The Children's Digital Media Center:

The Role of Interactivity and Identity in Children's Learning

Sandra L. Calvert

Georgetown University

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### Abstract

American children spend an average of 6 hours daily with media that are rapidly becoming digital and interactive. Knowing how to use these digital, interactive technologies will be a necessary skill for an educated workforce in the 21<sup>st</sup> century and may be a gateway to studying science and technology. Therefore, knowing how children use and learn from these digital technologies is an important step in ensuring that children will develop these basic skills.

Using an interdisciplinary team, researchers from the Children's Digital Media Center will advance theory and method in how children learn through digital interactive entertainment media. To do so, we are examining media at multiple levels of analysis in order to explicate the role that dialogue, in the form of interactivity and identity, plays in children's learning from entertaining digital technologies. Overall, these research activities will expand the knowledge base about: 1) the kinds of digital media that are emerging; 2) the kinds of interactive digital media experiences children choose to have; 3) the impact of these interactive experiences on children's long-term social adjustment and academic achievement; 4) how specific kinds of interactions with digital technologies impact children's learning; 5) how interacting with each other online influences children's identity construction; and 6) how observational and interactive experiences are represented in the developing brain. This knowledge base will be used to create synergistic activities among the researchers, policy makers, child advocacy groups, and creators in the children and digital media field.

### Introduction

American children spend their lives with media as a significant socialization agent. Our children spend an average of 6 hours per day with media with a current shift occurring in which children are watching television less, and interacting online more (Roberts, Foehr, Rideout & Brodie, 1999).

Media convergence is the process by which formerly distinct methods of communication merge to create new media (Wartella, O'Keefe & Scantlin, 2000). As convergence increasingly enters the media world, television as we know it will disappear. Our analog television broadcasting system is currently being replaced by a digital system. Digital television will allow vivid high-definition images and online interactivity. Increasingly, children will live and develop in a seamless media environment where varying platforms merge together, offering new potentials for learning. In this new environment, "medium or platform" will be less important than content and process effects of children's media exposure.

Although we know a great deal about what children learn from educational digital media in formal school settings (see Bransford, Brown & Cocking, 1999), we know comparatively little about how these new interactive entertainment digital media impact children's learning in informal, out-of-school contexts. Hence, there is a void in the knowledge base about how to use media judiciously to create delightful, entertaining, and informative content for children while limiting its harmful effects.

The purpose of the Children's Digital Media Center is to: 1) track the evolution and appropriation of new interactive media for children to provide a basis for studies of their impact on learning and social development; 2) develop a robust framework of theory and method for study of the special qualities of interactive media and their effects on children; and 3) conduct a series of investigations into the role of digital entertainment-related media characteristics (such as interactivity, production value, and control) on media choice, engagement, socialization, and learning. The center is located at Georgetown University, the University of Texas at Austin, Northwestern University, and the University of California Los Angeles.

# What Are Digital Media?

Digital media link former media together to display rich visual, auditory, fax, voice, and data images (Baum, 2001). The computer, particularly interfaced with the Internet, provides the backbone for

digital media as the computer is able to incorporate and interface with almost all previous media, including written words, pictures, music, and even the temporal flow of images and sound that characterize film, television, and phone conversations (Grice, 2001). In particular, "digital media link together computers, various audio-visual display and recording systems and remote multi-user networks like the Internet, all with the capacity for interactivity that is built into the computer interface" (Grice, 2001, p. 1). These qualities allow ubiquitous access to content and the possibility for interactive exchanges with feature-rich content.

Because digital media can link all previous forms of media, they are not separate and distinct from previous media (Grice, 2001). There are, however, defining characteristics of digital media including: 1) digitization, in which the form of data is reduced to on or off (0 or 1), the binary, flexible, abstract computer codes that allow for extremely clear visual and auditory images; 2) arbitrary or random access, in which information is stored and retrieved in a non-linear way; because information is stored in memory in a particular location with an address, all address locations can be accessed quickly; and 3) interactivity, in which a computer is structured to respond to both input and output, allowing for a dynamic interchange in creating content that was not previously possible (Grice, 2001). In this open context, computers can expand the potentials of human capabilities, including communication and expression patterns (Iwanami, 1999).

