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Toward a Redefinition of "Educational" in Babies' and Toddlers' Media: Overt Visual Attention, Verbalization, and Other Measures of Engagement as Indicators of Learning

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ABSTRACT

This paper provides an analysis of data from an earlier study in which children 12- to 24-months failed to learn from an educational infant DVD. Whereas children performed no better than chance on the original posttests, coders noticed verbal and nonverbal behaviors that appeared to indicate engagement with the content while it was playing. After an analysis of the videotaped trials, this project uncovered several behaviors indicating engagement, such as unprompted verbalizations of items on screen, verbal imitations of items on screen, non-verbal indications of engagement with the program, program elicited amusement, and both verbal and nonverbal behavior directed at the DVD player itself. Results are discussed in the context of Sproull (1973) and Crawley et al.'s (2002) findings that direct reactions to program content are indicators of "vicarious participation" which is a reflection, rather than a cause, of learning.

Keywords: Babies, Toddlers, Media, Learning, Engagement, Baby Einstein

INTRODUCTION

As has been well-documented, children under age two have great difficulty learning anything of educational value from televised media [1-6]. Research on this "video deficit effect" consistently demonstrates learning from a live model is far superior to learning from a televised model. In a recent video deficit effect study by the current author [7], children ages 12 to 24 months failed to learn from a four-minute video clip of the first three letters of the alphabet, as evidenced by responses to a posttest that were no better than chance. This result was found even after some children viewed the clip six times. Whereas that particular project was designed as a pretest-posttest quantitative study, during analysis of the videotaped trials of children viewing the video clip and completing subsequent posttests, coders were surprised to find these children consistently failing the posttests *when they appeared engaged in the content while it was playing on the screen*. Thus, the author believed these videotaped trials deserved a closer look.

Were these children truly engaged in the content? Were they somehow learning material not captured by the posttest design? What types of behaviors were these young children exhibiting that indicated "engagement" in the video content? Was this truly an indication of some type of learning? Even if these children didn't "learn" the material in the classic "memorize this and I'll test you on it" sense, is there something approximating learning taking place during viewing? To address these questions, the videotaped trials of all 30 children from the original study were reanalyzed. This paper presents the results from the analysis.

Context

The American Academy of Pediatrics (AAP) recommended in 1999 that children under age two receive no screen time, and they reiterated that stance again in 2011 [8]. Nevertheless,

creators of such children's television programs as *Teletubbies* have successfully marketed to this "diaper demographic," encouraging companies such as Baby Einstein, Brainy Baby, Nickelodeon, and even Sesame Workshop—referred to by some as the "Baby Genius Edutainment Complex"—to launch highly lucrative infant media products, many even claiming to be educational tools [9]. Recent research by Schmidt, Rich, Rifas-Shiman, Oken, and Taveras [10], however, revealed that television viewing in infancy was not associated with language or motor skills at age three, which cast doubt on the veracity of any "educational" claims made by infant media producers. In addition, Zimmerman, Christakis, and Meltzoff's [11] research recently revealed that among children ages eight to 16 months, for each hour spent viewing baby videos there was an associated significant *decrement* in language development. Although the study was correlational, its publication unleashed a firestorm of controversy surrounding the infant DVD market [12]. Research in this area was the impetus for the original project [7] that the present study reexamines.

As mentioned above, the author's original study examined the claims made by infant media creators that their content was educational by focusing on one such product: Brainy Baby's *First Impressions: Letters* video, finding that children 12 to 24 months performed no better than chance on a posttest asking them to match items seen in the video with the appropriate alphabet letter. However, perhaps the conclusion that the video was *not* indeed educational was too hasty. Perhaps it was less important how these children performed on a skills-based posttest after viewing, and more important to look deeper into the actual viewing process itself. To inform this hunch, it was essential to turn to literature from the Education field, and operationally define the hazy concept of "engagement."

