

ISSUE BRIEF

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The Effects of Electronic Media on Children Ages Zero to Six: A History of Research

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INTRODUCTION

In today's society, electronic media are thoroughly integrated into the fabric of life, with television, movies, videos, music, video games, and computers central to both work and play. Recent studies indicate that even the youngest children in the United States are using a wide variety of screen media, many at higher levels than recommended by child development professionals (Rideout, Vandewater, & Wartella, 2003). There are rapidly growing markets for early childhood television programming, computer software for toddlers, and video series for infants.

Pediatricians, educators, researchers, and policymakers have raised particular concerns about electronic media use among very young children. Developmental science suggests that children may be the most vulnerable between birth and school age to certain negative effects of media use such as obesity, aggression, fear, and sleep disturbances. Paralleling this vulnerability is a unique responsiveness to educational programming that has been linked to both immediate and long range educational benefits (Anderson, Huston, Schmitt, Linebarger, & Wright 2001; Wright, Huston, Murphy, St Peters, Pinon et al, 2001).

Neurodevelopmental research indicates that, unlike other organ systems, the human brain is embryonic at birth – it completes the majority of its development, including the production of necessary and destruction of unnecessary neural architecture, in response to environmental stimuli over the first 18 to 24 months of life. Stimuli that optimize the development of brain architecture include interaction with parents and other humans, manipulation of environmental elements like blocks or sand, and creative, problem-solving activities. Because screen media do not perform any of these functions, the American Academy of Pediatrics (AAP) officially state that the risks of infants using media outweigh the benefits and thus recommend against screen media use for children zero to two years of age. Due to research evidence linking media exposure to a variety of health risks from obesity to violent behavior (Bushman & Huesmann,

2001; Kaiser Family Foundation, 2004), the AAP also recommend that children two years of age and older be limited to one to two hours of electronic entertainment per day (American Academy of Pediatrics, 1999).

Despite the attention the AAP policy received from the press and the public, recent studies examining media use by very young children have indicated that the vast majority of parents have never heard of the recommendations and continue to allow and even encourage their very young children to use screen media (Rideout, 2004; Rideout, Vandewater, & Wartella, 2003). The *Zero to Six* study found that 74% of children under the age of two have watched television and 59% watch television on a typical day for an average of two hours and five minutes. Thirty percent of children zero to three years old and 43% of children four to six years old have televisions in their bedrooms. Those with screen media in their bedrooms use media for more time each day, and children in "heavy television" homes read less and learn to read later than those in other homes. Despite these data, more parents believe that television "mostly helps" rather than "mostly hurts" their children's learning (43% vs. 27%) (Rideout, Vandewater, & Wartella, 2003).

There is confusion about the effects of early media use among those who care most for children's health and well-being. Clearly a valid scientific research foundation is necessary for parents, educators, and child health professionals to make critical decisions regarding media use by infants, toddlers, and preschoolers. Unfortunately, compared to other areas in health and education, research on the effects of media use on very young children has not been a consistent funding priority for the Federal government¹, foundations, or academic institutions.

The purpose of this issue brief is to review the history of research about the effects of electronic media on children zero to six years old (including the funding sources), summarize the findings of the seminal studies in this area, and note gaps in the research base.

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METHODS OF OBTAINING AND ORGANIZING RESEARCH INFORMATION

In order to identify research relating to the effects of electronic media on zero- to six-year olds, several searches were conducted. For data on government funded research, a search of the National Institutes of Health (NIH) and the National Science Foundation (NSF) award databases was performed.² Data on non-government funding were obtained by examining the funders listed in research publications addressing media effects on children zero to six years old. If funders, dates, or amounts were not identified in a publication, authors were contacted directly and asked to provide the information. Funding data for this report are limited to research funded within the United States that resulted in peer-reviewed publications or technical reports.³ Funding awards were summarized by decades, but if a grant period extended across two or more decades it was only counted in the decade in which it was awarded.

To locate the research, the names of Principal Investigators from the government grants were searched in the academic databases PsycINFO, ERIC, Academic Search Premier, and MEDLINE in order to find published research that may have been funded by the identified grants. Additionally, searches of these databases were performed with the same search terms as the funding search in order to find relevant publications that may not have received government funding. Only peer-reviewed publications that included participants six years of age or younger were included in the research review. Theses, dissertations and technical reports were excluded. In order to be comprehensive, all research literature examining the subject was reviewed. Studies considered central to important research areas from each decade were summarized in this report. A full list of all reviewed studies can be found in the reference list. Starting from the first research in this area, which was done in the 1960s, and extending to the present, the review of findings is organized by decades to show the theoretical and methodological evolution of the research.

HISTORY OF RESEARCH ON THE EFFECTS OF ELECTRONIC MEDIA ON CHILDREN ZERO TO SIX YEARS OLD

In the 1960s, research about media effects on children zero to six years of age was in its infancy. Few studies were conducted and fewer grants awarded. However, since the 1970s, the number of grants awarded to support research in this area has been remarkably consistent. The majority of funding has been awarded by the Federal government through the NIH or the NSF. The number of grants awarded each decade from the 1970s to the 1990s varied only slightly (22, 20, and 27, respectively). What has differed is the distribution of funds across government and non-government sources. In the 1970s and 1980s, more funding was awarded from government than non-government sources.

In the 1990s, very few government grants were awarded in comparison to the non-government support provided. By the 2000s, the government has returned to funding this area of research, across more organizations than ever before, and the non-government support continues. The number of research grants awarded in the 2000s already equals the average awarded during each of the three preceding decades.