Current digital media build on convergence, in which previously distinct media merge and are combined in new ways. Examples of digital media include digital television (DTV), digital video players and recorders (DVD), compact disc players and recorders (CD) which are now merging with DVD players, and motion picture experts group (MPEG/MP-3) players which can download digitized music from sources like the Internet- these devices all provide crystal clear video and/or audio images; interactive television, which allows two-way interfaces with media content, thereby expanding options to control and select content; personal digital assistants (PDA's) which can be used to organize online calendars, collect e-mail on the run, and run software packages; cellular phones which provide wireless Internet access and can serve as a vehicle for e-commerce, allowing users to charge merchandise; virtual

reality interfaces which allow 3-dimensional images of the content the user is experiencing; and computers of all shapes and sizes that link these devices together and allow interactivity. Digital devices and interfaces are becoming very large, as in digital home theaters, and very small and portable, as in MP-3 players and PDA's. Wireless technology provides flexibility and accessibility to content anytime, anywhere.

# Who Uses Digital Media?

The early adopters of digital media are children and adolescents, particularly boys and youth from non-minority backgrounds. Youth today grow up with new emerging digital media just as earlier generations grew up with the radio or analog television sets.

In the Kaiser report (Roberts et al., 1999), researchers examined a nation-wide sample of children's access to, and use of, media. The researchers found that children live in a media rich environment. Almost all homes have access to a television set, and 2/3 of homes had access to computer and video game players. Almost all children use computers for entertainment.

The Kaiser report also documented the extensive time commitment made by children to media. The average American 2-18 year old spent approximately 6 hours, 32 minutes per day with some kind of media, and often used more than one kind of media at a time. The older children spent more time with media than younger children did: 8-18 year olds spent 7 hours, 57 minutes per day with media whereas 2-7 year olds spent 4 hours, 17 minutes daily. Although children still spent the bulk of their time with television, children who had access to computers were spending 52 minutes daily for recreational use and 1 hour, 26 minutes for total computer use. When online, children spent time in chat rooms, playing games, sending e-mail, and doing homework. More recently, children are spending time communicating through instant messaging, known as IM (Gross, Juvoen, & Gable, in press).

Boys more so than girls seek out new visual media, particularly media that involve gaming (Subramanyam, Greenfield, Gross & Kraut, 2001). Playing video games is a part of male culture and socialization (Wartella et al., 2000), and gaming is moving from consoles to portable hand held units as well as to units that allow the same game to be played at home and online. Girls, by contrast, often

gravitate to digitized content that is more text-based, particularly IM and e-mail that allow personal communication, tasks that are associated with traditional feminine interest patterns (Calvert, 2000).

Ethnic differences are found in purchase and access patterns to computers, the hub of the digital interface. Specifically, Asian Americans purchase the most computers followed by Caucasian Americans, Latino Americans, and African Americans, respectively (Marriott with Brandt, 1995). These findings reflect the digital divide, in which certain ethnic groups may be left behind in the information age because they fail to use computers, and in the long run become less marketable in the occupational arena.

How Do Digital Media Influence Children's Learning and Development?

Given that children and adolescents are among the earliest adopters of digital media and should be impacted by their use, we made the properties of new media that should influence children's engagement and learning a focus of our research program. We theorize that properties of dialogue, such as identity and interactivity, will lead to children's active engagement and learning from digital media. <u>Properties of Dialogue Leading to Children's Engagement and Learning</u>

The core concern of research on children's exposure to, and use of, media has been with the effects of media on their learning and social development, in short, with the role of media in socialization. Socialization is the process of acquiring roles and the knowledge and skills needed to enact them.

Within a media socialization perspective, the core socializing process is dialogue. Dialogue, an interchange with a human or mediated interlocutor, creates a structure for children to articulate and organize their emerging understandings as well as build on what others communicate to them (Wartella, et al., 2000). Dialogue is a relational idea, referring to the ways in which attention and mental activity are engaged and structured by the presence and presentations of others.

Theories of dialogue, especially the work of Bakhtin (1990) and Goffman (1981), provide a framework to understand the role of communication and social interaction in learning. In their work, two concepts are critical to a theory of dialogue: interaction and identity.

Interaction. Dialogue is an activity involving at least two agents, and it is carried out through a process of **interaction** (Jonassen, 1988). In its simplest form, interaction is an exchange of actions or

ideas that build on previous exchanges (Rafaeli, 1988). A medium is interactive, then, when it creates the possibility of dialogue, i.e., gesture and response.