REVIEW OF THE LITERATURE

This study is interested in behaviors, both verbal and nonverbal, associated with being "engaged" with educational content. Research in the classroom environment helps to clarify this concept. Ahlfeldt, Mehta, and Sellnow [13] noted that engaged students are active students who ask questions, participate, and work collaboratively (a.k.a. "active learners"). In Brooks and Woolfolk's [14] seminal work, they explained that studies of learning in the classroom tell us that nonverbal behaviors can also indicate engagement with content. Their study of proxemics, or where students choose to sit in the classroom, determined that students who willingly sit toward the front of the room are more engaged in the content. Additionally, nonverbal attentiveness behaviors are key to judging student engagement. Teachers in Brooks and Woolfolk's study perceived a student's upright posture, leaning forward, eye contact, head nodding, and smiling as attentiveness behaviors, and thus judged these students as more engaged. When applying these criteria for engagement to the television viewing process, then, sitting close to the screen, upright, forward-leaning posture, eye contact with the screen, and nodding and smiling/laughing while viewing appear to be important indicators that a viewer is engaged.

Though studies of how young children watch television have not highlighted the concept of engagement *per se*, it is imperative to review these findings as well. In Lemish's [15] seminal study of infant and toddler viewing behaviors, she uncovered distinct phases in how children process television content. Until age six months, children's attention to television is merely an orienting reflex, and they will turn their heads toward the television when they hear loud voices or sudden noises. Between six and ten months, children are attracted to certain sounds like distinct character voices and laughter. From ten to 18 months, children begin to focus more on the content of the program and become aware of specific characters. Lemish noted that by the first half of a child's second year, certain televised sounds/music would cause him

or her to stop other activities to run to the television where they would sway, bounce, dance, clap their hands, sing along, and vocalize in excitement while viewing. Using Brooks and Woolfolk's standards, these activities would be indicators of engagement.

Perhaps Sproull's [16] classic study of verbal and nonverbal behaviors while viewing *Sesame Street* is the most similar to the present study. She videotaped 30 preschool-aged children while they viewed a segment of the program either as single viewers or in groups, and coded the tapes for visual attention to the screen (in seconds), modeling behaviors, differences between single viewers and groups, and other meta-communication. Modeling behaviors included verbal imitative behaviors (i.e., repeating a word, phrase, or letter of the alphabet) and nonverbal imitative behaviors (i.e., "mouthing" a letter, drawing it in the air, imitating body movements of characters). The number of smiles and laughs elicited from the program ("program elicited amusement") was recorded as well as "direct program reactions" in which children responded directly to actions on the screen (i.e., talking directly to a character, pointing, trying to draw someone else's attention to the screen). These direct program reactions, according to Sproull, are indicators of vicarious participation. Whereas children in groups exhibited more verbal and nonverbal modeling behaviors than single viewers, and program-elicited amusement was more frequent in groups, at its core, this study still informs the present study of single viewers: in order to participate vicariously in this way, it follows that a viewer must comprehend the material to some degree. Thus, the viewer is engaged with the content.

More recently, Crawley, Anderson, Santomero, Wilder, Williams, Evans, and Bryant [17] explained children are strategic in deploying attention to television; they use learned features of television programs to guide their attention. In their study of the preschool program *Blue's Clues*, Crawley et al. determined that over repeated viewings of an episode, both verbal and nonverbal overt interactions with the educational content increased. This finding lead these researchers to support the theoretical notion that audience participation (i.e., engagement) is more likely to occur when the child viewer has a clear cognitive mastery of the content. Thus, overt program interaction appears to be a *reflection*, rather than a *cause* of learning. In other words, if a child is showing overt signs of engagement via verbal and nonverbal imitation and other direct program reactions, he or she must have *already* learned something from the content. This is an intriguing notion; if children in the current author's previous study [7] do display such behaviors, it follows that they did indeed learn some of the content, even in the absence of "passing grades" on the posttest.

Research Questions

In taking a closer look at the videotaped trials under this new paradigm, two research questions lead the analysis:

RQ 1: What common behaviors are displayed by children viewing the four-minute Brainy Baby First Impressions: Letters video clip?

Given data from Lemish [15] and Sproull [16], it appears that children tend to both verbally and nonverbally imitate/model, smile, laugh, and engage in direct program reactions while viewing. These studies provide some direction for analysis of the current videotaped trials. If children are displaying these types of behaviors, this indicates they were engaged with the content of the video, and thus some form of learning took place that was not captured by the posttest in the original study.

RQ2: Are there any relationships among the behaviors displayed?

It is possible that certain viewing behaviors are related to one another? Are children likely to display specific verbal behaviors, for example, when they spend more time with their "eyes on the screen?" Assessing these two research questions provide a basis for future analysis of viewing behavior, engagement with televised content, and learning.

