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Maximizing Informal Learning from Digital Technologies

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When Americans think of literacy, they generally think of children's ability to read and write words. This kind of literacy is indeed an important way to become a well-versed citizen in the information age (Neuman, Copple, & Bredekamp, 2000). However, often neglected and even diminished in importance are visual/iconic and musical/echoic modes of thinking, which tend to be prominent in the information technologies that comprise children's daily lives (Calvert, 1999). Visual and nonverbal auditory icons are also a legitimate mode of thinking, one that is undervalued and underused to reach children who do not readily understand the abstract verbal symbols that are required for success in school settings.

Media use a rich display of visual and auditory production features, known as *formal features,* that can readily be used to instruct and teach children even as they are being entertained (Calvert, 1999). In particular, formal features such as action, sound effects, and singing can be used as scaffolds, building bridges between how a child thinks at particular points in development to the knowledge to be learned.

Little is known about how children come to understand and become literate in the use of these media symbols that pervade their daily lives. Nor do we understand enough about how visual and nonlinguistic auditory symbols provide links to words in ways that can enhance or diminish literacy. Yet, African American and Latino children, who are often economically disadvantaged, are more likely to live in homes that are television dominated—where nonverbal, visual forms are prominent modes of experience—than are their Caucasian peers

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(Roberts, Foehr, & Rideout, 2005). Not only do children who live in lower-income families view more television than those who live in higher-income families, but they are also more dependent on educational media for learning skills that are needed to succeed in school (Huston et al., 1992; St. Peters, Fitch, Huston, Wright, & Eakins, 1991). Therefore, it is important that we understand how minority youth come to read the "grammar" of the media.

My point is a simple one that has important educational implications for minority youth: television viewing is often blamed for poor literacy skills, yet there is rich potential for television to enhance literacy skills as well, particularly for children who grow up in lower-income households. By focusing on forms of thought that ethnic minority children typically use in their daily lives—which tend to be visual, nonverbal, and musical in nature (Heath, 1989; Roberts et al., 2005)—scaffolds can be created to words that may facilitate African American and Latino children's literacy.

Two major lines of research and thought are pursued in this chapter. The first involves how formal features can be used to facilitate children's learning and understanding of verbal material, a more traditional kind of literacy. In this area, I focus on the role that formal features can play as scaffolds for children's verbal learning. The second line of thought and research involves how children come to understand the unique codes of media as a symbol system in its own right. Because ethnic minority children are heavy users of both television and music, it is particularly important that we come to understand how formal features can be used to facilitate their literacy skills. I then discuss implications of formal feature use for effective instructional design.

FORMAL FEATURES

Formal features are audiovisual production features that structure, mark, and represent content (Huston & Wright, 1983). They are the grammar of audiovisual media (Calvert, 1999). As seen in Table 16.1, these features at a macro level involve *action* (physical movement) and *pace* (the rate of scene and character change). At a micro level, these features include visual camera techniques such as *pans* in which objects are followed in a continuous sweeping motion, *zooms* to close-ups or away from objects, *fades* in which the screen goes black, *dissolves* in which one object appears on top of another, *cuts* from one point of view to another, and *visual special effects* in which the physical rules of reality are violated. Auditory micro features include *sound effects* in which loud noises occur; character *vocalizations* of unusual nonspeech sounds; *music* that is either in the *foreground* (prominent) or *background* (with dialogue); *singing* (music and language combined); *laugh track* (off-screen audience laughs); *dialogue* by *adults* (adults speakers), *children* (child speakers), or *nonhumans* (e.g., animals characters in cartoons); and *narration* (one person speaks and explains the story). Being able to decode and "read" these features is the essence of being a literate user of information technologies.

Table 16.1. Taxonomy of formal features

Features	Definitions
Macro features	
Action	Amount of movement
Pace	Rate of scene and character change
Visual micro features	
Cuts	Camera technique involving quick shifts in visual perspective
Zooms	Continuous camera technique moving the lens toward or away from an object or scene
Fades	Camera technique that goes to black
Dissolves	Camera technique that makes the edges of the scene blurry as a new image emerges
Pans and trucks	Camera technique in which objects or events are followed continuously on a horizontal or vertical plane
Visual special effects	Camera techniques such as trick photography, freeze frames, and fast motion
Auditory micro features	
Foreground music	Loud music with no dialogue
Background music	Music with dialogue
Vocalizations	Nonspeech noises
Sound effects	Unusual prominent audio effects (e.g., zip!)
Laugh track	Audible laughing by an off-screen audience
Child dialogue	Child speech
Adult dialogue	Adult speech
Nonhuman dialogue	Speech by an animal character or other nonhuman character
Narration	Speech by one individual, typically explaining on-screen events
Singing	Music and lyrics combined

