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# Digital Games as a Context for Children's Cognitive Development: Research Recommendations and Policy Considerations

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## ABSTRACT

We document the need to examine digital game play and app use as a context for cognitive development, particularly during middle childhood. We highlight this developmental period as 6- through 12-year olds comprise a large swath of the preadult population that plays and uses these media forms. Surprisingly, this age range remains understudied with regard to the impact of their interactive media use as compared to young children and adolescents. This gap in knowledge about middle childhood may reflect strong and widely held concerns about the effects of digital games and apps before and after this period. These concerns include concurrent and subsequent influences of game use on very young children's and adolescents' cognitive and socioemotional functioning. We highlight here what is currently known about the impact of media on young children and adolescents and what is not known about this impact in middle childhood. We then offer recommendations for the types of research that developmental scientists can undertake to examine the efficacy of digital games within the rapidly changing media ecology in which children live. We conclude with a discussion of media policies that we believe can help children benefit from their media use. Our hope is that this review will foster greater investigation of the cognitive socialization, as raised over 20 years ago by developmental psychologist and early games researcher Patricia Greenfield, that digital games serve during the middle childhood period, and childhood more generally.

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## FROM THE EDITOR

It is nearly a cliché to say that today's children are living in a media saturated environment. We hear countless anecdotal reports of parents giving their toddlers iPads and smartphones to keep them engaged and amused. Nationally representative surveys conducted over the last several years have consistently shown us that children are surrounded by many digital products and begin engaging with them at very early ages. With this *Social Policy Report*, the authors—a group of renowned developmental psychologists from across the country, led by Fran Blumberg of Fordham University and Kirby Deater-Deckard of University of Massachusetts Amherst—provide a wide-ranging and comprehensive review of a very popular medium for children: digital games. Moreover, they address the critical question of how developmentalists can "play a role in closing the gap between research and the design of efficacious games for learning and the promotion of cognitive development." In short, this *Social Policy Report* addresses the current state of the research literature on digital games, reviews various levels of policy statements regarding gaming for children and adolescents, and points out ways in which so inclined developmentalists can conduct research that could impact game development. That is a tall order.

The authors provide overwhelming evidence that gaming is an important activity of childhood and adolescence. Not only is it popular for children and young adults, but gaming has become a popular *family* activity with two-thirds of parents reporting that they play games together with their children. Second, as noted by the authors, gaming has made its way into formal education settings with games like *Minecraft* being regularly used in an increasing number of American schools. As a younger generation of teachers enter the classroom, they are likely to have been gamers themselves and thus more accepting of gamification in learning than earlier generations of teachers. Third, by reviewing the empirical literature on the impact of gaming on children's cognitive development, the authors draw attention to the relative paucity of studies on middle childhood gamers compared to the impact on younger preschoolers and older adolescents. Indeed, the report challenges researchers to conduct more research on this middle childhood age group. Finally, the report examines "policy" in a wide-ranging discussion that includes the traditional sense of federal government regulations and policies such as the Children's Television Act and CAMRA, as well as policy recommendations from such groups as the American Academy of Pediatrics, whose members advise parents on parenting practices, including how they mediate their children's use of media and technology.

This *Social Policy Report* offers a blueprint for developmentalists interested in studying how gaming—an undeniably popular activity of childhood today—may be influencing children's cognitive development. Given the growing number of SRCD members and scholars who have begun to investigate the role of media in children's lives, as evidenced by the addition of a Technology, Media, & Child Development panel at the 2017 and 2019 Biennial meetings, this report is a welcome addition both to the literature on the role of media in children's development and to expanding our notion of where and how research might influence public policies that impact children's lives.

# Digital Games as a Context for Children's Cognitive Development: Research Recommendations and Policy Considerations

The strong appeal of digital game play via dedicated video game consoles, computers, and, increasingly, mobile devices, remains indisputable. For example, in their recent survey of the computer and video game industry, the Entertainment Software Association (2018) reported that 64% of the 4,000 US households they sampled contained at least one individual who played video games 3 or more hours per week. A little under 30% of these players were aged 18 and under. Digital game play is often a family affair, with about two-thirds of the parents surveyed indicating that they played video games with their children on a weekly basis and perceived the games as beneficial to their children (Entertainment Software Association, 2018).

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Despite their ubiquitous use, there is very little research on the beneficial or harmful aspects of video games for school-age children's cognition or learning.This situation has ramifications for policy recommendations concerning their use that are also based on sparse research, or on policies that were created for regulating television use. This situation has ramifications for policy recommendations concerning their use that are also based on sparse research, or on policies that were created for regulating television use.

Video game use begins early in development, and data from a nationally representative survey indicate that the amount of play increases until stable use patterns emerge during middle childhood and adolescence (Common Sense Media, 2017).This Common Sense Media (2017) survey of U.S. children aged 0–8 found that, on average, children used interactive games about 25 minutes a day, with very little use before age 2. Children aged 2–4 played games for about 21 minutes, and children aged 5–8 played for about 42 minutes. By comparison, an earlier Common Sense Media (2015) survey indicated that children aged 8–12 interacted with games via mobile and video games devices an average of 1 hour, 19 minutes per day, which was similar to the 1 hour, 21 minutes of daily video game use by 12- to 18-year olds. Dedicated gamers were predominantly boys (70%), with 27% of adolescent boys, and notably, 2% of adolescent girls, reporting video game play as their favorite activity (Common Sense Media, 2015). Digital media use is a diet that also varies in quality and quantity of exposure (Anderson & Hanson, 2009). For example, dedicated gamers, who tend to be male, may be particularly attracted to learning via digital games. Focusing on the quality of the gaming experience further provides a window of opportunity for educational innovation. One groundbreaking school in New York City, Quest2Learn, has developed a curriculum grounded in digital game play and design. Although the field awaits definitive empirical evidence for the efficacy of these kinds of approaches as reflected in students' academic gains, the local policy trend is clear for integrating educational games such as *Minecraft* into schools (see Lane & Yi, 2017, for a review of *Minecraft* use in the classroom).

In a survey administered in 2013 to a nationally representative sample of K-8 teachers, 74% of teachers reported using digital games for instruction, with 80% of those teachers indicating that they primarily used educational games and apps (Takeuchi & Vaala, 2014). More recent research points to a broad range of technology and digital game used by teachers that may be influenced by their comfort with technology and the resources available to the schools in which they are based. For instance, in a 2016 survey of about 700 K-12 teachers in the U.S. (Education Week Research Center, 2016), 40% reported high to very high confidence in digital technology use in their teaching, whereas 60% reported low to very low confidence. Teachers with low confidence in digital technology use were more likely to be located in under-resourced urban districts, spent half as much instructional time using digital technology, and were far less likely to view their students as being adept with technology. As school districts continue to make policy decisions to integrate school curriculum with games and apps (albeit often without resources to support teacher training on how to use these tools in classrooms), developmental psychologists can serve as a useful resource for insuring that these policy choices are informed by research. This research should entail examination of developmentally appropriate scaffolds for digital game use in K-12 classrooms that inform pedagogical practice and training.

Interest in the ramifications of game play for learning extends beyond schools. Specifically, federal government agencies such as the National Science Foundation (NSF) and the Institute of Education Sciences (IES) continue to fund technology, app, and game development to foster students' development of academic skills at the precollege level. This funding commitment to examine educational game play and academic attainment is currently reflected in NSF's "Advancing Informal STEM Learning" (AISL, program solicitation NSF 17-573) program, which is receiving applications for new projects through 2019, with an intended funding allocation of $33M to $44M. What has emerged in industry and education, at the broadest level of societal and economic priorities, is an emphasis on young people attaining tech-savvy skills—a trend that will continue to grow (Council on Foreign Relations Independent Task Force, 2018).