We can define the quality of interactivity in media as their ability to sustain a rich conversation of gestures. In this sense, interactivity is a function of the range/multimodality of display possibilities, the nature of response options (and especially the degree of synchronous responding that is possible), and the ability to sustain a chain of interaction. Following Wartella et al. (2000), Wartella and Jennings (2000), and Sims (1997), we hypothesize that interactivity fosters children's engagement with content and consequent learning due to: (1) control over the learning environment (the degree to which children's actions make things happen); (2) responsiveness (contingent replies to children's actions); (3) production values (aesthetic qualities, and video and audio quality); and (4) personal involvement with the content (motivational elements that inspire children to participate in certain activities).

<u>Identity</u>. **Identity** refers to the social self, as constituted and negotiated within particular activities and contexts. It incorporates and builds on an understanding of personhood and agency and guides not only the ways in which people organize their actions but also the ways in which they interpret the actions of others, including non-human others (e.g., Reeves & Nass, 1996).

The ways in which children and adolescents explore their sense of self via online interaction with others has already attracted the interest of researchers. Examples include studies of adolescents' adoption of characters in MUD's (multi-user role-playing games) (Turkle, 1995) and the use of email and Instant Messaging to build identities and relationships with peers (Gross et al., in press). Our ethnographies and surveys of children's use of online technologies for communication with others will contribute systematic, empirical data to understand how media contribute to a child's emerging sense of self and relationship.

Another question to explore is how children develop and use a sense of their own agency and the agency of others to frame their experiences with interactive media. This fundamental question asks about the ways in which the presentation of content shapes its acquisition and impact. In particular, we need to know whether there are differences in the way information is received from or given to different kinds of dialogue partners, including real people, fictional characters, computers, and intelligent computer agents.

We plan to study the ways in which children's participation in dialogue, and their identification and

representation of computer and human agents in dialogue, frame the lessons they learn from media.

# Setting the Research Agenda

To address these fundamental questions about dialogue, leading to development of a new theory of learning through digital entertainment media, we are carrying out a five-year program of research to address four overarching research questions: 1) How are key properties of dialogue reflected in emerging technologies and their use by children? 2) How do key properties of dialogue influence engagement and learning? 3) How do interactivity and identity influence patterns of brain activation? and 4) How are key

Media	Properties of dialogue leading to engagement and learning	How are these properties deployed and used in digital media?	How do these properties influence engagement and learning?	How do these properties influence patterns of brain activation?	How are dialogue skills acquired from infancy to adolescence?
Theory of Learning through Digital Entertainment	Interaction     Control     Responsiveness     Production values	Surveys of emerging technology and use by children	Experiments on the impact of interactivity on engagement and learning	Experiments on the impact of interactivity on brain activation	Analyze verbal and nonverbal behavior for acquisition of interaction skills (e.g., imitation)
	<ul> <li>Personal relevance</li> <li>Agency</li> <li>Availability of models</li> </ul>	Ethnographic observation of children in online communities	Experiments on the impact of relevance, agency, models on engagement and learning	Experiments on the impact of social relevance and role models on brain activation	Analyze verbal and nonverbal behavior for acquisition of identity skills, especially personal stance

properties of dialogue skills acquired from infancy to adolescence? Our research agenda, summarized in Figure 1, is now underway with an initial phase of studies currently being conducted.

Children's and Adolescents' Access to, and Uses of, Digital Media

Research Question 1: How are key properties of dialogue reflected in emerging technologies and their use by children and adolescents?

We are currently witnessing an explosion of new technology, particularly in the area of interactive technology like computers and the Internet. At least 60% of U.S. children live in households with computer access, and 36.6% have Internet access (Subramanyam et al., 2001). What kinds of new digital platforms are emerging, engaging children in potentially new ways of experiencing and learning from media? How will children interact with each other in these changing digital environments, and how will those interactions influence their identity construction?

## Surveys of Emerging Digital Media

A first step in understanding how digital media will impact children's identities and interactions involves tracking the emerging digital platforms that are becoming available to them. Convergence provides a way to begin to understand this rapidly changing process.