Formal features vary in *perceptual salience,* that is, in their attention-getting properties. Perceptual salience involves stimulus properties such as movement, contrast, change, incongruity, and complexity, which are likely to have survival value for our species (Berlyne, 1960). Applied to information technologies, macro features such as action (movement) and rapid pacing (change and complexity) and visual and auditory micro features such as character vocalizations, sound effects, visual special effects, and frequent camera cuts (incongruity, change, contrast) have been classified as perceptually salient. By contrast, features such as adult dialogue, child dialogue, and narration, although potentially carrying the most informative linguistic content, are in and of themselves low in salience (see Calvert, Huston, Watkins, & Wright, 1982).

The linguistic features of adult dialogue, child dialogue, and narration have considerable potential to foster children's interest in and sensitivity to oral language. If words are written on the screen, literacy skills can also be promoted.

However, the varying salience of different features used to present content in information technologies creates a challenge: How do you get children to pay attention to and process language when there are so many other more interesting features to attract and hold their attention? In many media interfaces, the answer lies in the judicious pairing of other features—action, sound effects, character vocalizations, and singing—with written and spoken language. These features are maximally effective as a learning tool when they dovetail with the cognitive skills that children bring to bear on information at different points in development.

FORMAL FEATURES AS SCAFFOLDS FOR CHILDREN'S LEARNING

Vygotsky (1978) argued that young children need scaffolds, or bridges, that link what children currently know and understand to knowledge that is just beyond their realm of understanding. His approach focused on verbal, linguistic ways of learning, particularly the bridges that parents build between what their child knows and the knowledge to be learned. Just as knowledge may be more or less available to children during certain developmental time frames, so too are children's abilities to process certain symbol systems. According to Bruner, Olver, and Greenfield (1968), very young children think in enactive, motoric modes followed by visual iconic and finally abstract symbolic verbal modes. These modes of thinking can be activated and enhanced by using certain production features in a presentation, thus providing scaffolds to improve the effectiveness of informal instructional learning environments, including those presented in a linguistic format. Although less understood than the verbal scaffolds presented by parents, one thesis developed here is that formal features can also serve as scaffolds for children's learning.

Features as Early Elicitors of Imitation and Enactive Ways of Thought

Thinking with the body can readily be observed in infants' and young children's imitation of the many live adults and symbolic models that they view. Meltzoff (1988) demonstrated that even infants can imitate actions portrayed on a video, though the presentation had to involve contingent replies to what the infant did. These early imitative activities activate the mirror neuron system in which infants learn to understand by copying others' movements (Meltzoff, 2002).

We examined songs as ways to promote early learning by creating a scaffold between children's actions (i.e., enactive rehearsal) and the lyrics of the song (Calvert & Goodman, 1999). Toddlers either sang songs or sang the songs while displaying actions that conveyed the meaning of the song. For instance, they either sang *I'm a Little Teapot* and tipped their bodies over and "poured out" the tea or they just sang the song. The toddlers who used enactive ways of rehearsing the song lyrics subsequently understood the meaning of the song better than those

who simply sang it without the aid of motor rehearsal. Put another way, the motor behaviors provided a scaffold, that is, a link, to the meaning of the song lyrics.

Similar findings occurred when preschool-age children were exposed to an episode of *Dora the Explorer* in which we manipulated the interactive prompts that get children to act out content (Calvert, Strong, Jacobs, & Conger, 2007). In the original version, Dora asks children to do things with her such as climb the ladder to rescue Benny the Bull, thereby eliciting imitative actions from her verbal prompts. We manipulated this prosocial, educational story so that children were exposed to either 1) a control version in which there was no interaction and an adult sat at the back of the room; 2) a control observational version in which the adult sat beside the child while viewing; 3) a participatory version in which the adult interacted with Dora and the child could do so or not; and 4) an interactive version in which the program paused and the child had to use a computer to move the program to the next point. Children from Latino backgrounds, who tended to come from Head Start programs, were compared with their Caucasian peers who came from middle-class backgrounds. After viewing, children answered a verbal multiple-choice test. We found that the more children participated with Dora, the better they understood the central story content.