Increased screen time in school is augmented by children's and adolescents' greater access to apps and digital games at home. Notably, in their policy statement on school-aged children and media, the American Academy of Pediatrics Council on Communications and Media (2016a,b) highlighted the need for research examining digital media use among school-aged children to better delineate the positive and negative effects of that use over time (Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016). Such research may also inform the development of policies and programs to help children across all income levels access the types of games and apps that could contribute to their academic success throughout primary and secondary school (see Common Sense Media, 2017).

In this *Social Policy Report*, we document the need to examine digital game play as a context for cognitive development particularly during middle childhood to inform policy decisions at the local, state, and national level. We highlight this developmental period because children aged 6–12 years comprise a large number of the preadult population that plays and uses these media forms (see Common Sense Media, 2015), yet remain

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understudied with regard to the impact of their media consumption when compared to infants, toddlers, preschoolers, and adolescents (see Anderson & Subrahmanyam, 2017; Hirsh-Pasek et al., 2015). This gap in knowledge about middle childhood may reflect strong and widely held concerns about the effects of digital games and apps before and after middle childhood. These concerns include concurrent and subsequent influences of game use on very young children's and adolescents' cognitive and socioemotional functioning.

The ideas that we present here reflect consultation of current research and technological innovations that children and adolescents can now access. Many of the ideas also reflect the culmination of discussions among an international group of researchers and practitioners in cognitive and developmental sciences, communications, educational technology, and game design.[1] These discussions took place virtually and in person during 2015–2017, supported by a strategic planning grant from the Society for Research in Child Development awarded to the first two authors. A shared interest among group members was how best to examine the learning and skills development that ensued during middle childhood, as impacted by a rapidly changing digital game play market.

Our report is organized in three levels. In Level 1, we share highlights of the fairly extensive body of literature that has addressed media effects on cognitive development among young children and adolescents. This body of work has far outpaced the literature devoted to these effects during middle childhood, which we also highlight in this level. In Level 2, we offer recommendations for the contributions to policy and game design that developmental scientists can undertake to promote efficacious digital games within the rapidly changing media ecology in which children live (see Kirkorian, 2018) and policies concerning their use. In Level 3, we discuss what we can learn from previous and extant media policies to inform new initiatives concerning how interactive media impacts cognitive development.

## Level 1: The Impact of Media on Cognitive Development

Much of what is known about the impact of media on children's development is drawn from decades of research on television consumption and viewing behaviors. Two major points emerge from this research. First, effects depend on the content of the programming. For instance, while preschool educational television viewing has long-term positive associations with academic achievement in English, math, and science (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001; Fisch, Lesh, Motoki, Crespo, & Melfi, 2014), exposure to violent or even solely entertaining television has been shown to be negatively associated with cognitive development (Kirkorian, Wartella, & Anderson, 2008). Second, although television may appear to be a solitary activity, parenting moderates the effects of television viewing. Specifically, parents affect their children's television viewing by guiding content choices, and through co-viewing behaviors (see Uhls & Robb, 2017, for a review). For example, high-quality parent–child interactions during television viewing, including the use of dialogic questioning

and praise, augment the degree to which young children engage with and learn from educational television programs (Anderson & Pempek, 2005; Strouse, O'Doherty, & Troseth, 2013). Indeed, the American Academy of Pediatrics (2016a,b) incorporated this research into its policy recommendations, encouraging co-viewing.

As found in the television research, the quality of content and narrative features of digital games matters with respect to the potential positive effects of game play on learning outcomes (Clark, Tanner-Smith, & Killingsworth, 2016; Fisch et al., 2014). The specific aspects of the digital media that are most likely to affect learning outcomes are those that elicit and maintain the child's attentional and motivational engagement (Ronimus, Kujala, Tolvanen, & Lyytinen, 2014). Also, parent–child co-play varies widely between families (just like co-viewing of television programming), and this variation intersects in predictable ways with broader patterns of parent–child closeness, communication, and parental involvement in child learning (Wang, Taylor, & Sun, 2018). Notably, many parents are unsure of best practice to support their children's learning during co-play interactions, which could be remedied via research-based guidelines on how to do so (Flynn & Richert, 2015; Ho, Lee, Wood, Kassies, & Heinbuck, 2018).

## Media Use Among Young Children

The majority of the established research on the effects of interactive digital media on infants, toddlers, and preschoolers has focused on games and apps designed to strengthen preliteracy and literacy skills (e.g., Dore et al., 2018; Kirkorian & Choi, 2017). However, researchers have shown increasing interest in examining children's development of STEM (science, technology, engineering, and mathematics) skills in the context of app play. For example, Pila, Aladé, Sheehan, Lauricella, and Wartella (2019) examined preschoolers' ability to learn coding skills (e.g., sequencing, conditioning, and loops) via two developmentally appropriate apps. Findings showed that after regular practice with the apps over the course of a week, children showed improvement in specific commands used within the game albeit not in their ability to articulate what coding entailed. Griffith, Arnold, and colleagues also recently examined the efficacy of educational apps designed to promote literacy and mathematics skills. Their randomized controlled trial demonstrated that using high-quality educational app games, as operationalized by Common Sense Media ratings, fostered substantial emerging literacy and math skill gains, compared to the use of noneducational apps among preschoolers (Griffith, Hanson, Rolon-Arroyo, & Arnold, 2018). Griffith and Arnold (in press) also have recently shown that the quality of parenting behaviors during educational app use predicted children's engagement and affect while interacting with the apps. For example, parental warmth, engagement, playfulness, and autonomy support all predicted more positive child affect during joint interactions with the literacy and math educational game apps. The findings here suggest that the quality of the content to which young children are exposed is as important to their learning via app use as are their parents' involvement with their children while they play. Thus, policies that include and support parents' co-play may optimize the benefits of games and apps to which children of all ages now have access. In fact, as noted above, findings from the most recent survey of the digital game play industry do show that parents play interactive games with their children (Entertainment Software Association, 2018).

Recent findings indicate that parents also may be instrumental, particularly during early childhood, in fostering children's relationships with media characters that may

affect what children will learn from these characters (Richards & Calvert, 2016). These "parasocial" relationships refer to children's emotionally tinged relationship with a character (Horton & Wohl, 1956). Parents may encourage these relationships by exposing their children to a given character across different media platforms, via toy play (which could potentially include video game use), and through parasocial interactions, i.e., socially contingent interactions between the child and the character (Bond & Calvert, 2014).

Calvert et al. (2018) have recently shown how parasocial relationships may facilitate learning in the context of digital game and app play. Specifically, these researchers created an intelligent character prototype who was integrated into an educational game to teach preschool-aged children the add-one rule (i.e., that adding one to a number increases the sum by a single unit, e.g., 2 plus 1 is 3; see Baroody, Eiland, Purpura, & Reid, 2012). The prototype was based on Dora the Explorer, a popular transmedia character. In the prototype, the character responded contingently (i.e., through parasocial interactions) to what children said via a person hidden behind a screen, known as the game Wizard. Scaffolds were embedded in the game to assist children who had difficulties with the add-one problems. Children who had closer emotional ties, i.e., parasocial relationships, to the intelligent character learned the add-one rule better than those who had weaker emotional ties to her. Parasocial interaction that involved on-task math replies also improved math learning, whereas off-task replies to small talk distracted them from learning. Character presence and socially contingent replies by the character were also linked to better transfer of the add-one rule from the two-dimensional game to a three-dimensional math task.