Three trends are notable examples of convergence. The first involves the transition from analog to digital television. This shift will allow the programs viewed on television to merge with computer options of **interactivity**, making the television an activity that increasingly requires active participation and **engagement** with the information (Calvert, 1999). Already we see popular television characters moving to online sites, and children spend time in online interactions with these fictional characters. A second trend involves the evolution of the cellular phone from a talking device into one that can access the Internet, allowing users to browse, read e-mail, surf the web, and make purchases. This trend means that people, including adolescents, will have computer access wherever they are or wherever they go, making the cellular phone an important tool for social interactions that will feed identity construction. A third trend is for computers to be smaller and more portable, allowing them to be integrated into the daily

fabric of life. Small computers can already be carried on our belts, and visual images of the web images we see while surfing will be instantly available through "eyeglasses."

To examine trends in the development and utilization of digital media, Wartella and O'Keefe are conducting a longitudinal survey that tracks changes and emerging trends in new digital products created by the media industry (e.g., Microsoft, IBM, ATT) through relevant industry outlets, including periodicals, websites, and conferences.

# Survey of Children's Media Use

A second tier of surveys examines children's access to, and use of, these emerging digital media. In addition to macro level surveys like the Kaiser report (Roberts et al., 1999), more detailed surveys like the Child Development Supplement (CDS) of the Panel Study of Income Dynamics (PSID) track the long-term impact of digital media on children's academic success and social adjustment, particularly those from lower-income, ethnic-minority backgrounds. The PSID-CDS study is one focus of our research program.

The Panel Study of Income Dynamics began in 1968 as a nationally representative survey of U.S. families. In 1997, the Child Development Supplement began to be collected, focusing on the 3562 children within those families. One area of interest was the media use patterns (television and video game play only) of these children collected through time use diaries. Early findings indicated both age and gender differences. For instance, very young children viewed less television than older children, and the youngest children viewed the most educational television. Girls and boys both viewed about 12 hours of television per week, but they viewed different kinds of programs.

Currently, Vandewater and her colleagues are planning the next phase of data collection for the PSID-CDS in which they will examine information about both secular changes in children's media use in different cohorts of children, as well as the developmental role of electronic media use in children's scholastic success and social adjustment. The additional data gathered about media use will include 1) detailed information via time use diaries regarding children's and adolescents' use of the computer, Internet, and websites; 2) data from parents about the location of various media in the home, particularly

access in a child's or adolescent's room; and 3) data about children's and adolescents' average use of electronic versus print media via survey instruments. The additional data allow longitudinal analyses of the same children over time, time-sequential analyses comparing different cohorts of children of comparable age at two different points in time, and the addition of new information about children's use of the changing digital media landscape. This information will be particularly useful in examining the digital divide and how access to computer technologies, or the lack thereof, impacts low-income children. Gender and Ethnic Issues: Interactivity and Online Identity Formation

Although children are spending considerable amounts of time interacting with digital media, gender and ethnicity are implicated in differential media use patterns. Boys used to spend more time in computer activities than girls did, but that trend is changing. Girls now spend as much time as boys in online activities except for playing video games (Gross et al., in press; Roberts et al., 1999), particularly sports video games (Wright et al., 2001). Boys, though, still spend time on more diverse sites than girls do (Roberts et al., 1999). Moreover, Caucasian and Asian American children spend more time online than do African American and Latino American children, who are more interested in television viewing.

Very little is known about the qualitative aspects of adolescent Internet use-about the use of email and Instant Messaging, about the culture of chat rooms and MUDs, about teen online discourse, and about the impact of such written narrative experiences on development. These online negotiations with others constitute one way by which adolescents construct their identities (Gross et al., in press; Turkle, 1995). How exactly do online interactions influence identity construction? How will these patterns change as online entertainment content becomes more ubiquitous and diverse? Do these patterns vary as a function of gender or ethnic background? Experimental and ethnographic approaches will be used to collect data and to examine these questions.

Gross and her UCLA colleagues are examining the nature and psychological impact of online communication in the most popular among today's youth Internet users, e-mail and Instant Messaging. An earlier web-based diary study of 260 seventh and tenth graders' naturally occurring online communication found high levels of boy-girl online communication, thereby implicating the Internet as an important vehicle for early adolescents to interact with, and thereby construct their own identities, in relation to other-sex peers (Gross et al., in press). Researchers are now examining gender patterns in <u>what</u> adolescents naturally do online, <u>with whom</u> they communicate (same-sex or other-sex interaction), and whether distinct online uses and communication partners, motives and topics are differentially related to well-being and identity construction. Participants will record their online communication experiences as they occur, providing detailed characteristics of interactions including communication partner variables (e.g., age, sex, closeness of relationship) and the context of use (e.g., what else participant is doing while interacting, online and offline). Hierchical linear modeling will be used to examine if: 1) girls and boys communicate similarly or differently in online interactions; 2) the Internet serves a different social function for lonely or otherwise marginalized boys and girls as compared to their socially accepted peers; and 3) online communication at home affects adolescent boys' and girls' adjustment in school.