In homes where verbal discussion may not be a priority, such as low-income African American homes (see Heath, 1989), having an animated character "look" at children through a camera lens, ask questions of viewers, and engage children in program-related activities and discussion can potentially improve children's learning of educational program content. Perhaps television characters can serve the same function as an interactive adult, thereby providing scaffolds for children's learning in low-income households. Although the middle-class Caucasian children understood the content better than the lower-income Latino children did, Latina girls who were in the interactive condition understood the central story content better than the Latina girls in the observational condition (Calvert et al., 2007).

Action as a Mode of Thought

Preschool-age children often think in a visual, iconic mode (Bruner et al., 1968). Action or movement can enhance or disrupt children's learning of content, be it presented on a television or a computer (Calvert, 1999).

The classic study of children's learning from television was conducted by Hayes and Birnbaum (1980). In the study, they showed preschool-age children original intact programs or altered programs that had the sound track of one program combined with the visual track of another program. In mismatched conditions, children remembered the visual track over the verbal track. This outcome became known as the visual superiority effect: Children remember the visual track at the expense of the auditory track.

In our early work (Calvert et al., 1982), we wondered if the visual superiority effect was really because of the perceptually salient character actions. Moreover,

because action and dialogue are similar to iconic and symbolic modes of thought, we believed that action could facilitate children's learning, particularly at young ages when the predominant mode of thinking is more iconic than at subsequent points in development. By contrast, we expected that dialogue alone, a nonsalient form, would be of more benefit to older children. In our initial correlational study, preschool and kindergarten students and third- to fourth graders viewed an episode of *Fat Albert and the Cosby Kids*, a prosocial cartoon featuring a cast of animated African American boys and their live African American host, Bill Cosby. We had previously scored the formal features of that program, including the character action. We later linked children's attentional patterns to the program and their comprehension of program content to those features.

Children remembered the central plot-relevant content better when the language had been paired with action rather than when the central content was only spoken. These findings were true of the older as well as the younger children. In fact, the youngest children who understood the program best did not attend when Bill Cosby was speaking, presumably because his narrative comments occurred during low-action sequences and were incomprehensible, so they stopped looking. Our results suggested beneficial effects of action through the middle childhood years (Calvert et al., 1982). Similarly, 4- and 7–year-olds reproduced the actions more than the language of characters when they heard or viewed a story (Gibbons, Anderson, Smith, Field, & Fischer, 1986).

Lawler (1982), who was creating computer worlds during this same time frame, was able to improve his 2-year-old daughter's literacy skills by building vocabulary words into a program which put information on a visual beach scene. For an object to appear on the beach, his daughter Peggy had to key in the word. For instance, if she keyed in the word *pony,* a pony appeared on her beach. In other words, she had control of making events happen. Lawler created what became known as intrinsically interesting learning environments.

In subsequent experimental studies, my colleagues and I decided to examine the role of various formal production features in creating intrinsically interesting learning environments. In our first study (Calvert, Watson, Brinkley, & Bordeaux, 1989), we created a game called *Park World* in which objects were programmed to appear with or without action and with or without sound effects. Six different groups contained four objects each (e.g., the group *vehicles* contained car, truck, plane, and train), for a total of 24 objects. Four versions of *Park World* were created to examine the effects of movement and sound effects independently of the specific object. For example, across the four versions of *Park World*, the car appeared moving with sound effects, moving without sound effects, nonmoving with sound effects, and nonmoving with no sound effects. Kindergarten-age children listened to the same story about *Park World* for four days as the experimenter keyed in the objects. Each day, children selected objects to go in their park from the six sets and keyed in those object names. Children chose more objects that moved than those that were stationary to go into their park. On the fifth

day, we asked children to tell us all of the objects that were in *Park World.* Objects that moved were more likely to be recalled than those that were stationary. The findings suggested the importance of action for remembering information.

In our next study (Calvert, Watson, Brinkley & Penny, 1990), we randomly selected a version of *Park World* and added a voice synthesizer to speak the object names, creating what became known as *Talk World.* The action was retained. Here we became particularly interested in how to link action and language to improve children's recall of content. Children heard the story only one time in this version and were then asked to tell us the names of all the objects that they could remember from *Talk World.* This time we compared good and poor readers in kindergarten and second grade. There were no effects for kindergartners who were not yet reading; however, poor readers in the second grade recalled just as many objects as the good readers when the objects moved. By contrast, good readers recalled more objects than poor readers when the objects were stationary. The results suggested the beneficial effects of action for poor readers, as action basically provided a scaffold for children's verbal recall of object names.

