new parasocial relationships with specific media characters to get children to view STEM character-based programs in classroom or in out-of-classroom settings to supplement and strengthen their curriculum in ways that are exciting and engaging to children. As we apply our knowledge about parasocial relationships to create intelligent agents and robots to teach STEM concepts, we can also provide supplementary teaching assistance that can be used either in the school or in home settings to improve STEM learning.

The digital landscape, in which our children traverse real and imaginary worlds in the blink of an eye, is one that can benefit their development if we have the vision to look beyond what media characters are now and imagine what they can be in the future—as entities that do not exist, yet can teach and educate children, can be their trustworthy friends and companions, and can provide comfort and emotional support. Children's gift for imaginative thought makes this kind of reality possible.

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