The emerging research on parasocial relationships and children's early STEM learning indicates that certain characters can serve as effective social partners (see Richert, Robb, & Smith, 2011) and a potential resource of trusted "teachers" that traverse home and school settings (see Brunick, Putnam, McGarry, Richards, & Calvert, 2016), and different media platforms (Richards & Calvert, 2016). At present, these kinds of emotional relationships with media characters, including those found in interactive games, have untapped potential as sources of learning for children during early through middle childhood.

## Media Use During Adolescence

Studies that focus on adolescents frequently address the social ramifications of adolescents' interactions with digital media such as social media (see Sherman, Payton, Hernandez, Greenfield, & Dapretto, 2016), and the Internet more generally. Much of this work has concerned the negative effects of media exposure, particularly violent video game use, on aggressive cognition, behaviors, and affect, and on reduced prosocial behavior resulting from exposure to violent content (see Calvert et al., 2017; Gentile, Lynch, Linder, & Walsh, 2004; Weber, Ritterfeld, & Kostygina, 2006). Although the effect sizes in the literature relating violent video game play with aggressive outcomes are similar across several meta-analyses, the interpretations of these effect sizes have been a source of considerable controversy (see Calvert et al., 2017).

Few researchers have highlighted the positive benefits of digital media exposure among adolescents, such as its role in promoting new and sustaining older friendships

(Anderson & Jiang, 2018; Pempek, Yermolayeva, & Calvert, 2008), and strengthening relationships with current friends (Madden, Cortesi, Gasser, Lenhart, & Duggan, 2012; Pempek et al., 2008). Findings within the literature on social media use also show that adolescents use media to regulate their emotions in general and their concurrent mood in particular (see Blumberg, Rice, & Dickmeis, 2016, for a review).

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A substantial body of literature, mostly involving studies of young adults, has demonstrated that playing certain types of cognitively demanding video games can produce broad enhancements in perceptual, motor, and cognitive skills (Bediou et al., 2018; Powers, Brooks, Aldrich, Palladino, & Alfieri, 2013; but see Sala, Tatlidil, & Gobet, 2018). Studies of adolescents are fewer in number and have relied more heavily on correlational designs (Dye & Bavelier, 2010; Dye, Green, & Bavelier, 2009; Trick, Jaspers-Fayer, & Sethi, 2005). Notably, the enhancements in perceptual (e.g., contrast sensitivity) and cognitive (e.g., ability to track several moving objects simultaneously, shortened attentional blink) skills do not appear to be limited to "in-game abilities" (e.g., reaction time and processing speed in motor responses during game play; see Dye & Bavelier, 2010; Green & Bavelier, 2003; Li, Polat, Makous, & Bavelier, 2009), but show far transfer by generalizing to nongame assessments of processing abilities and even to real-world behaviors such as reading (Franceschini et al., 2013). With regard to spatial skills, training studies using the video game *Tetris* indicate benefits that persist over time for mental rotation and a range of other spatial tasks (Terlecki, Newcombe, & Little, 2008; Uttal et al., 2013). Other studies involving texting apps indicate benefits of engagement in texting for adolescents' literacy development (see Wood & Johnson, 2017, for a review). These kinds of findings have helped to quell long-standing societal concerns that digital media use in game play, texting, and social media posting yields only negative effects on adolescents' (and media users' overall), psychological and cognitive functioning, and well-being.

## Media Use During Middle Childhood

Investigation of developmental milestones as affected by digital media is less apparent in the research targeting the middle childhood period. Specifically, during this period, children's interactions with digital media are largely investigated with regard to their acquisition of content knowledge and general skills. These learning objectives are frequently based in activities that entail designing or playing digital games or engaging with simulations based in formal school settings, and to some extent, informal educational settings such as museums (see Allsop, 2016; Crowley, Pierroux, & Knutson, 2014; Evans, Norton, Chang, Deater-Deckard, & Balci, 2013; Kafai & Burke, 2015; Kafai, Quintero, & Feldon, 2010; Ketelhut, Nelson, Clarke, & Dede, 2010). Although few studies have focused specifically on middle childhood, a meta-analysis of studies involving K-16 students documented benefits of digital games for learning when compared to nongame conditions (Clark et al., 2016).

This work, which ostensibly had been advanced by national interests in promoting STEM learning (see MacArthur Foundation, 2012), has also emphasized indirect learning

outcomes such as students' attitudes toward the learning of STEM content and the digital medium in which the content is based, rather than more direct outcomes such as academic achievement. Not surprisingly, this body of work is infrequently found within the developmental psychology journals and seldom focused on how digital media exposure may impact cognitive development.

The period of middle childhood, as that of early childhood and adolescence, is one marked by cognitive enhancements. These enhancements include (but are not limited to) increasing sophistication in metamemory (see Schneider & Ornstein, 2015), the types of strategies used to recall content (Bjorklund, Dukes, & Brown, 2009), selective attention to that content (Miller & Seier, 1994), spatial and mathematical reasoning (Gilligan, Flouri, & Farran, 2017), reading fluency and comprehension (Hasbrouck & Tindal, 2006), argumentation (Papathomas & Kuhn, 2017), theory of mind (Weimer, Parault Dowds, Fabricius, Schwanenflugel, & Suh, 2017), and related executive functions (Best & Miller, 2010) such as working memory (Lecce, Bianco, Devine, & Hughes, 2017) and cognitive flexibility (Dick, 2014).

The dearth of research addressing the impact of media on these cognitive processes and abilities during middle childhood remains fairly noticeable within the literature concerning digital game use (Blumberg, Altschuler, Almonte, & Mileaf, 2013). Indeed, in two meta-analyses examining the impact of commercial video game use on information processing (i.e., visual and auditory processing, spatial imagery, executive functioning, and motor skills), only a small percentage of the available studies included youth, defined as a group with a mean age of 3–17 years (Bediou et al., 2018; Powers et al., 2013).

Among the few studies that have examined the ramifications of digital game play for cognitive development during middle childhood or adolescence (see Blumberg & Fisch, 2013; Calvert, 2015), findings have shown enhanced executive functioning (Best, 2012; Flynn & Richert, 2018; Flynn, Richert, Staiano, Wartella, & Calvert, 2014; Staiano, Abraham, & Calvert, 2012), metacognition (VanDeventer & White, 2002), mental rotation skills (De Lisi & Wolford, 2002; Quaiser-Pohl, Geiser, & Lehmann, 2006), basic mathematical understanding (Deater-Deckard, El Mallah, Chang, Evans, & Norton, 2014; Fisch, Lesh, Motoki, Crespo, & Melfi, 2011), and problem-solving ability more generally (Blumberg & Randall, 2013; Greenfield et al., 1994). Further, it is increasingly recognized that games may enhance some of the core cognitive abilities, such as selective attention, that underlie the ability to acquire academic content or skills (Franceschini et al., 2017)—a process that has been dubbed "learning to learn" (Bavelier, Green, Pouget, & Schrater, 2012). Serious educational games, in particular, have been shown to facilitate children's engagement in academic content in most subject areas and to promote transfer of content learned within the game to more academic tasks (Papanastasiou, Drigas, & Skianis, 2017; Pierce & Cleary, 2016). Serious educational games or serious games more generally may be characterized as those that are designed to educate, train, or persuade

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its players (see Blumberg, Almonte, Anthony, & Hashimoto, 2012); the latter of which we return to below when considering advergames.