The 1960s

The Funding

During the 1960s, none of the research published in this area identified dates in which funding was awarded. Funders for this work included both government and non-government sources. Of the seven grants that were given, five came from NIH, two of which were from the National Institute of Mental Health (NIMH). The other two grants came from Stanford University and the American Association of University Women.

The Research

Most research on media effects on zero- to six- year-olds in the 1960s was heavily influenced by Social Learning Theory. First described by Bandura and Walters in 1963, this theory profoundly influenced media effects research. The basic premise of the theory is that children learn through observation. Applied to media effects research, Social Learning Theory predicts that children can learn new behaviors from television and other audiovisual media.

Seminal media studies of the 1960s found that young children learned and reproduced specific acts of aggression they observed on film. A series of experiments demonstrated that children imitate aggressive acts they saw on film, especially when the aggressive model (adult performing acts of aggression) is rewarded or no adverse consequences are depicted.

Specific Findings

- Four- to six-year-old children were exposed for five minutes to an aggressive or non-aggressive film. After watching the film, the children were invited to play with a ball or a mechanical doll apparatus, in which pressing a bar caused one doll to hit the other on the head. Children exposed to the aggressive film pressed the bar to activate the hitting dolls more often than children who had been exposed to a non-aggressive film (Lovaas, 1961).
- Children aged three to five years observed either a live adult aggressive model, a filmed adult aggressive model, a filmed adult aggressor dressed like a cartoon character, or no model (control). They were subsequently frustrated (prohibited from playing with attractive toys) and taken to another room, where their free play was observed. Children in the three aggression groups displayed more aggression than children in the control group. Children who observed aggressive filmed models displayed

as much aggression as children who observed aggressive live models (Bandura, Ross & Ross, 1963).

- Children aged three to five years imitated a televised aggressive model when the model was rewarded or no consequences to the model were depicted. When the model was punished, children did not imitate the aggression (Bandura, Ross & Ross, 1963).
- Children aged three to six years imitated all physical and verbal behaviors of a televised model when they were directly rewarded for doing so. However, they displayed significantly less imitative aggression when the televised model was punished than when they saw the model rewarded or suffer no consequences. Thus, all children had learned the aggressive behaviors, but the children who saw the model rewarded or suffer no consequences were most likely to perform the aggressive acts (Bandura, 1965).
- Children aged five to nine years who watched an aggressive model on film while the experimenter provided negative comments were less likely than those who heard positive or neutral comments to be aggressive when taken to a playroom, but this inhibition occurred only if the experimenter accompanied the child to the playroom (Hicks, 1968).

The 1970s

The Funding

Support for research during the 1970s was characterized by more government than non-government awards. Of the 22 grants that were awarded, 15 were given by government sources. The remaining seven grants were awarded by non-government sources. The primary government funder during the 1970s was NIH. Within NIH, NIMH provided the most support, awarding ten of the 11 grants given by the agency.⁴ The NSF and the Office of Child Development also awarded grants during this time. Non-government funders during the 1970s included foundations, universities and non-profit groups. Foundation support was provided by the Spencer Foundation and the Markle Foundation. University support was given by the University of Wisconsin - Madison, the University of Washington and the University of Minnesota. Non-profit support came from Children's Television Workshop (CTW). Several studies were published during the 1970s for which funding dates could not be determined. Funders of these studies included the Federal Trade Commission, the National Institute of Child Health and Human Development (NICHD), NIMH, the National Institute of Education, the Office of Child Development, the University of Kansas and Field Enterprises Educational Corporation. In addition, four studies were published in the 1970s without funding support.

The Research

In the 1970s, there was an explosion of studies applying Social Learning Theory to new research areas. The power of television to teach young children was established through two important events of the decade. First, television's ability to teach aggressive behavior through modeling was a major component of the 1972 Surgeon General's Report (Murray, 1972). Second, *Sesame Street*, originally aired in 1969 and the focus of several studies in the 1970s, demonstrated that TV could be a powerful teacher of academic and social skills. Numerous research reports commissioned by Children's Television Workshop during the 1970s also established the value of formative research for creating effective educational programs for children. Finally, in the 1970s, researchers began systematically studying the effects of specific elements of children's media exposure, including media violence, attention/comprehension, response to advertising, and infants' responses to media.

Specific Findings

Media violence

- Three- to five-year-old boys randomly assigned to watch violent *Superman* or *Batman* cartoons at their nursery school once a day, three days a week, for four weeks, were more aggressive and less cooperative during a social interaction test situation than three- to five-year-old boys who were randomly assigned to watch *Mister Rogers' Neighborhood* during the same four week period (Friedrich & Stein, 1973).
- Preschool boys who watched a 3.5 minute film depicting aggressive play with a clown interacted more aggressively with the clown from the film during free play immediately after viewing. Boys in pairs acted more aggressively than boys alone, suggesting that imitation of modeled aggressive behavior may increase when children play in pairs (Drabman & Thomas, 1977).
- Five-year-old children imitated aggressive and neutral behaviors observed on film, regardless of the experimenter's positive, negative, or neutral comments about aggressive behaviors. Ten-year-olds were more likely to imitate aggressive and neutral behaviors when the experimenter made positive or neutral comments about the behaviors than when the experimenter made negative comments (Grusec, 1973).
- Five to 12-year-old boys who watched less than four hours of television per week were more aroused (as measured by galvanic skin response and change in blood volume) by viewing media violence than boys who watched more than 25 hours per week, suggesting heavy viewers had been desensitized by prior media violence exposure (Cline, Croft & Courier, 1973).