METHODOLOGY

Materials

Videotaped trials from all 30 children from the original study [7] were analyzed by two coders. The original participants were between 12 and 24 months old. A sample size of 30 was selected after consulting Cohen's [18] statistical power guidelines; if power is set at .80 and alpha at .05, 30 participants were sufficient to address the research questions of interest. All infants were recruited via electronic listservs and word-of-mouth snowball sampling.

The stimulus from that study was a segment of a DVD created by The Brainy Baby Company entitled *Baby's First Impressions: Letters*. The DVD was edited into a four-minute, six-second segment, which consisted of three sections: an introduction, an instructional section for letters A, B, and C, and a review of the three letters. Each letter is associated with three objects: "A" with Apple, Airplane, and Arm; "B" with Bear, Baby, and Balloons; and "C" with Cat, Clock, and Car. The introduction and review included children playing with colorful foam "floormat" letters. Participants viewed the video clip on a portable DVD player, and a video camera was set up to capture the child's behavior while viewing and the content of the DVD simultaneously.

Procedure

For this project, two trained coders filled out a coding sheet for each child, for each section of the video viewed by the child (i.e., Introduction, Apple, Airplane, Arm, Bear, Baby, Balloon, Cat, Clock, and Car), for each trial. Using a stopwatch, coders noted how many seconds the child spent with their eyes on the screen, kept a qualitative "timeline" of behaviors during each segment, and noted the number of times each child performed a series of behaviors. These behaviors were separated into three categories: Verbalizations, Nonverbal Behaviors, and Posture.

Verbalizations included the following: unprompted verbalization of the item on screen, verbal imitation of item on the screen, verbalization about the medium itself (i.e., the DVD player), verbalization about the program (i.e., "I like this!") to either the television or the experimenter, verbal "other" directed at the program itself (i.e., singing, etc.), verbalization to parent/experimenter that appears unrelated to the program (i.e., asking for a snack), and an "other" category. Nonverbal behaviors included: nonverbal indicators of engagement with the program (i.e., nodding, pointing, etc.), nonverbal imitation of actions on-screen, nonverbal "other" directed at the program itself (i.e., rocking, dancing, etc.), nonverbal program elicited amusement (e.g., smiling, laughing), nonverbal elicitation of encouragement from parent/experimenter, nonverbal behavior demonstrating non-attention to the program (i.e., looking away from the TV for more than 10 seconds, running/walking/crawling away from the experimenter, crying/fussing, etc.), nonverbal behavior directed at the DVD player itself, and nonverbal "other." The possible "posture" categories included: sitting still for the duration of the video section, sitting still for part of the video section, lying down (still) for the duration, lying down (still) for part, constantly shifting/fidgeting for the duration, walking/crawling around, walking/crawling away, and "other."

To assess intercoder reliability, the two trained coders coded three of the same children's trials. A t-test revealed no significant difference in recorded stopwatch time between the two coders, $t(1) = -2.058$, $p = .14$. Percent agreement on individual behaviors was 87%.
Data was analyzed using SPSS.

RESULTS

In sum, there were 1,007 unique incidents of verbal and nonverbal behaviors across all videotaped trials. To address research question 1, the most common behavior was nonverbal indications of engagement (i.e., nodding, pointing, etc.), followed by nonverbal elicitation of encouragement from a parent or the experimenter, followed by verbal imitation of items on the screen. This differs slightly from Sproull's [16] results, wherein the mean number of verbal imitations was three times the mean of nonverbal imitations. Most likely, this can be explained by the age of Sproull's participants, who were 4.5 to 5 years old and generally more verbal than the children in the present study.

Table 1: Frequencies of behaviors while viewing (N = 1007)

Behavior	Frequency	Percentage
Nonverbal indication of engagement with the program	n = 485	48.16%
Nonverbal elicitation of encouragement	n = 414	41.11%
Verbal imitation of items on screen	n = 405	40.22%
Unprompted verbalization of items on screen	n = 222	22.05%
Nonverbal behavior demonstrating non-attention to the program	n = 178	17.68%
Nonverbal program elicited amusement	n = 133	13.21%
Nonverbal behavior directed at the DVD player	n = 122	12.12%
Nonverbal "other" directed at the program	n = 93	9.24%
Verbal "other"	n = 69	6.85%
Nonverbal "other"	n = 42	4.17%
Verbalization about the DVD player	n = 21	2.09%
Verbalization to parent/experimenter unrelated to the program	n = 20	1.99%
Verbalization about the program	n = 16	1.59%
Verbal "other" directed at the program	n = 16	1.59%

Table 1 summarizes the frequencies of behaviors. During 62% of coded sections of video viewing, children sat still for the duration of the section.