Intimacy is another facet of identity construction (Erikson, 1959). To date, researchers have primarily documented and manipulated online communication among adult strangers. Interestingly, people who meet online versus face-to-face tend to: (1) become more intimate more quickly, (2) think more positively of each other, and (3) retain their greater liking for one another when they meet face-to-face (McKenna & Bargh, 2000). Online communication offers adolescents control over the rate of communication, an absence of physical cues, and anonymity. Given the prevalence of online communication among established, school-based friends (Gross et al., in press), it is important to know what kinds of patterns exist when people communicate with known as well as unknown others.

To answer these questions, dyadic Instant Message, face-to-face, and telephone interactions between adolescent friends and strangers will be compared. Data will be analyzed both quantitatively and qualitatively through self-reports (e.g., partner liking, intimacy of interaction), overall observer ratings of characteristics of interest (e.g., self-disclosure, conversational dominance), and discourse analysis.

Multi-user domains (MUDs) are another popular online activity in which social discourse takes place. Children and adolescents may construct identity, in part, by role playing messages that are relevant to who they are (Calvert, in press). By controlling the parameters available within a MUD, researchers can begin to understand how such social interactions are related to children's identity.

An online visual and textual MUD called TVTOWN, created by Calvert and her Georgetown colleagues, allows children to construct male or female characters. Children can also add props to create unique characters and diverse identity representations. Children then interact with other children online in TVTOWN which has scenes of an actual stage, an island, outer space, a park, an inner city street, and a castle that they can select. Within scenes, children can choose six different facial expressions to indicate how they feel. They can also move their character to different spatial locations within the scene they selected by clicking and dragging their character. Children communicate by writing in an onscreen blue box. The MUD itself keeps a running log of all visual and verbal activities that occur online.

Sixth grade children, a sensitive time for developing intimate other-sex relationships, are visiting TVTOWN and having two separate interactions with other children that they do not know who attend a different school. One interaction is with a same-sex child and the other with an opposite-sex child. We are especially interested in online social interactions that feed children's identity and the kinds of gendered collaborative exchanges they have with each other. We predict that girl-girl pairs will engage in more verbal interactions whereas boy-boy pairs will engage in more action-oriented interactions with boy-girl pairs falling in the middle for both kinds of interactions. Data will be analyzed using a qualitative methodology, developed by O'Keefe and Greenfield, for scoring linguistic presentations, focusing on how children co-construct their identities and social interactions.

#### Children's Learning from Media

Research Question 2: How do properties of interactivity and identity influence children's engagement and learning from entertaining digital media at different ages?

Children's learning from media depends on their age. Prior to middle childhood, children often have a limited understanding of complex, central plot-relevant television or computer content, particularly the motives and feelings of characters (Calvert, 1999). This makes young children more dependent on scaffolding techniques, such as adult-focusing commentary, designed to assist their learning.

## Control, Engagement, and Learning

One property of interactive media that is hypothesized to improve children's memory of targeted content is **control** of the learning situation. That is, the ability to control what a computer does is expected to improve a child's memory of content compared to one in which they have little or no control. But if a child has little understanding of what information should be accessed or focused upon, then control in and of itself should have little impact in improving children's learning of important content.

In an experimental study being conducted at Georgetown University, Calvert and her colleagues are comparing children's learning from an online educational storybook for those who: 1) control the story themselves with a mouse though they can also ask the adult to read parts of the story to them; 2) joint control of the story in which the adult first reads the story to the child and then gives the mouse to the child to explore key elements; and 3) no control in which the adult reads the story to the child and controls the mouse by clicking on those key story elements. Children in the joint control and the no control conditions are expected to remember more targeted content than those who control the story alone. Those in the joint control condition are expected to enjoy the activity the most.

# Identity, Responsiveness, Engagement, and Learning

Children like their favorite characters to respond to them (Calvert, 1999). While some argue that online interactions are more engaging than televised ones because the characters and the program can respond to you, some television programs involve children by having the host talk to and ask questions of the children in the viewing audience. These experiences are called participatory. How is learning different, or similar, in young children's interactive online experiences versus participatory televised ones? Do young children, who have not yet acquired gender constancy, prefer characters that are of the same ethnic background and gender?