- After watching an action adventure TV show, only three percent of kindergarteners and first graders mentioned motives or motives and consequences in describing the aggression in the show, compared to 63% of fifth and eighth graders. When asked to evaluate the aggressor, only 3% of kindergarteners and first graders included motives in their evaluations, compared to 70% of fifth and eighth graders. Sixty-seven percent of kindergarteners recounted only scenes containing aggression when describing the plot of the show (Collins, Berndt & Hess, 1974).

School achievement

- Children who watched more television at ages three, four, and five (according to parental estimates) had lower grades and were rated as less sociable by their peers at age six (Burton, Calonico, & McSeveney, 1979).

Prosocial media

- Preschoolers exposed to episodes of *Mister Rogers' Neighborhood* for eight weeks engaged in more imaginative play and positive social interactions when also provided with program-related play materials with prosocial themes, such as dramatic play props. Viewing *Mister Rogers' Neighborhood* alone did not increase imaginative play or social interactions (Friedrich-Cofer, Huston-Stein, Kipnis, Susman, & Clewett, 1979).

Attention and comprehension

- One- to four-year-old children's attention to television varies by child and program characteristics. Percent attention to *Sesame Street* in the lab was dramatically higher among four-year-olds compared to one-year-olds. Particular characteristics of the program, such as children, puppets, peculiar voices, and lively music, were correlated positively with children's visual attention to the screen (Anderson & Levin, 1976).
- Five-year-olds who watched *Sesame Street* in the presence of toys paid half as much attention to the TV screen as five-year-olds who watched the same program without toys. However, comprehension was the same for both groups, suggesting that young children monitor the audio track of television programs for cues indicating content that interests them and distribute their visual attention strategically (Lorch, Anderson & Levin, 1979).
- Preschoolers who watched a rapidly paced version of *Sesame Street* did not differ from preschoolers who watched a normally paced version on measures of hyperactivity, impulsivity and shortened attention span immediately after viewing (Anderson, 1977).

Response to advertising

- Seventy percent of four- and five-year-old children who watched a preschool program with a toy commercial placed near the beginning and end of the program said they would rather play with the advertised toy than with their friends in the

sandbox. Only 36% of children who saw the same program without the commercials preferred playing with the toy to playing with friends (Goldberg & Gorn, 1978).

- The total number of hours of commercial TV viewed per week by three- to eleven-year-old children (average age four to seven) predicted how many product requests they made at the supermarket. Children who watched more TV made more attempts to influence what was purchased at the store (Galst & White, 1976).
- Most kindergarteners did not comprehend disclaimers like "some assembly required" in a commercial. When the phrase "you have to put it together" was used, two times as many children understood the message (Liebert, Sprafkin, Liebert, & Rubinstein, 1977).
- When shown segments of a videotape containing children's programs and commercials, five- to seven-year-old children correctly revealed whether they were watching "part of the show" or a "commercial" about 55-65% of the time, just above what would have been expected by chance. Separation devices between programs and commercials, such as a character saying "we'll be right back after these messages" did not increase the likelihood that children would distinguish between commercials and programs (Palmer & McDowell, 1979).

Infants' responses to media

- In a laboratory experiment, six-month-old infants who were directly exposed to TV for about one hour each day (according to parental report) looked more at a television with picture and sound than at a picture-only version (Hollenbeck & Slaby, 1979).

The 1980s

The Funding

Research funding during the 1980s was characterized by more government than non-government support. Of the 20 grants that were awarded during this decade, 12 were provided by government sources. The remaining eight grants were awarded by non-government sources. The primary government funder during the 1980s was NIH. Nine of the 11 NIH grants were given by NIMH.⁵ The NSF awarded one grant during this decade. Foundations awarded the majority of the non-government support, with universities, non-profit groups and professional organizations providing the remainder. In particular, the Spencer Foundation awarded three grants. University funding came from the University of Wisconsin-Madison, and Arizona State University. Non-profit support was provided by Doctors Ought to Care and CTW, and the National Association of Broadcasters, a professional organization, funded one study. A number of studies were published during the 1980s for which funding dates could not be determined. Funders of this work included

NICHHD, NIMH, the US Department of Education, the University of Kansas, the University of Colorado Denver, Auburn University, University of Connecticut Research Foundation and the MacArthur Foundation. In addition, seven published studies were conducted without grant support.

The Research

In the 1980s, NIMH, following up on the 1972 Surgeon General's Report, commissioned a series of summary articles about the effects of media on children (Pearl, Bouthilet, & Lazar, 1982). Research in the 1980s focused on developing a variety of topics that were first explored in the 1970s, including attention/comprehension, fear reactions to frightening content, response to advertising, and infants' responses to media. The first investigations of video game effects and on positive interventions on media use were also done in the 1980s.

The major discovery of the 1980s was that children's attention to television is determined by how well they understand program content. In particular, cognitive developmental factors strongly influence how children are affected by television. In other words, children's cognitive development predicts their selective attention to television and, by extension, their ability to learn from television.