Much of the early work examining the effects of video game play on children's cognitive development, specifically with regard to the development of spatial ability, has links to the 1994 volume (15) of the *Journal of Applied Developmental Psychology*. In one seminal study within this volume, Subrahmanyam and Greenfield (1994) showed improved spatial skills performance among fifth graders who played a game emphasizing these skills (*Marble Madness*) relative to their counterparts who played a game emphasizing vocabulary skills. Improved spatial skills were particularly pronounced among those children who showed relatively weak skills before playing *Marble Madness*. In another study within this volume, Okagaki and Frensch (1994) found that experience playing *Tetris*, which highlights two-dimensional mental rotation and spatial visualization, improved performance on tasks assessing these skills among late adolescents. De Lisi and Wolford (2002) later confirmed these findings among third graders. Specifically, they found that those who also played repeated sessions of *Tetris* showed significantly improved scores on a mental rotation skills task when compared to their peers who had played repeated sessions of *Where in the USA Is Carmen Sandiego?*, a game that emphasizes social studies and geography content.

VanDeventer and White (2002) also demonstrated how game experience was linked to more general problem-solving skills, particularly metacognition (see also Ricker & Richert, 2017). Ten- and 11-year-old game players who were deemed either highly or less highly skilled in video game play, were asked to teach "novice" or inexperienced adults how to play *Super Mario Kart* and *Super Mario World*. During their instruction, highly skilled children were more likely than their less skilled counterparts to show evidence of planning and awareness of how to avoid obstacles and to advance in the game. Fisch et al. (2011, 2014) later found that third and fourth graders who used educational media (including games) that engaged their mathematical reasoning and problem-solving demonstrated better performance in their use of mathematical problem-solving strategies in offline problem-solving tasks. Further, over the course of the games themselves, children employed increasingly sophisticated skills and strategies as task demands became more challenging at higher levels of the games. Similarly, Blumberg and Randall (2013) reported changes in fifth-to-seventh graders' problem-solving strategies over the course of playing a recreational level-up game for 20 minutes. Notably, fifth-grade boys, as reflected in their think-aloud comments about the game while playing, made greater references to impasses over time, whereas fifth-grade girls made greater references to game strategies and goals for enacting specific moves. All seventh graders, however, made greater references to their specific behaviors and progress in the game over time, thus demonstrating greater emphasis on their play-by-play actions.

A relatively recent body of work has attested to the beneficial effects of "exergame" play (i.e., games that involve exercise and other forms of physical activity) on children and adolescents' executive functions (EF) after a short play session (Best, 2012; Flynn & Richert, 2018) and over time (Staiano et al., 2012). In a correlational study, Flynn et al. (2014) found that individual difference factors were related to changes in EF, whereby higher levels of exergame performance were associated with greater changes in EF.

By comparison, higher levels of reported boredom and frustration were related to smaller changes in EF. In a 10-week intervention study, Staiano et al. (2012) found that competitive exergame play led to greater improvements in EF skills when compared to cooperative game play and a no game exposure control group.

The research on exergame play and EF also suggests that the cognitive aspects of digital game play, such as selectively attending to certain game features while inhibiting others, may be important in fostering changes in EF. Although researchers have demonstrated that physical activity can boost EF (Best, 2010), a review by Diamond and Liang (2015) suggested that the cognitive component of aerobic activity was the mechanism of change, rather than exercise exclusively. (A similar conclusion regarding the key role of aerobic activity has been offered regarding exercise and cognitive benefits in old age; Kramer & Colcombe, 2018). Flynn and Richert (2018) tested this hypothesis by manipulating the level of physical activity and cognitive engagement over four conditions: exergame play, sedentary video game play, exercise, and a nonplaying control. They found that 7- to 12-year-old children in the two video game conditions showed improvements in EF more so than those in the other two conditions. Because children had played the same video game in both the active and sedentary conditions, the authors concluded that the cognitive engagement during video game play may have benefited EF. Whether gains in EF are demonstrated among different types of video games warrants further examination.

Efforts also have been underway to examine the positive impact of game-like training paradigms (not involving exercise) designed to enhance executive function (EF) skills (Au et al., 2015), particularly among adult participants. Much of the current research focusing on middle childhood has concerned children in need of EF training, with computer-based training often aimed at improving working memory and sustained attention (e.g., Klingberg et al., 2005; Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005). Brain training games, such as *CogMed* and *Braingame Brian*, train cognition using traditional assessments of cognition, and include elements similar to video games. For example, the video game avatar may explore a virtual world gaining points or powers by completing a working memory task (see Prins et al., 2013, for a description of *Braingame Brian*). To date, researchers have examined whether these games can improve EF for children with Attention Deficit Hyperactivity Disorder, Autism Spectrum Disorders, and Specific Language Impairment. Findings have demonstrated potential beneficial effects; however, meta-analyses have shown mixed results in improving cognitive performance (Rapport, Orban, Kofler, & Friedman, 2013; Robinson, Kaizar, Catroppa, Godfrey, & Yeates, 2014). For example, Rapport et al. found no effect for training on EF yet did find an effect of training working memory ($d = 0.63$) on its improvement.

The efficacy of gaming to promote EF skills among learners of all ages warrants consistent replication, particularly with regard to "far transfer" (Diamond & Liang, 2015; Melby-Lervag & Hulme, 2013) before widespread adoption of game play as an intervention for cognitive skills should be urged. Far transfer refers to learning in a given context that facilitates one's learning or ability to carry out a task in a new context as compared to near transfer in which learning in a given context facilitates one's learning in a similar context (see Barnett, 2014, for a treatment of transfer within video games). Further, myriad important questions remain unanswered including whether certain

individual differences mediate the effectiveness of such training (Jaeggi, Buschkuehl, Jonides, & Shah, 2011) and how to best "gamify" training to produce positive outcomes (Katz, Jaeggi, Buschkuehl, Stegman, & Shah, 2014).

The mechanics of children's digital game play via mouse-driven point and click interfaces and touchscreens also warrants greater investigation for its impact on cognitive development during the middle childhood. Such investigation is not new, particularly with regard to the ease of making a response using a mouse or initiating direct movements on a touchscreen (see Revelle, 2013). However, researchers such as Erb and Marcovitch (Erb, 2018; Erb & Marcovitch, 2018) have recently highlighted how manual dynamics such as mouse-tracking and reach-tracking (i.e., using one's fingers to reach from one position on a touchscreen to another) can be used by children to examine their cognitive control and its underlying processes in the context of digitally administered tasks. Examination of these dynamics is warranted as the amount of experience a child has with certain types of media might influence the way they perform on a cognitive task. Therefore, video game play using certain mediums (i.e., touch screens, mouse, controller) may be training the mechanics needed for high performance on cognitive tasks.

Embedding opportunities to assess the mechanical skills of mouse- and reach-tracking (i.e., via reaction time to complete a move or the spatial trajectory of a given move) within game and app log data, provides a vehicle for examining cognitive development among middle childhood media users in the digital age. More broadly, digital games elicit short bursts and longer sustained application of what have been referred to as "engagement states" (Deater-Deckard, Chang, & Evans, 2013). This area is a potential research target as children's engagement with the game and its content spans behavioral, affective, and cognitive dimensions, such as individual differences in attention, memory, motor speed and control, persistence, and positive and negative affect (approach/avoidance).

