

Infants' and Toddlers' Television Viewing and Language Outcomes

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Viewing data were reported every 3 months beginning at 6 months of age by the parents of 51 infants and toddlers. Viewing logs were coded for program, content, and intended audience. Using hierarchical linear modeling techniques, growth curves examining relationships between television exposure and the child's vocabulary knowledge and expressive language skills were modeled. Parent's education, child's home environment, and child's cognitive performance were statistically controlled. The findings support the importance of content and program type when describing media effects. At 30 months of age, watching Dora the Explorer, Blue's Clues, Arthur, Clifford, or Dragon Tales resulted in greater vocabularies and higher expressive language scores; watching Teletubbies was related to fewer vocabulary words and smaller expressive language scores; watching Sesame Street was related only to smaller expressive language scores; and viewing Barney & Friends was related to fewer vocabulary words and more expressive language. Reasons for differences are discussed.

Keywords: *television; infants; toddlers; language; communication*

The major developmental task facing babies and toddlers is learning to communicate. Language development is fairly robust. Most children, given a minimal amount of stimulation common in everyday environments, will acquire and use basic language (Shonkoff & Phillips, 2000). Although minimal environments are successful in triggering basic language development, considerable

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individual differences exist in typical language-learning circumstances that in turn, affect the quantity and quality of the linguistic input children receive. In one home observational study, during the period from 11 to 18 months, children heard on average 325 utterances per hour, ranging from 56 to 793 (Hart & Risley, 1995). Certain aspects of language development associated with higher order functioning are more susceptible to these variations in learning conditions than others. In particular, the impact of linguistic input on vocabulary acquisition and language production are two such higher order functions (Hart & Risley, 1995; Shonkoff & Phillips, 2000). The nature of the linguistic input a child receives can have large effects on how often the child actually talks and what words the child uses. Researchers examining the amount of talk mothers direct at their children found this linguistic input to be strongly related to children's vocabulary growth (Hart & Risley, 1995).

All of these studies suggest that amount of experience, whether direct via the child's actions or indirect via environmental input, is critical to understanding and learning from various stimuli. Environmental input encompasses a wide variety of sources, including parents, family members, caregivers, and television. Infants and toddlers are spending, on average, 2 hours with screens (e.g., television, computer) per day with nearly 1.25 hours of that time consuming television (Rideout, Vandewater, & Wartella, 2003). It is critical to evaluate the developmental impact of this screen time. This article is an important step in understanding television viewing patterns in the homes of infants and toddlers and the relationships between this viewing and language outcomes. More specifically, this article examines total television viewing, broader content categories of viewing (i.e., informational, entertainment, adult), specific programs, and subsequent relations between these categories of viewing and vocabulary size and expressive language outcomes.

Several years ago, when the first author was conducting an evaluation of the children's program *Dora the Explorer* (Linebarger & Kosanic, 2001), a mother of a 15-month-old boy commented, much to her chagrin, that the first word her son ever said was *backpack*. Part of the routine of *Dora the Explorer* involves the lead characters, Dora and Boots, inviting young viewers to engage with the show by shouting *backpack* during times when the characters are in need of some object to help with their journey through the episode. This parent's comment was intriguing and underscores, at least anecdotally, that even very young children are capable of learning from television in some meaningful way. There is a small but growing body of literature examining what infants and toddlers comprehend from television. These studies have been conducted mainly in the contexts of experimental paradigms designed to elicit a variety of behaviors including deferred imitation (Barr & Hayne, 1999; Meltzoff, 1988), learning from emotional cues (Mumme & Fernald, 2003), search behaviors (Schmitt & Anderson, 2002), and vocabulary learning (Grela, Lin, & Krcmar, 2003; Pruden, Hirsh-Pasek, Maguire, & Meyer, 2003). Most of these studies involve laboratory situations where the infant or toddler is expected to imitate behaviors,

search for hidden objects, or discriminate phonemes. Within these artificial contexts, learning from a televised model is limited in comparison with learning from a live model. One possible interpretation is that with most learning that infants do, experience plays a central role. It is only through repeated and consistent activity that infants acquire new skills and understand concepts (Pruden et al., 2003). Perhaps the relative dearth of findings associated with learning in these lab situations is a function of inexperience and not a function of an infant's underlying ability (or lack of) to learn from television.