Specific Findings

Attention and comprehension

- Two-, three-and-a-half-, and five-year-old children were exposed to comprehensible and incomprehensible video clips of *Sesame Street*. The incomprehensible clips included randomly reordered scenes, foreign language, or backwards speech. Children's attention to the incomprehensible segments was significantly less than to normal *Sesame Street* segments, indicating that when television content is not understandable to children, they pay less attention to it (Anderson, Lorch, Smith, Bradford & Levin, 1981).
- Three- to seven-year-old children displayed comprehension of audiovisual sequences conveyed through cinematic techniques, such as editing and special effects. Children were asked to recreate stop-motion animation film segments with the dolls in the film. Cinematic techniques such as pans, zooms, and cuts did not impair children's reproduction of the film events, although a greater proportion of seven-year-olds than four-year-olds clearly understood the sequence of events (Smith, Anderson & Fischer, 1985).
- As a child looks at the television screen, the probability of looking away from the television decreases over time. Children are least vulnerable to distraction when engaged in long looks at television. This research led to the theory of attentional inertia, which states that the longer a viewer looks at the television screen, the probability of that look continuing increases (Anderson, Choi, & Lorch, 1987).

- The proportion of time that children look directly at the television screen increases during the pre-school years, reaching about 70 percent during elementary school and then leveling off. This reflects children's growing comprehension of television content with increasing cognitive development (Anderson, Lorch, Field, Collins, & Nathan, 1986).
- Family characteristics influence young children's viewing of educational programs. Family television viewing diaries revealed that viewing of *Sesame Street* increased from age three to three-and-a-half to four years, decreasing thereafter. Maternal employment, preschool attendance, and older siblings in the family (for 3-year-olds) predicted less *Sesame Street* viewing, whereas younger siblings in the family (for 5-year-olds) predicted more viewing (Pinon, Huston & Wright 1989).
- Children's attention to particular characteristics of a pro-social television program predicted comprehension of that program. After viewing a pro-social cartoon, children in kindergarten, third, and fourth grade answered a series of questions about the depicted story. Kindergarteners' comprehension reflected attention to the television in response to salient auditory cues like sound effects, whereas older children's comprehension reflected attention during sequences containing child dialogue and action (Calvert, Huston, Watkins & Wright, 1982).
- Violence and action contribute independently to preschoolers' attention to television and to their social behaviors after viewing. Imaginative play increased after children saw a low action/low violence program or no television, but decreased after a high action/high violence program. Aggressive behavior increased after viewing high action/high violence or high action/low violence programming (Huston-Stein, Fox, Greer, Watkins & Whitaker, 1981).
- Preschoolers (three- to five-year-olds) can learn novel words from television. Five-year-olds learned more words from television than three-year-olds (Rice & Woodsmall, 1988).

TV viewing and aggression

- Preschoolers who had behavior problems in school watched more television than children who did not have behavior problems in school; these aggressive children also specifically watched more violent action-adventure programs and less pro-social programs, like *Mister Rogers' Neighborhood* (Singer & Singer, 1980).

Fear reactions to frightening content

- Children's fear reactions to media content reflect their level of cognitive development. Parents reported in a survey that preschoolers (three- to four-year-olds) were most afraid of media content that looks scary (such as fantasy or fiction), whereas older children were most afraid of things that could really happen, even if they did not appear very scary (Cantor & Sparks, 1984).

- Cognitive strategies like “tell yourself it’s not real” were less effective at reducing fright reactions to media content among preschoolers compared to older children. “Non-cognitive” strategies like holding a blanket were more effective among preschoolers than older children (Wilson, Hoffner, & Cantor, 1987).

Response to advertising

- After viewing commercials for no-sugar-added snacks (milk and fruit) and public service announcements promoting nutrition simultaneously with positive comments by an adult observer, three- to six-year-old children chose snacks containing added sugar less frequently than children who watched either commercials for snacks with added sugar (with or without adult comment on their poor nutritional value) or commercials for no- sugar-added snacks without adult positive comment (Galst, 1980).
- Preschoolers were more aggressive after viewing commercials with high salience formal features (high action, fast pace, and many visual changes) than after viewing commercials with low salience formal features (Greer, Potts, Wright, & Huston, 1982).
- The phrase “part of a balanced breakfast” often used in cereal ads, was misunderstood by young children; it gave them the false belief that cereal by itself is a healthy, complete meal (Palmer & McDowell, 1981).
- Nine out of ten (91%) three- to five-year-olds correctly used the term “commercial” to identify an advertisement, but only three in ten (31%) understood that the commercial wasn’t part of the story of the program that preceded it (Kunkel, 1988).

Infants’ responses to media

- Fourteen- and 24-month-old infants imitated specific manipulations of toys performed by adults on video, immediately after viewing the video and 24 hours later (Meltzoff, 1988).

Effects of video games and computers on young children

- Four- to six-year-old children engaged in more aggressive acts and fewer pro-social acts after watching the *Road Runner* cartoon or playing the video game *Space Invaders* compared to during baseline free play. There were no differences in aggression or pro-social behavior between watching TV and playing video games (Silvern & Williamson, 1987).
- Three- to five-year-old children used commercially available pre-reading skills computer software with or without adult assistance for three twenty-minute sessions in their preschool classrooms. No differences were found in the children’s pre-reading concepts before and after using the software, and adult assistance had no effect on

children’s test scores. Children expressed little interest in the computer, as compared to books or toys, after the sessions (Goodwin, Goodwin, Nansel, and Helm, 1986).

Intervention on media effects

- Reducing young children’s television time may increase their scores on IQ and Matching Familiar Figures tests, as well as their time spent reading. Families with six-year-old children were randomly assigned to either a restricted viewing or unrestricted viewing group. For six weeks, parents decreased viewing by half among children in the restricted group; these children had higher test scores (tested within one week of the end of the experiment) than pretest matched peers in the unrestricted group (Gadberry, 1980).