## Level 2: How Might Developmental Psychologists Contribute to Policy Development Concerning Digital Games and Apps?

Developmentalists can make strong contributions to research and policy pertaining to the design of games and apps given their understanding of cognitive milestones that contribute to learning. Accordingly, we encourage developmentalists to take into account the "big picture" of how to apply methods from digital games research across a wide range of questions about cognitive development and learning. This effort should be conducted in ways that directly inform policy and practice around digital game and technology use with school-age populations. This consideration entails evaluating innovations in research and application that are made possible through the use of digital gaming platforms (e.g., "real time" stealth assessment and dense multi-indicator data that are collected in the background during game play; observation of behavior in augmented/virtual reality contexts; cf. Bailey & Bailenson, 2017). In this section, we address key areas to

Developmentalists can make strong contributions to research and policy pertaining to the design of games and apps given their understanding of cognitive milestones that contribute to learning.

which developmental scientists can impact policy development and potentially close the gap between research and the design of efficacious games for learning and the promotion of cognitive development.

## Media Literacy

Media literacy has been generally defined as the ability to "access, analyze, evaluate, and create messages" (Livingstone, 2004, p. 3). The impact of media literacy instruction during middle childhood, and adolescence (see Powers, Brodsky, Blumberg, & Brooks, 2018), should remain a priority for future research, particularly among developmental psychologists, and for policy recommendations at all levels (Bjørgen & Erstad, 2015; Disney, Connelly, & Waterhouse, 2017). This need will become increasingly pressing, as access to media for instructional and recreational purposes continues to expand, and the lines between games and apps designed to educate and persuade are further blurred. One enticing form in which persuasive messages for products such as unhealthy foods and snacks, may be embedded is via "advergames" (see Calvert, 2008). These games have been construed as branded entertainment that highlight a given product's logo and trademark in the context of an interactive, digital game (Mallinckrodt & Mizerski, 2007). Because these games have been seen as exposing potentially vulnerable populations to unwanted content, advergames have captured the concern of watchdog groups and regulatory organizations such as the Advertising Standards Authority (United Kingdom) and the Federal Trade and Communications Commissions (United States). A recent meta-analysis showed a modest-to-moderate effect of dietary advergames on unhealthy eating behavior among children and teens (Folkvord & Van't Riet, 2018). Presently, insufficient research has been done to determine whether the effect weakens with advances in cognitive development across childhood. This area is ripe for inquiry by cognitive developmentalists who could strive to test competing theories of how embedded advertising operates at different developmental stages (e.g., effects of mood and persuasion knowledge; Van Reijmersdal, Lammers, Rozendaal, & Buijzen, 2015). Such work would inform regulations and broader policies that might reduce the deleterious effects of exposure. Further, these policies may include those promoting advertising literacy (which entails understanding the persuasive intent of advertisements) and media literacy more generally.

The need for educational policy and curriculum stressing media literacy within US schools has long been advocated by the Center for Media Literacy (www.medialit.org) and the National Association for Media Literacy Education (www.namle.net). To date, media literacy education, when included in classrooms, has tended toward either a prescriptive/protectionist stance that emphasizes being wary of deception, misinformation, or fake news propagated via media such as advertisements, social networks, or vlogs, or an empowerment stance that emphasizes opportunities for global citizenship and creativity as allowed via media forms such as certain YouTube videos and serious games (Hobbs & Jensen, 2009).

Definitive media literacy standards are not specified in the Common Core State Standards (CCSS). However, organizations dedicated to promoting media literacy education in schools, such as the Center for Media Literacy and the National Association for Media Literacy Education, have contended that connections may be made between the CCSS goals in English Language Arts (ELA) or history, for

example, and media literacy education (Moore & Bonilla, 2014). This linkage is not unusual, as media literacy has long been included as part of ELA classes (see Hobbs & Frost, 2003).

Thus far, at least 22 states have adopted their own media literacy standards (The Center on Standards and Assessment Implementation, 2017), in the absence of national standards, that are largely based on the 2007 version of the standards from the International Society for Technology in Education (ISTE, 2007). These standards focus on creativity and innovation, communication and collaboration, research and information fluency, digital citizenship, technology operations and concepts, critical thinking, problem-solving, and decision making.

However, both the standards for media literacy education and the student outcomes to be attained through their implementation vary widely by state. This situation compromises the making of definitive statements about the media literacy skills students are acquiring and the sophistication of those skills. A further issue concerns whether the media literacy skills that are shared in the school setting are reinforced or potentially undermined by caregivers. Developmental psychologists could examine this question in collaboration with media literacy educators. Such collaborations could contribute to policymakers' ability to make informed decisions about how best to implement developmentally appropriate media literacy instruction in academic curricula nationwide, and to help parents and guardians learn about best ways to introduce media literacy practices at home.

## Transfer of Learning

One highly salient concern for researchers and game developers is whether a given game or app requires players to use the knowledge and skills for which it was designed to promote (Fisch, 2016). This concern pertains to the larger issue of transfer of learning as noted above, whereby far transfer remains more elusive than near transfer (see Barnett, 2014; Blumberg, Almonte, Barkhardori, & Leno, 2014; Masson, Bub, & Lalonde, 2011; Powers & Brooks, 2014). Thus, a game or app designated as educational may warrant further consideration from a policy and research standpoint. For example, the designation of an app as "educational" is largely unregulated, unmonitored, and rarely based on evidence-based research to confirm the educational objectives purported by the app developers (Hirsh-Pasek et al., 2015). The nonprofit organization Common Sense Media provides a platform for expert review and parent/child rating systems of apps, including a five star educational rating. However, parents and educators need to be motivated to consult this website as the information shared about a given app is not linked with the app store or designers.

A related issue is whether playing educational games and educational apps actually initiates transfer of the content and skills that they are designed to impart (Lamb, Annetta, Firestone, & Etopio, 2018) rather than serving as a vehicle for executing a given game mechanic (i.e., slicing zombies in thirds to illustrate fractions). This consideration has ramifications for how teachers and parents evaluate and select educational apps for instructional use (Lee & Kim, 2015). Links between social-emotional development during middle childhood and cognitive outcomes, particularly in relation to children's parasocial relationships with characters and

particularly during interactive game use, is another promising and unexplored venue for transferring information from 2D to 3D contexts.

Our recommendation is that policymakers create research initiatives to investigate how children learn best from digital media. These initiatives should take into account the nexus of cognitive development during middle childhood and game/app design features and user experience (see Hodent, 2017) drawing on guidelines for how learning occurs in the context of digital games (Hirsh-Pasek et al., 2015). Further, much can be learned about how to approach widespread adoption and regulation of educational ratings from the Entertainment Software Rating Board (ESRB), a nonprofit self-regulatory organization for video game developers and publishers. Since 1994, the ESRB has provided content and age-appropriate ratings for video games and apps that are bought in stores or downloaded from the Internet. The video game industry has since adopted these ratings and discloses them before games are released. The ESRB reviews the packaging or works with developers in the online app stores to ensure ratings are properly and prominently displayed. Content disclosure violations are dealt with by removing the app from the app store or fining or recalling the video game from the store. Greater examination of the basis on which games and apps come to be rated as educational is warranted, particularly among those interested in children's cognitive development.

Our recommendation is that policymakers create research initiatives to investigate how children learn best from digital media. These initiatives should take into account the nexus of cognitive development during middle childhood and game/app design features.