Although most language acquisition studies from television have been conducted with children aged 2 years and older, there is some limited evidence that children younger than 2 are engaging with and using various communicative skills while viewing. Lemish and Rice (1986) reported that a 10½-month-old child pointed at Big Bird (from *Sesame Street*) while viewing; a 13½-month-old recognized a horse from *Black Beauty*, enthusiastically pointed at the horse, and repeated "baba, baba" many times; and an 18½-month-old child pointed to a cat on *Sesame Street* and repeated "kitty" many times (p. 258). These examples demonstrate the power of televised images in eliciting communication. However, questions remain about whether infants and toddlers are able to learn from television (vs. commenting about images they see onscreen) or whether television is able to affect infants' and toddlers' communicative abilities. Grela et al. (2003) found that toddlers were able to learn new words from a televised model if the model used strategies known to evoke language in live interaction situations. In contrast, toddlers who watched *Teletubbies* (a program with poor language models and little elicitation of participation or communication) were not able to learn new words. Therefore, it may be that specific language-promoting characteristics incorporated into televised programs or used by televised models can be successful in helping toddlers learn language.

In addition to appropriate language-promoting strategies, infants and toddlers may need repeated and extensive experience with television to more effectively understand the televised messages. In much early experience research, researchers have found that early, consistent, and sustained positive experiences are important in fostering a variety of skills including language development. This cumulative experience appears to place children on a particular developmental trajectory that is hard to diverge from as the child enters school and beyond (e.g., Walker, Greenwood, Hart, & Carta, 1994). In the Hart and Risley (1995) study described earlier, the amount and quality of linguistic input was related to vocabulary and language production at age 3 as well as later academic outcomes in kindergarten through third grade (Walker et al., 1994). Troseth (2003) has found that infants are capable of learning to search appropriately for objects when they have had opportunities to engage with and repeatedly experience the particular search task. As children gain more experience with television, their abilities to understand its messages and translate those messages into some form of learning (depending on the program's content) increase (e.g., Crawley, Anderson, Wilder, Williams, & Santomero, 1999).

Given infants' and toddlers' relative paucity of experience with television, it might be expected that repeated exposure to individual programs would have a greater impact than total viewing or viewing associated with specific content categories (e.g., child educational or entertainment programming). With older children, we have found that separation of programs into content categories was sufficient to detect relationships between viewing and developmental outcomes (e.g., Anderson, Huston, Schmitt, Linebarger, & Wright, 2001). Wright et al. (2001) also reported that earlier viewing (i.e., at 2 to 3 years old) was a stronger predictor of later school readiness and vocabulary than later viewing. These sets of studies suggest that early experience and repetition of the stimulus may be very important in helping the youngest viewers comprehend and benefit from or conversely, be harmed by television's messages.

Differences in the ways that environmental influences, including television, affect experience and learning have been described above. Can infants and toddlers learn from television in any meaningful way that translates into observable differences? The purpose of our original research was to examine longitudinally how infants and toddlers develop communicative behaviors as a result of interactions in both the home and child care setting (Walker et al., 2003). Within this venue, we were able to embed questions about television exposure, including amount and type of exposure, every 3 months from 6 months of age to 30 months of age to investigate whether linguistic input in the form of televised messages was associated with infants' and toddlers' communicative ability.

METHOD

PARTICIPANTS

Participants were 51 midwestern families (23 boys, 28 girls), 90% Euro-American. These children and their families were recruited from 17 different child care centers located in the greater Kansas City metropolitan area and Lawrence, Kansas. Sixty-four percent reported incomes above U.S.\$55,000 and 27% reported incomes between U.S.\$20,000 and U.S.\$55,000, whereas 9% reported incomes below U.S.\$20,000. On average, mothers reported 16.0 years of education (i.e., 4-year college degree) whereas fathers reported just slightly less, at 15.6 years of education. This sample was primarily a middle- to upper-middle-class group of families.