The 1990s

The Funding

Funding for research in the 1990s was characterized by a significant decrease in government support. Of the 27 total grants that were awarded during this decade, only five were awarded by government agencies. The remaining 22 grants were awarded by non-government sources. The primary government funder in the 1990s was NIH, which awarded three grants, all from NICHD. NSF and the U.S. Department of Education (USDE) each awarded one grant during this decade. Non-government funders in the 1990s included foundations, universities, the media industry, and non-profit groups. The greatest support for research was provided by a single corporation in the media industry. Viacom subsidiaries Nickelodeon and Nick Jr./MTV awarded eight grants. Non-profit support was provided by CTW, The Public Broadcasting System (PBS), and the American Heart Association. Foundation support came from the Annenberg Foundation, the Charles Revson Foundation, and the Markle Foundation. University support included the University of Wisconsin - Madison, Kansas State and the University of New Hampshire. Several studies were published during the 1990s for which the date of funding could not be identified. The funders for this work included the University of Illinois, the University of North Carolina, the University of Kentucky, Yale University, the University of Massachusetts - Amherst, the University of California - Santa Barbara, R.J. Reynolds Tobacco, the MacArthur Foundation, and Connecticut Public Television. In addition, 13 published studies were conducted without identified funding support.

The Research

An interdisciplinary approach dominated the investigation of media effects on young children during the 1990s. Scientists from a variety of fields, including psychology, education, communication, public health, epidemiology, and medicine, applied their discipline’s theoretical and methodological approaches to this research. Longitudinal designs became more prevalent, discovering familial and contextual influences on the development of

children's media habits and documenting long-term effects of educational television. Finally, a biomedical perspective was applied, with researchers measuring children's physiological responses to television and documenting the physical and mental health outcomes of television use.

Specific Findings

Attention and comprehension

- In a study of 40 five-year-olds, children were instructed to watch *Sesame Street* and simultaneously stop an intermittent buzzer. Children responded more slowly when the content of the segment was comprehensible than when it was in gibberish or a foreign language, affirming that children's comprehension of televised content drives their attention to it (Lorch & Castle, 1997).
- Using time-lapse photography to measure the viewing of 50 children (aged two, five, eight and twelve years), researchers looked at the relationship between children's looking at the screen and formal features of the program. Cuts, movement, and purposeful character behaviors were all related to children's visual attention (Schmitt, Anderson & Collins, 1999).
- Children's comprehension of television programming is higher when they are engaged, and their attention is maximized if information is provided in both the auditory and visual modes (Lorch & Castle, 1997; Rolandelli, Wright, Huston & Eakins, 1991).
- The relationship between children's television use and other activities varies as a function of the content of the program. Entertainment television viewing was related to fewer educational activities and less social interaction. There was no relationship between educational television and any of these activities (Huston, Wright, Marquis & Green, 1999).

Television and reality

- In a study of two- and two and one-half-year-old children, participants watched a monitor showing an experimenter hide a toy in a room. Children were asked to find the toy in the actual room shown on the monitor. Younger children completed the task with significantly more errors, illustrating their difficulty in using information from a televised event to understand a real-life situation (Troseth & DeLoache, 1998).
- The ability for children to learn from televised images lags behind the ability to learn from live, observed events. One hundred and eight children (12 months, 15 months, or 18 months of age) saw either a televised or live experimenter remove a mitten from a puppet and shake it to ring a bell. When given the identical puppet to play with, either immediately or twenty-four hours later, children who had seen the live performance were more likely to imitate the action (Barr & Hayne, 1999).

- Older children have more sophisticated understandings of the visual codes of television. Three-year-olds often mistake television images for real items residing within the TV set, while four-year-olds can recognize televised images as pictorial representations (Flavell & Flavell, 1990). Five-year-olds, while less skilled than seven-year-olds, are able to use features of television to determine if programs are providing information that is factual (news programs or documentaries) or fictional (dramas) (Wright, Huston Reitz & Piemyatet, 1994).

Television and learning

- *Sesame Street* viewing was found to be beneficial to children's vocabulary development. A two-year longitudinal study followed two cohorts of children (160 three- to five- year- olds and 166 five- to seven- year-olds). Children who spent more time viewing *Sesame Street* (as measured with viewing diaries) achieved higher scores on a picture test of vocabulary, regardless of parental education, family size, gender, and parental attitudes. This relationship was stronger for the three- to five-year-old cohort than for the five- to seven-year-old cohort (Rice, Huston, Truglio & Wright, 1990).
- With repeated exposure to single episodes of educational television, children's comprehension and thinking skills were found to be enhanced without loss of attention. Forty four-year-old children viewed the same *Sesame Street* videotape once a week for three weeks. Repeated viewing was associated with better comprehension of the tape's content (Sell, Ray, & Lovelace 1995). Children aged three to five years were randomly assigned to view a *Blue's Clues* episode once or for five consecutive days. Children's attention to the program remained constant, but their verbal and non-verbal interactions with the program and comprehension of its content increased with repetitive viewing (Crawley, Anderson, Wilder, Williams & Santomero, 1999).