To address the second research question, three separate correlation matrices were run. First, all verbal behaviors were correlated with each other, as well as the "eyes on screen" (EOS) measure. Sproull [16] found similar results, in that eye contact with the screen was related to a number of non-viewing behaviors, some verbal (i.e., conversing with another child) and some non-verbal (i.e., head turns). In this study, only three were significant: a low-moderate, positive correlation between EOS and unprompted verbalizations (r = .294, p = .000); a low, positive correlation between EOS and verbal imitation (r = .146, p = .002); and a low- moderate positive correlation between unprompted verbalizations and verbal imitation (r = .201, p = .000).

A second correlation matrix addressing relationships among nonverbal behaviors revealed several significant correlations, both positive and negative (see Table 2). Among these, the strongest were: EOS and elicitation of encouragement (r = .362, p = .000); nonverbal "other" directed at the program and nonverbal behavior directed at the DVD (r = .309, p = .000); and EOS and nonverbal program elicited amusement (r = .290, p = .000).

The third correlation matrix addressed relationships between verbal and nonverbal behaviors. Twelve of these relationships were significant (see Table 3). Among these, the strongest were: Unprompted verbalizations and nonverbal indications of engagement (r = .418, p = .000); verbalization about the medium (DVD) and nonverbal behavior directed at the DVD player (r = .417, p = .000); verbal imitation and nonverbal program

Table 2: Significant Correlations Among Behaviors (Nonverbal)*

	EOS	**Indication of Engagement**	**"Other" Directed at Program**	**Program Elicited Amusement**	**Elicitation of Encouragement**
Indication of Engagement	.116 (.016)				
"Other" Directed at Program	.215 (.000)	.175 (.000)			
Program Elicited Amusement	.290 (.000)	.275 (.000)	.203 (.000)		
Elicitation of Encouragement	.362 (.000)		.254 (.000)	.242 (.000)	
Non-attention to the Program	-.263 (.000)	-.127 (.008)		-.163 (.001)	
Behavior Directed to the DVD player	.128 (.008)	.278 (.000)	.309 (.000)		.179 (.000)
Nonverbal "other"				-.107 (.027)	

*Significant Pearson correlations are in each box, followed by the p value in parentheses

Table 3: Correlations of Verbal and Nonverbal Behaviors*

	Unprompted Verbalization	Verbal Imitation	Verbalization about the DVD player	Verbal "Other" directed at the Program	Verbalization Unrelated to the Program
Nonverbal Indication of Engagement	.418 (.000)	.153 (.001)		.114 (.018)	
Nonverbal "Other" Directed at Program	.253 (.000)				
Nonverbal Program Elicited Amusement	.257 (.000)	.277 (.000)			
Nonverbal Elicitation of Encouragement	.137 (.005)				
Non-attention to the Program		-.156 (.001)			.138 (.004)
Behavior Directed to the DVD player	.155 (.001)		.417 (.000)		
Nonverbal "other"		-.102 (.034)			

*Significant Pearson correlations are in each box, followed by the p value in parentheses

Elicited amusement (r = .277, p = .000); and unprompted verbalizations and nonverbal program elicited amusement (r = .257, p = .000).

DISCUSSION

Some of the more compelling findings from this analysis involve the relationship between the "eyes on screen" measure and behaviors such as unprompted verbalizations about items on the screen, verbal imitation of these items, and program-elicited amusement. Whereas these correlations are low to moderate, they do support the notion that when these children were visually engaged with the program content, they cognitively processed the material at a level that allowed for overt, relevant interactions. In the same vein, strong significant correlations between behaviors such as unprompted verbalizations about the content and nonverbal indications of engagement (such as nodding and pointing at items on the screen); verbal imitation of items on the screen and program-elicited amusement; and unprompted verbalizations about the items on the screen and program-elicited amusement were not at all surprising. The children who were paying attention and engaged with the content also appeared to truly enjoy the experience.