DESIGN

A longitudinal process-product design (Brophy & Good, 1986; Carta & Greenwood, 1987) with repeated measures was used to document the differences in early experiences related to communication. Process measurements included moment-to-moment recording of adult-child interactions. Product

assessments included typical developmental tests, naturalistic play-based assessments, and parent self-reports. Data were collected using multiple sources and methods including parents, direct observations of caregiver-child interactions, and individualized and group information about the amount and type of experiences that young children have in both their child care settings and their homes.

MEASURES

Child and Family Characteristics

Demographic information. Information was collected from parents regarding their child's gender, birth date, race, disability status, and the age at which their child first showed an interest in television.

Viewing log. Parents were asked to report the number of hours of television their child watched per week. In addition, parents listed the names of all the programs, number of days per week their child viewed each program, and the amount of time spent viewing each program on each day.

All programs listed in the viewing logs were classified on two dimensions: (a) intended audience (i.e., child, adult) and (b) program type (i.e., informative, entertainment, sports, news; Center for Research on the Influences of Television on Children, 1983). The aggregate coding dimensions used for these analyses included total television, the broad categories of child informative, child entertainment, and adult programming as well as specific children's programs. These programs were chosen for analysis if at least 25% of the sample reported viewing the program on at least two different occasions. These criteria were set to maximize the power associated with the number of observations and the study sample size. We combined viewing from *Blue's Clues* and *Dora the Explorer* (26% of the viewers) together as well as viewing from *Arthur* and *Clifford* (33%). Both combinations involved two programs that were very similar in format and produced similar individual growth curves. Other programs included *Dragon Tales* (31%), *Sesame Street* (47%), *Barney & Friends* (67%), *Teletubbies* (39%), and Disney movies (55%). The times spent viewing in total, across individual content categories, and within programs were transformed (square root of $[x + 1]$) to obtain an approximately normal distribution.

Home Observation for Measurement of the Environment. The Home Observation for Measurement of the Environment Inventory (Caldwell & Bradley, 1984) is designed to measure the quality and quantity of stimulation and support available to a child in the home environment assessed during a 45- to 90-minute observation. The focus is on the child in the environment as a recipient of inputs from objects, events, and transactions occurring in connection with the family

surroundings. The version designed for use during infancy (birth to 3 years) is composed of 45 items clustered into six subscales with alphas for each subscale above 0.90. Observers were trained to 95% or greater interobserver agreement, using families with similar demographics who were not involved with the study, prior to conducting in-study observations. There was very little variability within each of the subscales except Organization of the Environment and Parental Involvement. Therefore, these 2 subscales were used in the parent composite as an index of parental behaviors.

Cognitive Development

Bayley Scale of Infant Development (2nd ed.) (BSID-II). The BSID-II (Bayley, 1993) was used to assess children's general cognitive developmental performance. The BSID-II is standardized and widely used to assess cognitive development with adequate predictive validity and reliability coefficients (e.g., $r = .88$ to $.90$). Certification to administer the BSID-II involved videotaping and comparing administration and scoring to a predefined task analysis for each age level (e.g., 6, 12, 18 months). Administrators were required to achieve 90% reliability in administration and scoring to be certified at each age level (in practice, reliability averaged 96% or higher). The BSID-II was administered every 6 months and was used to control for children's individual differences at each wave of administration.

Vocabulary Development

MacArthur Communicative Development Inventory. The MacArthur Communicative Development Inventory (Fenson et al., 1993) is a standardized parent report inventory used to record vocabulary acquisition. The Communicative Development Inventory has two scales: the Infant Scale (covering 8 to 16 months) and the Toddler Scale (from 16 to 30 months). The Infant Scale includes items that assess comprehension, word production, and aspects of symbolic and communicative gesture. The Toddler Scale examines word production and grammar. Satisfactory internal consistency, reliability, and validity have been reported for the Communicative Development Inventory (.95/.96). These scales were distributed to parents every 6 months beginning at 12 months of age. For these analyses, word production was used.