Viewing habits and family environment

- In a two-year longitudinal study of children's viewing habits, multiple one-week television viewing diaries were completed for 326 children in two cohorts (three- to five- and five- to seven-year-olds). Children's viewing patterns changed very little over the course of the study. While results showed that as children aged they viewed more cognitively demanding programs, the researchers concluded that family characteristics were the strongest contributors to viewing patterns (Huston, Wright, Rice, Kerkman & St. Peters, 1990; Truglio, Murphy, Oppenheimer, Huston & Wright, 1996).
- A longitudinal study of children's television use found that children tend to watch adult programs in the presence of their parents and child programs without their parents present (St. Peters, Huston, Wright, & Eakins, 1991). Furthermore, the more time children spent co-viewing with parents, the less time they spent watching PBS educational

programs (Taras, Sallis, Nader & Nelson 1990). These findings underscore the idea that children's viewing is often determined by their parents' viewing habits.

Fear reactions to frightening content

- In a study of 163 five- to nine-year-olds, researchers found that children experienced more fear when they believed that a televised threat existed locally (Cantor & Hoffner, 1990). Results from a telephone survey of 285 parents of school-aged children found that older children were more frightened by news stories and less frightened by fantastic content than were younger children (Cantor & Nathanson, 1996). In a study of 186 children in two age groups (five to seven and nine to twelve years), prior knowledge of a happy ending to a scary event was shown to reduce children's fear (Hoffner & Cantor, 1991). Viewing a suspenseful program with an older sibling was shown to reduce the young child's arousal (Wilson & Weiss, 1993).

Response to advertising

- Children as young as two years old were found to have established beliefs about specific brands that are promoted by television advertising and parental behavior (Hite & Hite, 1995). Young children (three to six years old) were shown to have the ability to recognize brand logos for all types of products (over 50% were able to identify "Old Joe Camel"). The ability to recognize brand logos was increased with television viewing, with age, and when visual cues were used in advertising (Fischer, Schwartz, Richards, Goldstein, Rojas, 1991; Henke, 1995; Macklin, 1994).

Health outcomes

- Viewing frightening television, even programming deemed appropriate for preschoolers, raised children's heart rates and caused symptoms of post-traumatic stress disorder (PTSD). In a survey study of 116 parents of three- to five-year-olds, 40% of parents reported at least one symptom of PTSD that occurred after a child viewed a scary event on television and that lasted at least a month. Sleep difficulties were one of the most common symptoms (Crum, 1994; Groer & Howell, 1990).
- For a study of physical activity, the behaviors of 191 three- to four-year-olds were directly observed for up to four days a year for four years. Researchers found that the more time children spent watching television, the less likely they were to engage in physical activity. Television viewing, however, was not related to measures of children's obesity (DuRant, Baranowski, Johnson & Thompson, 1994).

Computer use

- Four- and five-year-old children were exposed to computer software in their preschool classrooms three times a week for seven months. Children used either developmentally appropriate computer software, developmentally appropriate software

with supplemental learning activities, or non-developmentally appropriate computer software. Children who used the developmentally appropriate software had improved intelligence test scores, non-verbal skills, dexterity, and long-term memory. When supplemental activities were provided, children also improved in verbal and conceptual skills. Creativity was reduced among children who used non-developmentally appropriate software (Haugland, 1992).

The 2000s

The Funding

Support for research on electronic media effects on children zero to six in the 2000s has been characterized by more government grants than non-government awards. To date, 27 grants have been awarded to support this area of research. Fifteen of those grants have been from government sources and 12 grants have been from non-government sources. The primary government funder in the 2000s has been the NIH, awarding 11 grants. Within NIH, the National Institute for Child Health and Health Development (NICHD) has awarded the most grants. NSF and the US Department of Education have been the other government funders. To date, NSF has awarded three grants and the US Department of Education has awarded one. Other NIH funders include the National Institute on Deafness and Other Communication Disorders (NIDCD), the National Heart, Lung and Blood Institute (NHLBI), the National Institute of Nursing Research (NINR) and the National Institute for Mental Health (NIMH).

Non-government funders in the 2000s have been distributed across non-profit groups, foundations, professional groups, the media industry and universities. The most support has come from non-profits including WGBH Boston, the Center for Ecoliteracy, Sesame Workshop and the Public Broadcasting Service (PBS). Foundation support has come from the Fisher Price Foundation and the Kaiser Family Foundation. Professional support has been provided by the American Academy of Pediatrics. Support from the media industry was awarded by Sirius Thinking Ltd. University support has been given by Ohio State University and the University of Pennsylvania. The funders of research of which the funding date could not be identified include NSF, the Nesholm Family Foundation, the Bernard van Leer Foundation, the University of Illinois and the American Heart Association. In addition, four studies were located in which no funding was provided.

The Research

Research on media effects on young children in the 2000s has largely focused on demonstrating learning from educational television programs. The overwhelming majority of research studies continue to focus on television, but a few studies have examined children's use of computers. Continuing the public health focus on media effects, obesity has emerged as a growing concern among researchers.