Calvert and her Georgetown colleagues will examine if young children are more engaged with, and learn more, when they interact with a computer program than when they participate with a television host from that same series, particularly as a function of children's ethnic background and gender. An adult will expose Latino and Caucasian preschool boys and girls to one of three conditions of *Dora the*  *Explorer* (a young animated Latino girl) that vary in **responsiveness**: 1) a **participatory** condition where the television host asks children to do things; 2) a **nonparticipatory** condition where the television program is edited to eliminate the host's questions to the audience; and 3) an **interactive** condition with a computer program from the same series. Engagement and learning are expected to be higher in the interactive and participatory conditions than in the non-participatory one, particularly for Latino girls.

#### Neuroscience, Brain Activation, and Learning

Research Question 3: How do interactivity and identity influence children's patterns of brain activation from entertaining digital media?

Most existing research on the process of learning has not focused on learning through the media, and most work on media socialization has been done in isolation from new developments in the learning sciences. A goal of our center is to ground studies of media socialization, which focus on learning through informal and entertainment communication, in recent work from the learning sciences, including studies of the representation and activation of content in the brain.

The key processes on which we plan to focus are the impact of control over the learning environment, responsiveness, production values, and personal involvement on engagement and learning, as reflected in patterns of activation in the brain. Previous research has already demonstrated that differences in media content and presentation result in differential patterns of activation within the brain (Anderson, Fite, Petrovich & Hirsch, 2001; Murray et al, 2001). One study was of adults, the other of children. We plan to build on these two pioneering studies to carry out detailed experiments, across the age range from six to twelve, using functional magnetic resonance imaging (fMRI) techniques to identify neural differences underlying learning that result from different modes of media processing.

# fMRI, Interactivity, and Learning

Past neuroimaging of memory indicates that the extent of prefrontal cortical involvement during encoding is correlated with superior subsequent memory for encoded material (Brewer et al., 1999; Wagner et al., 1999). Vaidya and her Georgetown colleagues will examine children's processing of online scenes to determine how interactivity, in the form of responsiveness, influences neural processing. Tenyear-old girls and boys will be exposed to several audio-visual scenes and told to click on three specific objects. Some scenes will have objects that respond when clicked; other scenes will have objects that do nothing when clicked. Responsiveness within scenes will be counterbalanced across participants. The main hypothesis is that increased interactivity will result in superior subsequent memory because it engages the prefrontal cortex to a greater extent than less interactive modes of processing. The Neural Basis for Children's Understanding of Social Relations Presented on Video

Social relationships that are embedded in stories are the basis of current analog television programs and will be the heart of future digitized stories. These social interactions are also a basic means by which children and adolescents should begin to posture themselves in relationships as they construct their identities.

Fiske and his colleagues at UCLA are currently using fMRI to determine what goes on in the brain when adults watch movies depicting everyday social interactions. Based on over 30 experimental and ethnographic studies, four elementary relational models have been found that people use to generate, coordinate, interpret and evaluate most social interactions (Fiske 1991; Haslam, forthcoming). These relational models are 1) communal sharing (some feature that makes a group of people socially equivalent), 2) authority ranking (asymmetrical, linearly ordered differences among people), 3) equality matching (keeping track of additive differences, using even balance as the reference point), and 4) market pricing (socially significant ratios such as cost/benefit ratios). For the fMRI work, they made 20-second movies: 18 depict a variety of communal sharing interactions and 18 represent authority ranking interaction. Their first study confirmed that watching and interpreting a social interaction involves adult neural activity that differs from simply watching one person alone. The neural activation that results from observing authority-ranking interactions also differs from observing communal-sharing interactions.

Some researchers believe that for any given function, children use the same evolved, specialized neural structures that adults use; other researchers argue that children's learning from a given domain may involve areas quite distinct from the structures used to sustain adult action in that domain. Fiske and colleagues are now examining these competing developmental hypotheses when social relations are

presented on video. Specifically, fMRI is being used to study 7-8 and 11-12 year-old children's neural structures for understanding the same movie clips of Communal Sharing and Authority Ranking interactions that were used in the earlier study of adults.

# **Developmental Considerations**

# Research Question 4: How are dialogue skills acquired from infancy through adolescence?

Digital media technologies are creating more ways to connect more kinds of people, including very young children. Two developments, in particular, will influence the ways in which the reach of media will be expanded: multimedia and ubiquitous computing.