CONCLUSIONS

As a follow-up to a study reporting no detectable learning from Brainy Baby's *First Impressions: Letters* DVD [7], results of this project indicate that learning may indeed be present, but possibly only "in the moment." Posttest performance in the original study was dismal; any content that might have been learned was not captured by the experimenter after the DVD concluded. However, the present study may have isolated verbal and nonverbal indicators of some form of cognitive processing while viewing. As Sproull [16] and Crawley et al. [17] noted,

direct reactions to program content on-screen are indicators of "vicarious participation," and in order to participate in such a manner a child must have some rudimentary understanding or comprehension of the material presented. In essence, children who exhibit verbal and nonverbal indicators of participation are engaged with the content.

The question remains: is engagement enough to be considered "learning?" At this point, the answer is no. But what does appear obvious is that children are interacting both verbally and nonverbally with the content, they are engaged with the content, and that this engagement was not captured by the posttest in the original study. So perhaps scholars of young children and media need to re-evaluate the definition of "educational" where baby and toddler media is concerned. If these DVDs are introducing concepts with which children can engage while they are on the screen (even if it cannot be captured in a posttest-type situation), maybe they can be classified as educational to some degree.

Crawley and colleagues [17] noted that over repeated viewings of *Blue's Clues*, both verbal and nonverbal overt interactions with the program increased, which lead them to support the notion that vicarious participation is more likely to occur when a child has an understanding of the content. If we extend that argument to the present study, it would indicate that any child displaying overt behaviors directed at the Brainy Baby DVD had mastered the content to some degree. Children ages 12 to 24 months are beyond the simple "orienting reflex" toward televised content [15], thus overt reactions to the content must be based on some level of awareness of the content.

Directions for Future Research

As the data from this project is further analyzed for a future study, in the tradition of Crawley et al. [17], an examination of overt behaviors over repeated viewings of the DVD is crucial. If indeed a child's verbal and nonverbal behaviors increase with each viewing, the argument that overt program interaction is a *reflection*, rather than a *cause*, of learning will be even more strongly supported. Revisiting the education literature to further this point, scholars such as Ahlfeldt et al. [13] demonstrated that overt signs of "active learning" do not cause the learning itself, but rather are indicators that a child is engaged in the content. This is an important distinction when applied to young children's viewership of educational media. Therefore, further analysis of data from this study is imperative and forthcoming.

Interestingly, the most displayed behavior over all children's trials was the elicitation of encouragement while viewing, or looking to the parent or experimenter for reinforcement. There was a high positive correlation between the "eyes on screen" measure and the elicitation of encouragement, so these children were not sacrificing actual viewing time when looking for reinforcement; it appeared to be more of a "I'm supposed to be watching this, right?" type of behavior. For these young children, one can surmise that television viewing is not typically a solitary activity, and perhaps an activity with which they are not yet comfortable. In fact, as a number of children displayed both verbal and nonverbal interest in the medium itself (rather than the content on the screen), medium-related learning (i.e., what television is and does) may have trumped content-based learning in some instances, thus explaining some failure at posttest in the original study. This suggests that exposure to televised media early in life first and foremost serves to teach children what the medium is all about; they have to learn what television is and how to use it effectively before they can learn the content (see DeLoache [19] for a review of the dual-representation hypothesis). If nothing else, videos such as Brainy Baby's *First Impressions: Letters* serve to teach about the medium. So perhaps we can call these

media "educational" even if they aren't teaching children in the classic sense of "learning a skill." Future research can bear this out.

These behaviors directed toward the video screen itself are particularly interesting when coupled with newer technology, such as the Apple iPad. Given recent research from scholars such as Zack, Barr, Gerhardstein, Dickerson, and Meltzoff [20] regarding infant imitation from touch-screen technology, the combination of *viewing* the content and being able to *manipulate* content in this novel medium may offer the best chance for learning from a 2-dimensional screen. In this scenario, nonverbal behavior such as touching or pointing at items on the screen offer young viewers more than just engagement with the content, but rather *manipulation* of content. These children would truly be active learners. Future studies should continue to explore this educational process, with an emphasis on both verbal and nonverbal reactions to the screen. Perhaps adding such a kinesthetic dimension to electronic learning opportunities is the key to crafting digital media for very young children that truly holds the potential for learning.

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