Rehearsal is a mechanism that enhances children's learning of educational content. Following Salomon's (1974) ideas of activating (i.e., calling upon) versus supplanting (i.e., providing) cognitive skills, I (Calvert, 1991) modified how the story was presented in *Talk World.* In the verbal label condition, we continued to read the words (i.e., supplantation condition). In the no label condition, rather than reading the targeted words, we now paused (i.e., activation condition). Objects still moved or were stationary. Preschoolers' and kindergartners' spontaneous production and subsequent recall of objects was then examined. Children in the no label condition were far more likely to produce the names of targeted words, particularly when the objects also moved. For both age groups, using action and verbal labels together facilitated recall better than having no action or no label. The kindergarteners' recall was most likely to benefit from having both verbal labels and action presented simultaneously, suggesting that they were able to integrate the different forms of presentation better than the preschoolers did. Here, then, we see beneficial effects of action as a scaffold for language for both rehearsal and memory of content.

Children with developmental disabilities such as autism often are challenged when learning language, in part because they are more interested in machines than in the human interactions that are a major context for language development (Baron-Cohen, Wheelwright, Lawson, Griffin, & Hill, 2002). Computers, therefore, are a potentially useful mechanical domain for teaching language to children with autism. To examine the potential of production features in a computer scenario for children with autism, Monique Moore and I created a scenario in which children could learn words that were associated with moving objects on a computer display. The Lovaas method, in which children are taught to pay attention to an adult to facilitate language acquisition, was used in conjunction with the computer program or alone as the control condition. After instruction,

children were asked if they wanted to play outside or keep playing on the computer. We also assessed their verbal learning. Preschool children who had autism were more motivated to continue playing the computer game and learned more nouns when they had been instructed via the computer than by the Lovaas method alone (Moore & Calvert, 2000).

In summary, although visual content can interfere with children's recall of verbal content when a mismatch occurs between the verbal and visual content, action generally helps children understand verbal content when these two forms present consistent information. Beneficial effects occur whether the content is presented via television or computer interfaces. Action seems particularly helpful for children who are young, who do not read well, and who have developmental disabilities such as autism. Even though older children get better at processing words without some kind of visual scaffold, action can still benefit children's learning well into middle childhood. Latino children benefit from programs designed to elicit interaction from them.

Singing for Verbatim Recall

Singing is a reflective feature that combines language with music (Huston et al., 1981). Although educators have often thought that singing is a useful way to improve learning, the scaffold that it provides to language offers a bridge to verbatim memory, not to comprehension of content.

School House Rock was an instructional series designed to teach children history, science, mathematics, and English. Short vignettes of approximately 3 minutes presented animated bits with singing to accentuate the message. In our first study of *School House Rock* (Calvert & Tart, 1993), we examined a vignette about the Preamble to the U.S. Constitution. College students were compared in conditions in which the Preamble was either spoken or sung. Immediate and long-term recall of the words to the Preamble was assessed after several viewings. Students who had seen the sung version of the Preamble recalled more of the words in the exact original order than those who had seen the spoken version of the vignette. The results linked repeated exposure to a sung vignette to very good short-term and long-term memory of words.

In a subsequent study (Calvert, 2001), I examined a history vignette from *School House Rock* about the Revolutionary War. The conditions varied the use of a visual or a nonvisual track and the use of a sung or a spoken audio track. This time, children viewed the vignette only once. Contrary to prediction, children understood the spoken track better than the sung track. Although unexpected, these findings dovetailed nicely with an intriguing finding from our Preamble study: Words were sometimes substituted in students' renditions of the Preamble that did not preserve the original meaning of the Preamble. For example, one person in the singing condition wrote "to ensure the blessings of liberty to ourselves and our *prosperity*" rather than ""to ensure the blessings of liberty to ourselves and

our *posterity*." These findings suggested some problems in using singing to teach information that went deeper than superficial memorization of the lyrics.

"I'm Just a Bill," another *School House Rock* history vignette, described how a bill goes through the process of becoming a law. I manipulated how much children were exposed to this vignette (Calvert, 2001). Specifically, third graders and college students were exposed to the vignette in its original spoken and sung soundtrack either once or four times. After the final exposure, verbatim recall, verbal sequencing of how a bill becomes a law, and comprehension of the content was assessed. The repetition condition increased all students' verbatim recall and verbal sequencing of content but not their recognition of the important story content. When asked what a bill was, one child told us that a bill was "something that you pay."