Specific Findings

Television and learning

- Children who regularly watched *Blue's Clues*, a curriculum-based interactive TV program for preschoolers, scored higher on standardized measures of problem solving and flexible thinking than children who did not watch *Blue's Clues*, even though both groups of children had scored equivalently on a pre-test prior to *Blue's Clues* exposure (Anderson, Bryant, Wilder, Santomero, Williams, et al., 2000).
- Educational TV viewing at two and three years of age predicted school readiness among low to moderate income children (Wright, Huston, Murphy, St Peters, Pinon, et al, 2001).
- Viewing of educational programs like *Dora the Explorer*, *Blue's Clues*, *Dragontales*, *Arthur*, and *Clifford* between six and 30 months of age was associated with accelerated language growth, whereas overall television viewing (including adult programs) was associated with reduced vocabulary (Linebarger & Walker, in press).
- Data from the National Longitudinal Survey of Youth indicated that TV viewing at age one and three was associated with parental reports of attention disorder symptoms at age seven. Attention disorder symptoms were indicated by parent response to the five-item hyperactivity subscale of the Behavioral Problems Index (BPI), which assesses concentration, impulsivity, and restlessness. For every additional 2.9 hours of TV viewed per week at age one, a child was 28% more likely to exhibit attention disorder symptoms at age seven (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004).
- Arguably the most significant study published to date in the 2000s is Anderson, Huston, Schmitt, Linebarger, and Wright's (2001) *Early Childhood Television Viewing and Adolescent Behavior*. In the early 1980s, Anderson and his colleagues installed time-lapse video cameras in the homes of 106 Massachusetts families for a ten-day period and recorded their television viewing and interactions in front of the set. An additional 228 families in Massachusetts and 326 families in Kansas (in addition to the 106 families with video cameras installed in their homes) completed TV viewing diaries. Five hundred and seventy of the 660 initial families were able to be recontacted by telephone when the children were adolescents, and their high school transcripts were obtained. Preschoolers who viewed educational TV programs had higher grades and read more books in high school. Among girls, viewing violent programs in preschool was associated with lower high school grades.

Health outcomes

- The likelihood of obesity among low-income multi-ethnic preschoolers (aged one to five years) increased for each hour per day of TV or video viewed. Children who had TV sets in their

bedrooms (40% of their sample) watched more TV and were more likely to be obese (Dennison, Erb & Jenkins, 2002).

- Children (average age of four years) preferred specific foods advertised on video more than children who had not seen the foods advertised on video (Borzekowski & Robinson, 2001).
- Body fat and body mass index increased most between the ages of four and 11 among children who watched the most TV (Proctor, Moore, Gao, Cupples, Bradlee, et al, 2003).

Infants' responses to media

- One-year-olds avoided an object after they watched an actress react negatively to it on video, suggesting that infants can apply emotional reactions seen on television to guide their own behavior (Mumme & Fernald, 2003).
- Two-year-olds who watched themselves on TV via a live video camera hookup for several minutes once a day for two weeks were able to locate an object hidden in a room after watching a live video of an adult hiding the toy in the room (Troseth, 2003). Previous studies had revealed that two-year-olds (without such videocamera experience) could not locate a hidden object based on information from video (Troseth & DeLoache, 1998).

CONCLUSIONS

From birth to age six, children develop and change rapidly. Because early experiences lay the groundwork for later development, children are particularly vulnerable during these years. Lack of good nutrition, for instance, can dramatically affect a child's later growth, while positive early experiences can initiate a positive trajectory that continues throughout children's lives.

Media are increasingly part of very young children's environments. Television programming is being made especially for infants, toddlers, and preschoolers, and national marketing campaigns are dedicated to convincing parents that their children need media products for infants such as baby videos and apps. On the positive side of the ledger, there is evidence that thoughtfully designed television used at the appropriate developmental stage can be educational. At the same time, other research shows that entertainment media can contribute to aggressive behavior, anxiety, and obesity in young children. The need to develop scientifically based, practical answers to important questions about media's effects on the physical, mental, and social health of very young children is now greater than ever.

Over the past 40 years, funding for research in the area of media's effects on young children has not been a consistent priority. Despite limited opportunities for funding, researchers committed to investigating the effects of media on very young children have been quite resourceful, in many cases

converting other grants to work on this research, pursuing the work as part of projects focused on other issues, or funding the research out of their own pockets. Limited resources have been well spent and much has been learned. However, what we know about this area remains limited in scope compared to what we might discover with adequate research funding.

What We Have Learned

Early research demonstrated that children can learn specific, novel behaviors from television. The learning of aggression from media violence received substantial attention in the 1960s and 1970s, but has been less of a focus in recent decades. This is in part because many leading media researchers believe that the evidence that media violence contributes to anxiety, desensitization, and increased aggression has been compelling and virtually unanimous. Among very young children, violent media have been shown to elicit fear responses that are long lasting, linked to PTSD symptoms, and can occur after one exposure.

Advertising and its effects on consumerism in children have been a continuing concern of researchers since the 1970s. Research has shown that very young children are unable to recognize the persuasive intent of advertising. Policies limiting or banning direct advertising to children have been developed by groups as diverse as the American Psychological Association (APA) and the European Union. While there are ethical concerns associated with advertising to children for any product, parents and child health professionals are particularly concerned about the proliferation of child-targeted advertising for high sugar-, salt- and fat-containing snack foods.

The positive influences of age-appropriate, curriculum-based educational television on children's cognitive abilities and school readiness have been well-documented. Basic scientific research on how children attend to and comprehend television has evolved into sophisticated studies of how children can learn from electronic media. This, in turn, has led to the design and production of a number of effective educational television programs, starting with *Sesame Street*, which many experts regard as one of the most important educational innovations of recent decades. Formative research and evaluation of educational television has led to increasingly sophisticated educational programming, such as *Blue's Clues* and *Dora the Explorer*. Longitudinal research has shown that appropriate educational television teaches young children the skills necessary for immediate and long term school success.