## Gamification of Education

Hurdles also remain in incorporating educational games consistently into school curricula across the United States, as not all schools have the requisite access to digital media and technology (e.g., devices, high-speed Internet). Further, teachers may feel unsupported by their schools in terms of training for use of games and other digital tools in their classrooms (Blackwell, Lauricella, & Wartella, 2016; US Department of Education, 2017). This situation has been reportedly exacerbated in high-poverty schools (see Herold, 2017). Further, there has long been tension between the need to teach the skills that underlie the ability to acquire academic content versus teaching the content itself (e.g., Binet, 1909; Prawat, 1992). Thus, collaboration between developmental psychologists and educators is warranted to examine and identify best practices for developmentally appropriate instruction when using games as educational tools. Such efforts are likely to inform extant policy at the state level.

For example, according to the Every Student Succeeds Act of 2015 (ESSA), states must give students access to technology and use evidence-based methods of incorporating technology into curricula and instruction (and train teachers how to do so effectively) to improve academic success and digital literacy. Digital games are not directly addressed in the ESSA. However, some states include digital games in their curriculum policies. For example, the New Jersey Curriculum Core Content Standards indicate that preschool children should collaborate using digital games with classmates and that high school–

age students should be creating digital games and tutorials (State of New Jersey Department of Education, 2014).

Digital games are also addressed in school district curricula in New Jersey. For instance, the School District of the Chathams, in Chatham, New Jersey, includes digital games in their Design and Technology curricula from kindergarten through high school (School District of the Chathams, n.d.).

## Capitalizing on Game Data Analytics

Learning analytics and educational data mining have emerged rapidly over the past decade, to optimize the use of the myriad digital data generated through education technologies in an era of frequent assessments in schools. Analytics involves application of computational techniques (often with massive datasets) to detect patterns in digitized data at the individual, group/classroom/grade, school, or broader level. These techniques can lead to, for example, improvements in the prediction of future scholastic success, more accurate visualizations of learning outcomes for individuals and groups, more detailed information about ways to individualize learning materials for each student, and improved measurement of potential causal effects of specific features of educational content and pedagogy. This effort can be seen in the work of Roberts, Chung, and Parks (2016) that used data analytics in the context of an educational game to provide parents with feedback on their children's progress. Best usage of data analytics within schools and how to train teachers to insure best usage seems an area ripe for further developmental investigation in preparation for future educational policy recommendations.

## Level 3: What Policies Do We Need for Structuring Media Use During Childhood?

Corresponding to the lack of current research on the impact of media on cognitive development in middle childhood is the lack of national policies regulating or guiding interactive media use for children during this period. However, we do have evidence of policies regarding media in general, notably for television, that have been implemented with varying success but may guide collaborations between developmental scientists and policymakers about future media use policy (Wartella, Caplovitz & Lee, 2004). These include federal and state government policies, and efforts initiated through self-regulatory agencies, scientific statements by professional organizations, school districts, and teachers, and parental mediation of children's media use (Blackwell et al., 2016; Calvert et al., 2017; Gentile, 2018; Király et al., 2018). We present several national-level policies that have been implemented for television that may have ramifications for the development of policies for the educational game and digital app industry.

One example is the Children's Television Act (CTA), a federal government policy that is implemented by the FCC and requires commercial broadcasters to include educational and informational (E/I) programming for children as part of their public obligation requirement (Kunkel, 2003). After implementation, the programs created to meet that requirement have varied considerably in their quality, with low-quality E/I programs accounting for roughly 20–25% of programs from 1995 to 2000 (Jordan, 1996, 2000; Jordan, Schmitt, & Woodard, 2002; Jordan & Woodard, 1997, 1998; Schmitt, 1999). The broad definition of "educational" was one reason for these problems, as E/I programs were defined as any program that "furthers the positive development of the child in

any respect," including cognitive, intellectual, social, and emotional needs (FCC, 1991, p. 2114). Because of ongoing problems in the quality of E/I programming, the FCC introduced the 3-hour rule in 1997, which required broadcasters to provide a minimum of 3 hours of educational and informational programs per week with core educational programming airing between 7 a.m. and 10 p.m., scheduled on a weekly basis, and lasting a minimum of 30 minutes (FCC, 1996). An examination of children's learning from educational programs, including those designated by commercial broadcasters as E/I programs, revealed that second- to sixth-grade children preferred programs with social-emotional themes and learned social-emotional content after viewing those programs; children who viewed television programs with an academic focus also learned academic content (Calvert & Kotler, 2003). Taken together, the results suggest that E/I television programs can result in children learning both academic and prosocial lessons, albeit those outcomes depend on children's access to high-quality programs that are sufficiently engaging so that they will choose to view them. With regard to more recent interactive media forms, digital games and digital apps may be far more difficult to monitor or regulate in terms of E/I quality, particular in the absence of clear standards for E/I quality as imposed by the game industry.

Another component of the Children's Television Act is a statutory provision that limits the amount of commercial time during children's programs to 12 minutes per hour on weekdays and 10.5 minutes per hour on weekends, a regulation that has been followed by approximately 90% of networks and stations (Kunkel & Wilcox, 2012). The CTA requirements are currently being reviewed by the FCC (MB-Docket No. 17-105), with broadcasters arguing for relaxation of the "outdated" CTA rules and advocates opposing those changes. Whether such policies could be imposed on digital games and apps developed for child and adolescent audiences remains an open question and one that would be further informed by developmental research.

For instance, there is a growing concern among parents, researchers, and child advocates regarding YouTube's illegal collection of children's data used for targeted advertisements (Campaign for a Commercial Free Childhood, 2018a,b). The Children's Online Privacy Protection Act (COPPA) requires that sites disclose to parents/guardians what data they are collecting and ask permission before collecting data about and from their children (Children's Online Privacy Protection Act of 1998 [2013]). In a complaint filed to the FTC (Campaign for a Commercial Free Childhood, 2018a,b), advocacy groups argued that YouTube was collecting data about children who used its site without seeking parent/guardian permission (and then using the data to target children with advertising). YouTube contended that it was not responsible for seeking parental permission as its site policies state that the site is for individuals age 13 and older (Maheshwari, 2018; Schwartz, 2018). YouTube does currently offer a separate YouTube Kids app that provides parents/guardians with information on data they collect and how they use it (for advertising and personalized content) and requires parent/guardian consent before children can use the app. However, child advocacy groups claimed that YouTube was aware that children were using its main YouTube platform, as many of its top channels targeted child viewers and provided targeted advertising to them (Campaign for a Commercial Free Childhood, 2018a,b). In September 2018, Congressional Representatives David Cicilline (D-RI) and Jeff Fortenberry (R-NE) reached out to Google,

YouTube's parent company, requesting information about the data they collected from children (Maheshwari, 2018).

To date, there are policies that have considered the entire media context for children, including television and interactive media. The American Academy of Pediatrics regularly reviews research on media and child development to guide their policy statements. Recently, this group released policy statements on Media and Young Minds (2016), Media Use in School-age Children and Adolescents (2016), and Digital Media and Sleep in Childhood and Adolescence (LeBourgeois et al., 2017). The 2016 release of new media guidelines for young children was based on a policy recommendation from 1999 (AAP, 1999) to 2011 (AAP, 2011), that children under the age of 2 should not be exposed to any screen time. The updated 2016 policy considered the changing digital landscape by including aspects of interactive media and potential benefits of media for young children, such as skyping with grandparents (AAP, 2016a,b). The policies addressing children and adolescents focused more on the risks of using media (i.e., cyberbullying, negative health behaviors, Internet gaming disorders; AAP, 2016a,b) than on potential benefits, such as using educational interactive games as an engaging way to learn. The AAP recommended that parents limit screen time during certain times of day (i.e., homework and bedtime), co-view with their children, and communicate about how to use media safely (i.e., privacy, avoiding cyberbullying, and online advertising). This last emphasis on media literacy also was recommended by the American Academy of Pediatrics Council on Communications and Media (2016a,b) for pediatricians who were seen as responsible for helping the parents of their patients to learn more about the benefits and risks of media exposure.