Taken together, the findings suggest that singing provides an excellent and durable way to rehearse and remember content in a verbatim form; however, if you want to improve comprehension of the message, speaking the same content is the best way to improve memory. These findings support Craik and Lockhart's (1972) levels of processing theory in which content can be processed at a superficial level without a deeper understanding of the meaning of that content. It appears that singing, unless accompanied by enactive rehearsal such as what we did with *I'm a Little Teapot*, is a superficial learning technique, whereas the use of language without singing is more likely to receive deeper processing. Thus, although singing provides scaffolds to verbal content, its effectiveness as an instructional feature depends on the kind of lesson to be learned. A challenge for instructional design is to create additional scaffolds between language and songs that can yield deeper processing of the content. One such possibility may be to use rap, a musical form that is popular in African American culture that combines spoken language with a rhythmic presentation.

Parsing Content: Sound Effects and Vocalizations as Markers of Important Content

In addition to serving as a mode in which to represent content, formal production features can parse and mark content for further processing, thereby providing a scaffold to the verbal linguistic content that follows. Our early naturalistic study of *Fat Albert and the Cosby Kids* was the first place that we documented this beneficial effect (Calvert et al., 1982). In the episode that we studied, Fat Albert would say, "Hey, Hey, Hey, I've got something to say." Then, he would say important verbal content that helped children understand the story. Children who selectively attended the most immediately after character vocalizations (in this case, Fat Albert's "Hey, Hey, Hey") understood the central story content the best. We hypothesized that children initially attend to vocalizations because of their perceptually salient qualities. Even after children were familiar with sound effects, we argued that these perceptually salient audio features still captured attention

and elicited active processing because the sound effects had become a learned signal that was associated with important story content.

In subsequent experimental studies, we manipulated sound effects inserted at key scene transitions to see if it helped children understand the central plot-relevant content of the narrative. In one study, we found that sound effects inserted at three key scene changes increased kindergartners', but not third- and fourth graders', recognition of the implicit, central plot-relevant content (Calvert & Gersh, 1987). The older children in the study understood the central content, but the younger children needed the sound as a scaffold (Calvert & Gersh, 1987).

In a follow-up study in which we varied how rapidly the scenes and characters changed, we found that sound effects worked best for the rapidly paced program (Calvert & Scott, 1989). Specifically, young children were more likely to selectively attend to scene changes in the rapidly paced program when sound effects were present, not absent. Moreover, selective attention at these key program transitions predicted kindergartners' comprehension of the content. Older children, by contrast, did not need the sound effects for comprehension of the rapidly paced program. Research indicates that infants begin to integrate sound effects with target actions at about 1 year of age (Somander, Garcia, Miller, & Barr, 2005).

Taken together, the results suggest the value of sound effects as a way to draw attention to key program content that can then lead to temporal integration of the plot line. Put another way, sound effects and character vocalizations can help children build a scaffold to link important program transitions and fill in the gaps when they are viewing television programs. The effectiveness of these salient features to guide attention occurs very early in development.

DOES LITERACY INVOLVE MORE THAN READING AND WRITING TEXT IN THE INFORMATION AGE?

Our traditions as a species are deeply rooted in our creation of and use of written language, an aspect of thinking that makes us unique from other species. Written words as a mode of cultural transmission became dominant when the printing press emerged, allowing that aspect of thought to be widely disseminated with ease (Calvert, 1999). We now live in a world where we not only can view other people's thoughts through production practices such as flashbacks in time but we can also create and transmit our visual realities through devices such as cameras or drawings that we interface with computers. In these ways, newer technologies allow us to communicate with one another in visual as well as in musical and written forms of thought. Little is known about how we come to understand and use nonverbal symbols even though they comprise much of what children experience in their daily lives.

Take a feature such as a camera zoom versus a camera cut. The camera zoom provides focus; it simulates how one uses one's eyes to learn information. A camera zoom moves into a close-up of an object, modeling the skill of whole to part

or vice versa (Salomon, 1974). By contrast, camera cuts call upon viewers to fill in the gap of going from part to whole. Salomon's classic research (1974) demonstrated that young preschool-age children benefited the most after exposure to a camera zoom, which supplanted (i.e., provided) the cognitive skill for them, whereas older children benefited the most from viewing a camera cut, which activated that cognitive skill, calling upon the children to produce the activity of going from part to whole themselves.

