The Symbol Systems of Media in Relation to How Children Think at Different Ages

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When scholars 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, 2007). 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.

A central point that I will make in this lecture is that media use is often blamed for poor literacy skills, yet there is a rich potential for media to enhance literacy by linking important information to intrinsically-interesting formal features such as action and singing. Two major lines of research and thought are discussed in this talk. The first involves how formal features can be used to facilitate children's learning and understanding of verbal material, a traditional kind of literacy. The second line of thought involves how children

come to understand the unique codes of media as a symbol system in its own right. Both depend on children's representational capacities.

Developmental changes in how children think. How children think about and represent information changes as a function of development. Bruner and his colleagues theorized that infants tend to think in enactive modes of representation, preschoolers tend to think in iconic visual modes, and older children tend to think in abstract verbal, linguistic modes.

Formal features dovetail and supplement children's representational skills. When a presentation gets children to interact with a character, such as pretending to climb a ladder, an enactive mode of representation is generated which can assist information processing. Similarly, when a presentation provides a visual depiction of information to be remembered, such as a character handing another character a present to make up to them for being unkind, a visual iconic mode of representation is elicited. Words appear in most media presentations. Words are abstractions and are the most difficult code to process. Linguistic presentations without other supports are often difficult for young children to understand, though older children are much more able to do so.

Formal production features. For children to understand media messages, they must be able to decode the symbol system of media, which is itself a kind of grammatical system. Media use a rich display of visual and auditory production features, known as *formal*

features, the audio-visual production features that structure, mark, and represent content (Calvert, 1999, 2007). These formal features can readily be used to instruct and teach children even as they are being entertained (Calvert, 2008).

Scholars in the field of psychology conceptualize children's learning from media by two major theoretical approaches: the exploration to search model and the comprehensibility model. These models were originally developed to study preschool- and grade-school-aged children's learning from television, but are now being applied by scholars at the Children's Digital Media Center to study infants' and toddlers' very early learning from screen media.

According to the exploration to search model, developed by Huston and Wright (1983), formal features vary in their perceptual, attention-getting properties. In particular, features vary in how much they display perceptually salient qualities such as movement, contrast, complexity, surprise, and incongruity that are likely to elicit attention and interest from young viewers. Perceptually salient features are hypothesized to be attention-getting from the beginnings of life because they have survival value (e.g., one should attend in the natural environment if there is rapid movement or a loud noise because it could signal impending danger). Applied to formal features, those that exhibit high levels of perceptually salient qualities include moderate or rapid action, rapid pace (scene and character changes), visual and auditory sound effects, and rapid camera cuts. These features should be especially likely to attract the attention of younger and less experienced viewers. Low salience features

primarily involve dialogue, narration, and low action sequences. With age and development, attention should be garnered more by meaningful content rather than by perceptual salience *per se*, signaling a shift by older viewers to dialogue and language as it becomes a larger part of their search for information.

The comprehensibility model, developed by Anderson and his colleagues, focuses on the child's search for meaningful content. This theory hypothesizes that children are always in search of meaningful content, regardless of the salience of the presentation. When dialogue is manipulated, for example, preschool-aged children attend more when the content is comprehensible and presented in its original form than when the same content is presented in a foreign language or presented backwards (Anderson et al., 1981).

Both perceptual salience and comprehensibility are used when creating children's television programs. Entertainment programs such as cartoons use high concentrations of perceptually salient formal features, but educational programs designed for those audiences also include reflective clusters. Reflective features include long, slow camera zooms that supplant the cognitive skill of going from whole to part by modeling that eye movement for viewers. Another reflective feature is singing (Huston-Stein et al., 1981). In empirical studies, children attend to perceptually salient features like sounds effects and character vocalizations, but also prefer child and female dialogue over adult male dialogue, a finding that supports the comprehensibility model (Anderson et al., 1981; Calvert et al., 1982). In

our latest studies, supported by an IRADS grant from the National Science Foundation, we hypothesize that perceptual salience may have its greatest impact during very early development.

Preliminary findings from our IRADS research, in which we conducted a formal feature analyses of videos designed for very young children, generally reveal the use of very high levels of perceptually salient features such as rapid pacing and numerous camera cuts. Although these programs are perceptually salient and may be attention getting, these techniques should make it very difficult for infants and toddlers to understand the content because they require cognitive skills to integrate content that are poorly developed in very young viewers (i.e., being able to fill in the information gaps via inferences in order to integrate content across scenes and across camera shots). Indeed, rapidly-paced television programs are difficult for older preschool-aged children to understand (Wright et al., 1984). In the formal feature analysis of infant-directed videos, we also found some support for the comprehensibility model: adult female narration was used in the videos more often than adult male narration.