Many of the AAP recommendations pertain to young children, although middle childhood is a time of high media use paired with continued cognitive development. These recommendations also tend to focus more on the quantity of screen time as opposed to the quality of screen time. Our contention is that policymakers address the latter with consideration of, for example, those types of games that could be considered educational and most appropriate for school-based curriculum. The most recent Royal College of Paediatrics and Child Health (RCPCH; www.rcpch.ac.uk) recommendations (2019) moved in this direction by providing key questions for families to use to help them negotiate screen time, such as "does screen time interfere with what your family wants to do?"

Guidance for policymakers around interactive media may be also be sought through the work spearheaded by professional organizations such as an American Psychological Association Task Force that was convened to evaluate the available research base concerning the impact of violent media on children and youth (Calvert et al., 2017). This task force evaluated the evidence both via meta-analysis and an in-depth evidentiary review of recent research (from 2009 to August 12, 2013), focusing on those studies that reflected methodological rigor. The meta-analysis and evidentiary review yielded support for linkages between violent video game use and aggressive cognitions, affect, and behavior, as well as heightened physiological arousal and decreased empathy. However, insufficient empirical evidence was found to address the concern that violent game use was associated with criminal or delinquent behavior, as not enough studies had examined this issue. In-depth exploration of the more recent work suggested that the

aggression results were relatively stable across a variety of methods, in both longitudinal and cross-sectional research, using both experimental and correlational designs. Notably, while arguments about violent video games often presume effects upon children, relatively few of the task force–identified studies involved children under the age of 16, and fewer still, if any, involved children under the age of 10. This situation likely reflects ethical concerns about exposing children to violent video game content. While there have not been national-level policies implemented to regulate violent video game content, much can be learned from the Task Force work. Specifically, we see effective policy about digital game and app impact on cognitive development as emerging from an expert review of the evidence collected to date; a review that includes developmental psychologists whose work addresses this impact in coordination with those within the industry who develop the games and apps that children use.

. . . we see effective policy about digital game and app impact on cognitive development as emerging from an expert review of the evidence collected to date; a review that includes developmental psychologists whose work addresses this impact . . .

Notably, consistent funding has been an ongoing problem for basic and applied research that can be used to guide policy decisions about children's exposure to, and use of, media. The Children and Media Research Advancement Act (CAMRA Act), bipartisan legislation initially sponsored by Senators Lieberman and Brownback, was designed to provide a designated federal funding source to examine the impact of media on children's and adolescents' cognitive, physical, social, emotional, behavioral, and physical development. More specifically, the Public Health Service Act was to be amended to establish a program within the National Institute of Child Health and Human Development (which was changed to the Centers for Disease Control and Prevention) to study the impact of electronic media on children's development. The impetus behind the CAMRA Act was that media were a ubiquitous source of influence on children's development with ongoing Congressional hearings taking place about that influence, yet there was insufficient empirical knowledge about the impact. A key problem was the lack of a single funding agency in which investigators could send proposals to enable media effects to be examined systematically. The initial CAMRA Act garnered sufficient support to pass the Senate (S 1902) on September 13, 2006, with funding to be located at the Centers for Disease Control and Prevention. The CAMRA Act had also been introduced into the House of Representatives by Representative Markey, but never passed in that legislative chamber.

In 2018, the CAMRA Act was reintroduced into the Senate. Advocates had argued that the digital landscape had become an even more pervasive, potent, and understudied influence on children's developmental outcomes than when the original bill was introduced more than a decade earlier. Funding in the current bill would be located at the National Institutes of Health. Passage of the CAMRA Act could result in a wealth of information to inform research and policy about the influence of digital media exposure on all age groups, including middle childhood.

## Conclusions

Media use is pervasive throughout children's development, with interactive media playing an increasingly important role in this process (Common Sense Media, 2015, 2017). Although there is an emerging literature about the impact of interactive media on young children's and adolescents' cognitive outcomes, comparatively little is known about interactive media effects, as yielded via digital game play, during middle childhood. This report sought to fill this knowledge gap by proposing research to maximize children's cognitive outcomes, leading to best practices in schools and to efficacious educational policies. Such a direction has promise to move our nation forward by integrating media experiences into the lives of children, and those responsible for their care and education, in ways that foster 21st-century learning and thinking skills. Our hope is that readers of this report will contribute to fulfilling this promise.

## Endnote

[1] Participants included: Fashina Aladé, David Arnold, Patricia Brooks, Sandra Calvert, Michael Evans, Shalom Fisch, C.Shawn Green, Shayl Griffith, Karla Hamlen, Celia Hodent, Bruce Homer, Jo Iacovides, H. Chad Lane, Kasey Powers, Marissa Putnam, Sharon Tettegah, Lori Walters, and Bieke Zeman. The working group was convened and the meetings co-chaired by Fran Blumberg and Kirby Deater-Deckard.

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## Author Bios

**Fran Blumberg** is a Professor in the Division of Psychological and Educational Services at Fordham University's Graduate School of Education. She currently directs the Contemporary Learning and Interdisciplinary Research PhD program there. Her research interests concern the development of children's attention and problem-solving skills in the context of informal and formal digital learning settings. She has received funding from the Spencer Foundation, the National Science Foundation, and the Center for Curriculum Redesign. Dr. Blumberg currently serves on several editorial boards, including Computers in Human Behavior and Games for Health Journal. She also serves on the Senior Program committee for the 2019 APA Technology, Mind, & Society. She is the editor of *Learning by Playing: Video Gaming in Education* (Oxford University Press, 2014), coeditor (with Mark Blades, Caroline Oates, and Barrie Gunter) of *Children and advertising: New Issues and New Media* (Palgrave-Macmillan, 2014), and coeditor (with Patricia Brooks) of *Cognitive Development in Digital Contexts* (Academic Press, 2017).

**Kirby Deater-Deckard** is Professor in the Department of Psychological and Brain Sciences at University of Massachusetts Amherst, and a Fellow of the Association for Pscyhological Science. He serves as Program Leader in Developmental Science, Associate Program Leader in Neuroscience and Behavior, Director of the Healthy Development Initiative at the UMass Center at Springfield, and as a panel member for the Institute of Education Sciences. Deater-Deckard's research and teaching spans biological and environmental influences on individual differences in social-emotional and cognitive development in childhood and adolescence. The main emphasis in this work is on parenting and intergenerational transmission of self-regulation (e.g., executive function, emotion regulation, vagal tone), and utilizes behavioral, cognitive neuroscience, and genetics research methods. Deater-Deckard's publications span developmental and family sciences, with research currently and recently funded by NSF, NIH, and the US-Israel Binational Science Foundation. He was coeditor of *Parental Stress and Early Child Development* with Robin Panneton, associate editor of the *APA Handbook of Contemporary Family Psychology* (Barbara Fiese, editor in chief), and is coeditor of the Taylor and Francis book series, Frontiers in Developmental Science, with Martha Ann Bell.