The dramatic expansion in computing power and bandwidth over the last three decades has created new capabilities to deliver content in the form of interactive multimedia, combining text, audio, video, and even touch and smell (Calvert, in press). People who formerly were excluded from an audience due to sensorimotor deficits or lack of relevant technology fluencies will increasingly be addressable via an appropriate interface configuration. Similarly, the seamless incorporation of digital technologies into homes and schools means that digital media will have an increasing presence in the lives of children, including very young children and infants.

Children's media choices change as they develop. Changes in media use patterns result from changes in use opportunities as well as developmental changes in children's cognitive and social skills that make certain content more engaging and comprehensible (Huston & Wright, 1998). Even so, patterns established at an early age tend to be highly predictive of later media-related preferences and scholastic achievement (Anderson, Huston, Schmitt, Linebarger, & Wright., 2001; Neuman, 1991). For instance, boys who viewed more educational television programs as preschoolers scored higher in science, mathematics, and English during high school (Anderson et al., 2001).

Nonetheless, there are very few studies that focus on preschool children's use of digital media or on the beginning uses of digital media that take place in infancy and toddlerhood, that track children's digital media use over time, or that consider sensitive periods in the acquisition of certain media-related skills and activities. In the infancy area, both child-usable media (e.g., interactive toys) and appropriate research paradigms (e.g., an imitation paradigm) are now available, and we plan to conduct studies in this importantl new area to provide insight into the ways by which infants learn from media. In addition, we will use sensitive periods of development, such as the development of a sexual identity, to frame questions about how children use, and are impacted, by media use at particular points in their lives. Experimental, ethnographic, and observational methods will be used to collect data.

# Infant Imitation as a Mechanism of Learning

A hallmark of true learning involves how children transfer knowledge from one medium to another (Bransford et al., 1999). Prior to the use of dialogue, infants can use preverbal modes of communication, such as imitation (Piaget, 1964).

Deferred imitation is a particularly useful technique for determining that an infant has retained a memory over time. More specifically, in order for infants to imitate either live or videotaped models, a representation of the target action must be formed and retained over time. For videotaped models, the 3-dimensional object (3-D) presented during the test must match attributes stored as part of the memory representation of the original 2-dimensional (2-D) video display. During the second year of life, infants will imitate actions demonstrated by videotaped models (Barr & Hayne, 1999; Meltzoff, 1988). However, there is a considerable developmental lag in infants' skills at transferring learning from videotapes to real-life situations when compared to learning from a live demonstration.

Two areas are of considerable interest in understanding imitation effects in relation to transfer issues. The first involves infants' exposure to repetitions of videotaped content in real life. Although infants often see material repeatedly, experimental research has rarely manipulated repetition to examine media transfer effects. One exposure to a stimulus limits an infant's ability to encode, retrieve, and act on (e.g., imitate) this information over a delay in time. The second area involves infants understanding of 2-D versus 3-D information. Interestingly, while young infants readily discriminate between 2- and 3-D information on the basis of visual cues, at first they functionally treat 2-D objects as if they were 3-D. It is possible that initially infants more readily use 2-D information to acquire information and only later in

development show a developmental lag in the transfer of 2-D to 3-D processing. If so, multiple exposures may assist younger more than older infants' learning.

Barr and her Georgetown colleagues are examining the effects of repetition and age on infants' skills to imitate a learning sequence through transfer of knowledge from a videotaped to a live situation. The effects of multiple exposures to videotaped demonstrations on deferred imitation on 3-D objects are being compared to a live demonstration and a control group for infants who are 12-, 15-, and 18-months old. For multiple exposure groups, parents will show the videotape either 1, 2, or 4 times in their homes on one day; testing will occur 24 hours later. This experimental research will establish parameters for infants of different ages to reliably imitate videotapes as well as shed light on infants' use of 2-D and 3-D cues.

# Developmental Differences in Children's Sexual Identity: Dialogue in Chat Rooms

One of the emerging changes in adolescent identity is that some interactions become sexual, and adolescents increasingly define themselves as sexual people (Erikson, 1959). Adolescence marks a sensitive period in sexual identity that can be observed in other-peer dialogue.