Camera dissolves are a media convention that generally represent a shift in time, including major time changes such as flashbacks. Although the dissolve does not have a direct link to how we use our eyes, it is a representation that is easier to understand than a camera cut when conveying a flashback. For instance, Calvert (1988) found that kindergartners and first graders were much more likely to understand that a flashback had taken place when a dreamy dissolve rather than an abrupt camera cut had occurred between the scene transitions. Although fourth- and fifth graders were less dependent on the camera cut for comprehension of the time change, even they understood the camera dissolve best. How children come to understand camera dissolves and cuts is unknown.

IMPLICATIONS FOR INSTRUCTIONAL DESIGN

As can be seen from the empirical research, production features provide a vast array of options to provide scaffolds for motor, verbal, visual, and sequential ways of learning. Pauses and prompts that are built into a program can elicit active processing from very young children who interact with the characters and content, thereby yielding enactive ways of remembering content and imitative displays of that learning. Action provides a visual mode to represent content that can facilitate but also disrupt memory of linguistic information, depending on how those scaffolds are built between these two symbol systems. Singing provides a reflective way of processing words, though it can stay superficial unless enactive bridges are built to elicit deeper processing of the content. Sound effects and character vocalizations elicit attention and facilitate processing of central and sequentially presented content though they can be distracting if they do not match the ecology of the visual presentation.

One interesting design challenge is how to facilitate children's attention to, and learning of, written rather than oral words presented in screen media. I have observed poorly designed interfaces in which the action is being presented at the same time that the written words are appearing on screen. The goal of the design is to get children to read, but the presentation is probably drawing attention away from the words and to the moving images. The solution may well be to have the words appear while a still image is on screen and then have the images move after the words are read and written. If the words are appearing as they are being read, the moving words should elicit attention and processing, thereby improving literacy. Faces are also distracting because children tend to look at the person rather

than the words on the screen. *The Electric Company*, a 1970s educational television program designed to enhance literacy skills, dealt with this design issue by having two faces appear sideways and in shadow, thereby facilitating attention to written words that were blended on the screen rather than to the faces.

As an instructional design feature, singing has the educational benefit of preserving a verbatim memory of events that can be accessed for very long periods of time. The design challenge of singing is to get children and even adults to think more deeply about the content so that they not only remember the lyrics but understand the message. Fortunately, words can be processed at any time so that information is available if listeners are prompted or motivated to think about the underlying message. At young ages, enacting the lyrics helps children get the right message (Calvert & Goodman, 1999), and repeating the song helps enhance verbatim memory of the content (Calvert & Tart, 1993). Although we have not studied singing that is accompanied by written words, that approach may be helpful for yielding deeper processing at older ages, as may the use of rap.

As instructional design features, vocalizations can readily elicit children's visual attention, thereby providing a bridge to the significant program content that improves learning. Perceptually salient sounds are a good ecological fit when embedded within rapidly paced television programs (Calvert & Scott, 1989). They are most useful at very young ages in terms of plot comprehension, but they elicit attention and processing at many developmental time frames, starting in infancy and continuing at least through middle childhood (Somander et al., 2005; Calvert et al., 1982). Sound effects are easily integrated into previous productions, which we often did during our studies, making them a very cost effective way to improve the instructional effectiveness of existing programs.

CONCLUSION

Children spend much of their daily lives with screen media. At this point, television is still the dominant medium in children's homes, particularly those from African American and Latino families who live in television-centered homes (Roberts et al., 2005; Rideout & Hamel, 2006). Children from these ethnic minority groups also tend to be less successful in school than their Caucasian peers.

Much has been done via programs such as *Sesame Street* to improve the educational outcomes of low-income children (Fisch & Truglio, 2001). More could be done to facilitate learning television content through the judicious use of production features. For instance, music is a very popular form of presentation in African American and Latino culture (Roberts et al., 2005). Musical forms, such as rap, could be used to teach verbal academic lessons to African American children in a form that is interesting and relevant to their culture. Parents who talk to their children facilitate language development, but many minority children come from homes that are not overly talkative (Heath, 1989). In these cases, productions can be crafted to elicit active participation, including verbal discussion with the charac-

ters. Although the future promises to be a more interactive one, our research indicates that similar design principles apply to computer as well as television platforms.

In the 21st century, which is dominated by visual and digital media, it is timely to think about how our information technologies are influencing literacy, both in its traditional verbal form as well as in its visual, musical, and increasingly interactive form. The judicious use of formal features as scaffolds to the content and to the form of children's thought are essential to the creation of well-designed instructional platforms and to our understanding of what literacy entails in the 21st century.

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