**Sandra L. Calvert** is a developmental and child psychologist, whose scholarship illuminates the children's media area, including policy implications. Dr. Calvert is Professor of Psychology at Georgetown University, an affiliated faculty member at the McCourt School of Public Policy, and the director of the Children's Digital Media Center. She is a fellow of the American Psychological Association, the International Communication Association, the Association for Psychological Science, and the recipient of the Georgetown University Career Research Achievement Award. Dr. Calvert has authored seven books and more than 100 articles and book chapters. Her current research, funded by the National Science Foundation, studies the effects of children's relationships with media characters, including their learning from an intelligent character prototype that responds contingently to them. She has served on two committees for the National Academies: one on food marketing and obesity, and another on protecting children from online pornography; on a task force for the American Psychological Association examining the impact of violent video game exposure on youth aggression; testified before the U.S. Senate Committee on Commerce, Science, and Transportation about the Children's Television Act; and served as a consultant for numerous companies and advisory boards to improve the quality of children's media.

**Rachel M. Flynn** is a developmental psychologist whose research centers on media's impact on cognitive development. She is a Research Assistant Professor in Medical Social Sciences at Northwestern University, and the Associate Director for the Institute for Innovations in Developmental Sciences. She received her PhD from the University of California, Riverside where her dissertation, "Acute Effects of Exercise, Physically Active Video Game Play, and Inactive Video Game Play on Executive Functioning Skills in Children," was funded by a Dissertation Year Program Fellowship and the Graduate Dean's Dissertation Research Grant. She also received a Doctoral Consortium Award from the Foundation for Digital Games. She completed her postdoctoral training at New York University. Dr. Flynn's research examines the mechanisms of media's effects on child development through two primary lines of research: 1) how children learn from media; and 2) how media can promote physical health, social interactions, and cognition, particularly executive functioning (EF) skills, such as attention, inhibition, and working memory. Her most recent research uses eye-tracking methods to examine how attention mediates the relationship between educational media content and STEM or language outcomes. She is particularly interested in the individual child characteristics that differentially impact learning, such as age, gender, and culture.

**C. Shawn Green** is an Associate Professor of Psychology at the University of Wisconsin-Madison. He received his PhD in Brain and Cognitive Sciences from the University of Rochester in 2008. He then completed a postdoctoral fellowship at the University of Minnesota focused on machine learning approaches to studying human behavior before joining the University of Wisconsin faculty in 2011. His lab's research focuses on human learning, broadly construed, including factors that influence learning rate, depth of learning, and generality of learning (i.e., whether learning "transfers" to new situations). In this, his lab employs both classic psychophysical learning tasks (e.g., those that involve lines, simple shapes, gratings, etc.) as well as much more complex forms of learning experience—such as those inherent in modern commercial video games. Among other things, research from his group has shown that playing certain types of modern video games ("action video games") induces broad enhancements in perceptual, attentional, and cognitive skills. His work has been published in high-ranking science journals such as Nature, Current Biology, and Psychological Science and has been featured in popular media outlets such as the *New York Times, Wired, Scientific American,* and the Netflix series *Bill Nye Saves the World*.

**David Arnold** is a developmental and clinical child psychologist whose research focuses on understanding and fostering healthy development in children in low-SES diverse communities. He is a Professor of Psychological and Brain Sciences at the University of Massachusetts, Amherst, where he has served as the director of the Developmental Science Program and was the recipient of the University's Distinguished Teaching Award. Dr. Arnold conducts research on promoting children's emergent academic skills in economically disadvantaged communities, and has experience developing and evaluating relevant assessment approaches. He recently completed two experimental evaluations of the effects of educational apps, finding significant benefits to emergent math and preliteracy skills. This work included multimethod assessments of relevant constructs, including parental practices around mobile technology, and direct observations of parent–child interactions around apps. Dr. Arnold has published over 50 journal articles in developmental, clinical, and educational journals. His work has been funded by NIH, Head Start, the William T. Grant Foundation, the Ford Foundation, the Spencer Foundation, and the Overdeck Family Foundation. He was an expert speaker for IES' Preschool Grant Initiative and the policy implications of his work were recognized by the National Academy of Science/National Research Council's Board on Children Youth and Families.

**Patricia Brooks** is Professor of Psychology at the College of Staten Island, CUNY, where she directs the Language Learning Laboratory. Her research focuses on individual differences in language learning and the development of effective pedagogy to support diverse learners. She is Deputy Executive Officer of the PhD Program in Psychology and on the Executive Committee of the PhD Program in Educational Psychology at the CUNY Graduate Center. She serves on the Executive Committee of the International Association for the Study of Child Language and the Review Committee of the Psychonomic Society. She is Faculty Advisor to the Graduate Student Teaching Association (GSTA) of the Society for the Teaching of Psychology, APA Division 2. She is a 2018 Fellow of the Wikipedia Education Foundation and organizer of the WikiProject Women in Psychology (https://en.wikipedia.org/wiki/Wikipedia:WikiProject_Women_in_Psychology). Brooks is the coauthor of two textbooks, *Language Development* (with Vera Kempe) and *Teaching Psychology: An Evidence-Based Approach* (with Jill Grose-Fifer & Maureen O'Connor). She coedited the *Encyclopedia of Language Development* (with Vera Kempe), *Cognitive Development in Digital Contexts* (with Fran Blumberg), and *How We Teach Now: The GSTA Guide to Student-Centered Teaching* (with Rita Obeid, Anna Schwartz, & Christina Shane-Simpson).

***Social Policy Report*** is a quarterly publication of the Society for Research in Child Development. The *Report* provides a forum for scholarly reviews and discussions of developmental research and its implications for the policies affecting children. Copyright of the articles published in the SPR is maintained by SRCD. Statements appearing in the SPR are the views of the author(s) and do not imply endorsement by the editors or by SRCD.

## Purpose

The *Social Policy Report* (SPR) is a quarterly publication of the Society for Research in Child Development (SRCD). Its purpose is twofold: (1) to provide policymakers with comprehensive, nonpartisan reviews of research findings on topics of current national interest, and (2) to inform the SRCD membership about current policy issues relating to children and about the state of relevant research.

## Content

The SPR provides a forum for scholarly reviews and discussions of developmental research and its implications for policies affecting children. Topics are drawn from a variety of disciplines and cover a wide range of issues that affect child and family development through the lens of social policy, such as health care, parenting practices, and education policies. SRCD recognizes that few policy issues are noncontroversial and that authors may well have a "point of view," but the SPR is not intended to be a vehicle for authors to advocate particular positions on policies. Presentations should be balanced, accurate, and inclusive. The publication nonetheless includes the disclaimer that the views expressed do not necessarily reflect those of the SRCD or the editors.

## Procedures for Submission and Manuscript Preparation

Articles originate from a variety of sources. Some are solicited by the editorial board, while others are proposed by the authors. Authors interested in submitting a manuscript are urged to propose timely topics to the lead editor via email. Topic proposals should take the form of an extended abstract (approximately 2 pages) that outlines the topic and scope of the proposed report. Manuscripts vary in length ranging from 30 to 45 pages of text (approximately 8,000 to 12,000 words), not including references and figures. The manuscript should be double-spaced throughout with 12-point font and should adhere to APA guidelines. Manuscript submission should include text, abstract, references, and a brief biographical statement for each of the authors and should be sent as a .doc, .docx, or .rtf file.