Traditionally discourse is defined as utterances that are a part of talking; talking can be in the form of a monologue, a dialogue between 2 people, or linguistic exchanges among several people in a group situation. Examples of discourse involving 2 or more people include conversations, arguments, class discussions, and negotiations. Online discourse includes both discourse conventions, such as the conventional opening, continuation, and end of a conversation, as well as abbreviated communication styles, including codes of veiled sexual discourse. To the uninitiated, this discourse often seems like a conversation in a different language. How is language used in electronic discourse? What are these new codes and conversational norms, and what is their social function in adolescent identity development?

UCLA researchers Greenfield and Subrahmanyam are examining developmental differences in the discourse on AOL's children and teen chat rooms. Adults monitor both sites. Pilot work indicates that adult monitors intervene at the slightest hint of sexuality in the children's chat room, but not in the teen chat room, where coded sexuality is the norm. This study will examine changes in children's communications with one another as a function of age, and the ways that adolescents code sexual language with one another.

#### Impact of Adult Monitoring on Adolescent Language in Chat Rooms

Adolescents who are unsupervised on the Internet may have more opportunities to act and speak in ways that may be destructive to identity construction than those who are supervised by adults. Greenfield and Subramanyam will compare the culture of an unmonitored and a monitored teen chat room. Pilot work indicated that in the unsupervised chat room, sex, aggression, and racism were rampant, whereas in the supervised chat room, sexuality was omnipresent, but coded, and aggression was virtually absent (Greenfield, 2000). This comparison is a natural observational study that will reveal the role of adult authority in structuring the cultural learning of young people, particularly their sense of sexuality.

## Social Policy and Programming Implications

At a broader cultural level, this program of research conducted at the Children's Digital Media Center has the potential to inform policy decisions as well as impact the kinds of digital programs that are available for children and adolescents to use. The potential of media content to harm youth often drives public policy decisions. For instance, there are current concerns that children's exposure to sexually explicit content on the Internet is harmful to development, yet the First Amendment limits ways to stop the dissemination of this content. There are also few data on either children's or adolescents' online sexual interactions. The studies conducted by our center will fill this void and provide information to be used in the decision-making process about children's access to inappropriate Internet content. Another age-based concern involves infants' exposure to any media; the American Academy of Pediatrics argued that very young children should not be exposed to television programming, but there are no data to suggest harm. Our center will shed light on how very young children and infants are impacted by media exposure.

The digital divide is another social policy area that challenges us to rethink how to engage children with new media in ways that foster their learning and development. Survey and experimental data collected by our team will provide information about the kinds of content that are most likely to

engage children from different ethnic backgrounds in new media as well as how media use patterns map onto academic success and failure in schools.

Gender differences in media use are yet another area of social concern. Although girls are now participating with new media, boys still are the game players who explore Internet spaces. These differential media use patterns may potentially have long-term effects on who simply uses the computer, and who controls its content.

The search for high-quality content is ever a challenge in children's media. Implementation of the Children's Television Act, which requires broadcasters to provide educational and informational television programs for youth, may well change when digital programs become the norm. Currently, the FCC requires commercial broadcasters to provide 3 hours of children's educational and informational television programs each week as a requirement of the Children's Television Act. In the new digital environment, what will this requirement mean? Digital programs allow the possibility of interactivity. If interactive programming is better understood than non-interactive programming, then perhaps the FCC policy could be altered to require that a certain amount of digital educational programming be interactive. Our data will shed light on how well children process programs that vary in interactivity, and hence, on what policies are appropriate for future programming requirements.

Finally, our data will illuminate the literature about the kinds of production techniques that foster children's learning. Producers can use this information to create quality digital media for youth that entertain, engage, and teach in informal settings.

#### Conclusion

The Children's Digital Media Center brings together an interdisciplinary group of researchers, representing the fields of human development, psychology, sociology, anthropology, and medicine, who will work together over the next five years to create and test a theory of learning about digital entertainment media. This program of research, based in media socialization theory, will use diverse methodological approaches to advance the knowledge base about the role that properties of dialogue, as evidenced in interactivity and identity, play in children's learning from entertaining digital media. These

data will advance both theory and method about our understanding of how the most popular pass times of children influence who they become and how their interactions with digital media will impact how they grow, learn, and develop. At a broader social level, this research will provide information that can influence social policy decisions about the ways that digital media are used in our culture. In addition, this research has the potential to serve as a guide for producers of children's media who can use this information to create delightful entertaining content that has the potential to inform and socialize youth in an engaging way.

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