Formal features and verbal processing. The grammar of the media affects children's learning of language in two major ways: 1) *by signaling children* that an important verbal event is about to occur; and 2) *by providing dual modes to represent content* (Calvert, Huston, Watkins & Wright, 1982). Both of these processes depend on the use of perceptually

salient features. In the first instance, features such as sound effects can be used prior to the appearance of verbal linguistic information in children's television programs. The perceptual salience of a sound effect elicits an orienting response if a child is inattentive, thereby calling attention to what is occurring on the screen. The next information that appears on the screen is likely to be processed because of the temporal contiguity between the sound effect and the language, thereby improving comprehension of the verbal, linguistic content (Calvert et al., 1982).

Forms such as action, singing, and dialogue can be used as *modes to represent content*, and often provide a dual way to think about important information. The striking visual action of characters on a screen, particularly when there is moderate movement at about the speed of a walk, can improve memory of the associated linguistic content. When there is a match between actions and the verbal labels of those objects in a computer game, for instance, preschool-age children remember the words better (Calvert, 1991). Action in this example provides a visual, iconic way of thinking that is developmentally appropriate for young children. By linking actions with language, dual modes are provided to help young children learn the more abstract, linguistic content. Not surprisingly, mismatching action and language leads to an interference effect, with the visual track having more valence than the auditory track for preschool-age children. Similarly, singing can help children remember educational media content, providing a mnemonic device that helps children recall auditory

information verbatim. However, this kind of processing is often superficial, leading to lower levels of comprehension of the meaning of the passage than a comparable spoken presentation. These effects can be altered if children act out the information that is being sung, thereby providing an enactive, physical mode of thought to supplement the sung passage (see Calvert, 2008, for a summary of this research).

Digital screen literacy: Understanding form. While forms can be used to improve children's understanding of linguistic information, *knowing the meanings of forms per se* is also an important component of 21st century literacy. For instance, a dreamy camera dissolve typically represents a major shift in time and place. Children understand this media convention by middle childhood (Calvert, 1988), and 21st century children have ample opportunity to use dissolves themselves, such as when they create transitions during a power point presentation. Similarly, a camera zoom models how to visually focus attention on an object (Salomon, 1974). The camera lens provides a representation of how to use one's eyes to gain important information. Playing video games in which the task is to move through a maze is associated with better visual spatial skills, an important aspect of intellectual development (Subramanyam & Greenfield, 2008). All of these are examples of how forms influence representational thinking without the use of verbal linguistic tools.

At the Children's Digital Media Center, we are currently exploring how infants begin to read a screen. As we predicted, the earliest responses to video at age 6 months seem

driven by perceptual salience followed by more differentiated responses to formal features with development and experience. With those developmental and experiential changes, young children learn to read the grammar of media. For example, Barr and her colleagues found that 6-month-olds imitate when sound effects are matched or mismatched with content, a perceptual salience effect, but 12-month-olds' imitation is disrupted when the sound effect is out of synch with the content. Put another way, infants learn the difference between a salient meaningful and non-meaningful sound effect by age 1. Similarly, eye-tracking studies reveal developmental shifts in learning to use camera cuts: 1-year-old viewers do not discriminate between cuts as content boundaries, but preschoolers and adults do (Kirkorian, 2007).

A key problem that infants experience with screen media is known as the video deficit, which is a failure to transfer the visual images that they view or interact with to real-life settings (Anderson & Pempek, 2005). Put another way, infants and toddlers generally do not understand that a representational experience stands in for a real experience. We are examining if children are better able to transfer knowledge when presented in a computer game of "hide and seek", which involves contingent interactions, than when they view a video version of the same game. For children who are age 30 months, there are no differences in learning from the computer versus the video version of the game. However, by age 36 months, our preliminary findings indicate that the content embedded in the video version is transferred better to real-life situations than is the same content presented in a

computer version. We believe that the computer version requires children to multitask, moving their attention from how to use the computer keyboard to remembering the content on the screen. Because the video version only requires them to process and remember where the objects are hidden, children perform better when just observing than when also having to act on the symbolically-presented content.

Conclusion. Long ago Marshall McLuhan argued that media were unique in their form, not in their content. In the information age, audiovisual forms are embedded in children's everyday lives. The evolution of information technologies has allowed children to move from viewers of formal features to creators who use these forms to display their own thoughts and knowledge. Through an understanding of the representational capabilities of children at different points in development (i.e., enactive, iconic, symbolic), formal presentational features can be used to enhance what children are learning. In this way, the ubiquitous influence of media can be harnessed to provide interesting and educational lessons to children in a form that is engaging and understandable to them. They can use this knowledge of form, in turn, to create and disseminate their own ideas.

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