Future Directions for Research

Despite the progress that has been made, there are still several areas where further research is critical:

Advertising. Billions of research dollars are spent by corporations to determine how to attract and cultivate brand loyalty among children. Yet most

advertising research is proprietary, inaccessible to the general public, and intended to encourage children to buy products, regardless of how those products might affect children's overall health and well-being. Additional research is necessary to determine if exposure to such advertising during this vulnerable and formative time in children's lives is associated with lifelong consequences. Preschoolers, toddlers, and perhaps even infants can form "relationships" with characters in television programs, videos, or interactive media. These connections can be exploited through new types of advertising including toy merchandising and product tie-ins. New advertising techniques, such as product placement or online games featuring products for children, have also emerged along with new media platforms. Research is necessary to understand these dynamics and to protect very young children and their parents from unfair manipulation.

Educational media. Further funding for formative and evaluative research of educational media is necessary to ensure that programs claiming to teach young children are fulfilling their potential. Much of the research on educational television has been funded by private institutions and media producers. Considering the three-hour requirement of the Children's Television Act and the goals of the No Child Left Behind initiative, the Federal government has much to gain from ensuring the availability of quality, effective educational television. Often, low quality programs are claimed as fulfilling the educational requirements of broadcast affiliates. Ongoing research is necessary to continue to produce and evaluate superior educational television programming, and to determine the positive and negative effects of early non-educational media use on language development, acquisition of reading skills, and school motivation.

Interactive media. Research is needed to investigate the effects of new, interactive media that are marketed for young children. Preschool children and toddlers are increasingly targeted as consumers of video games, computers, the Internet, and electronic toys. These "new media" are on a growth trajectory to surpass old media such as television and movies in terms of exposure and influence. New media are increasingly graphic, immersive, and interactive. Such technological advances may offer potential benefits, including better visual attention, hand-eye coordination and child-controlled learning, as well as possible dangers, such as ergonomic injuries, more subtle exposure to marketing influences, and the learning and rehearsing of unhealthy or dangerous behaviors. Attention and comprehension research that has been so effective in informing the development of educational television needs to be expanded to interactive media in order to advance the creation of educational software, and research should evaluate the effects of new media on children's cognitive, physical, and social development.

Infant media. As media are increasingly developed for infants, research also must turn in that direction. There has been a veritable explosion in media products available for very young children, particularly

infants and toddlers. Sales of “baby videos” have tripled over the past two years (Khermouch, 2004). For decades, researchers thought children did not begin systematically viewing television until two or two and a half years of age. Now that content is created specifically to attract and maintain infants’ attention, research should address the widespread use of media by infants and investigate the potential effects of such use.

Background media. In addition to issues about programming created specifically for children, the impact of background media on children also deserves attention. Recent research has shown that one-, two-, and three-year-olds’ play and focused attention episodes are significantly shorter in length in the presence of background television (Evans, 2003). Parent child interactions are also significantly less frequent in the presence of background television (Kerkorian, 2004). These results are intriguing, yet further research is necessary to document the effects of exposure to television in the home on very young children’s development. Certainly this is an area ripe for further exploration.

Long-term outcomes. Controlled experiments exploring the long-term outcomes of media use patterns in early childhood, including the following of AAP or APA guidelines, are critical for this research area. There has only been one study demonstrating a link between early television viewing and attention disorder. The National Children’s Study proposed by the NICHD and the Environmental Protection Agency represents a unique opportunity to better understand the effects of media as a powerful and pervasive environmental health influence and to locate potential intervention points.

Media interventions. In order to mediate the effects of media on young children, interventions such as media literacy programs and parental education curricula should be designed and evaluated. There have been almost no media literacy programs designed for zero- to six-year-olds. The United States is far behind other countries in this regard; Australia and the Netherlands begin teaching media literacy in preschool and continue it through higher education. Research in older children indicates that media literacy may be the most effective intervention with which to counter negative media effects.

Media influences on young children are not only strong and pervasive, but also potentially controllable – especially in the early years when parents determine the majority of their children’s media exposure. In order to ensure healthy media diets among children, it is important to understand how parents make decisions about their children’s media use, so that effective interventions can be designed where appropriate. Anticipatory guidance and child-healthy advice about media use provided by pediatricians at “well baby” visits can function as a “tipping point” to encourage parents to think carefully about the media their children consume.

While government funding for studies on media effects has been limited, researchers have been very productive, generating findings that have influenced public policy and led to the creation of effective educational television programming.

But research has not come close to keeping up with the pace of new media development. Infants, toddlers and preschoolers today are developing in an environment saturated with media, and unanswered questions about concerning their use of electronic media. In order to fully grasp the positive and negative consequences of this media use, funding must be available for a comprehensive, cohesive research agenda on media effects.

Endnotes

¹ As an example, using indexed terms to search the National Institutes of Health (NIH) Computer Retrieval of Information on Scientific Projects (CRISP) database for grants awarded by the government in 2004, “Preschool” combined with “Mass Information Media” yielded two results, while Preschool combined with other health and development topics yielded many more results: Nutrition (43), Reading Disorder (17), Diabetes (11).

² The NIH Computer Retrieval of Information on Scientific Projects (CRISP) database maintains award information on grants from 1972 to the present. The NSF database maintains award information for 1900 to the present. The following terms were used to search both databases: media, television, music, video, video games, movies, motion pictures, films, internet, computers, toddlers, young children, infant human (zero to one year), child (zero to eleven years), and preschool child (one-five years).

³ The primary funding data available to date include funder name, award recipient, award date and description of project for government supported work. The NIH, the primary funder of work in this area, does not make funding award amounts publicly available on its database. For non-government work, funding dates were difficult to obtain. Often, awards were received in one decade and research using the funding was published one or two decades later. Further, many non-government funders, such as foundations and corporations, do not make award information publicly available.

⁴ The other NIH funder was the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK).

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