Expressive Language Production

Early Childhood Indicator. The Early Childhood Indicator (Carta et al., 2002; Luze, Linebarger, Greenwood, Carta, & Walker, 2001) is a general outcome measure of expressive communication for children between the ages of 3 and 36 months. Using a play-based format, the frequency of child communica-

tive behaviors (i.e., gestures, vocalizations, single- and multiple-word utterances) during a 6-minute period was recorded, permitting the monitoring of infant's individual growth over time. Reliability with the Preschool Language Scale-3 (Zimmerman, Steiner, & Pond, 1992) and a caregiver report yielded correlations of .75 or higher. This measure has been used successfully to verify the effects of intervention (Walker, 1999). Overall interobserver reliability was reported to be .90 (Luze et al., 2001). The Early Childhood Indicator was administered every 3 months beginning at 6 months of age. For these analyses, the combined frequency of single- and multiple-word utterances was used.

ANALYTICAL APPROACH

The analytic strategy was two pronged. We wanted to describe the development of television viewing patterns by recording children's first interest in watching television and the development of viewing trajectories. Then, we developed equations describing each child's cumulative television exposure for each program, the broader content categories, and total viewing from 6 months to 30 months of age. These equations were derived by modeling all exposure data available for each child to obtain slopes and intercept values. These values were then entered into a formula with values for each of the 9 waves of data collection (i.e., 6 months, 9 months, through 30 months) and summed to form a cumulative exposure variable for each category for each child.

Next, to maximize the likelihood of detecting relationships between the predictors and outcomes, minimize individual differences, and ensure that effects of viewing were the ones reflected in the language outcome measures, controls for both child and family characteristics were included in all analyses. We chose to control for the child's current cognitive developmental functioning at each wave of assessment (vs. using only the child's initial or first cognitive assessment). Then, we developed and assembled a composite of parent and home variables to further separate the cumulative contributions of family characteristics from those associated with viewing. This composite was formed by a *z* score transformation of variables related to parent demographics and interactions that were significantly correlated with child outcomes including child's birth order, parent's education, family income, and the Parental Involvement and Organization subscales of the Home Observation for Measurement of the Environment Inventory.

Hierarchical linear modeling (HLM) (Raudenbush & Bryk, 2002; Raudenbush, Bryk, Cheong, & Congdon, 2001) was used to examine children's language growth with time. HLM-Level 1 analyses were used to compute slope (rate of growth) and intercept parameters as a function of individual differences and person-specific growth. In addition, each child's current cognitive functioning as measured by the BSID-II was centered at the grand mean and included as a time-varying covariate at this level (Boyle & Willms, 2001). HLM-Level 2 analyses were used to examine whether individual differences varied as a

function of television viewing (i.e., total television, content categories, specific television programs). A parent composite, centered on the grand mean, was included as a control variable to minimize the influence of family and individual differences and maximize the likelihood of detecting viewing effects.

Our analysis plan included testing the viewing diet of the infants and toddlers by entering categories that were mutually exclusive and exhaustive, thereby controlling for total amount of viewing in tests of individual content categories and programs. For the content category analysis, the viewing diet included child educational, child entertainment, and adult programs. For the specific program analysis, the viewing diet consisted of the program, all other child educational viewing, and all remaining viewing (i.e., child entertainment, adult viewing). The intercept means in this study were centered at 30 months of age to evaluate the cumulative end-point effects of viewing.

Finally, given the modest sample size and to estimate the practical significance of the results without disregarding findings simply because we did not have enough power to detect a meaningful relationship, we examined adjusted critical t values and alpha levels using a procedure called compromise power analysis outlined by Erdfelder, Faul, and Buchner (1996). Compromise power analysis protocols vary according to which test statistic is used (e.g., t test, F test) and provide revised critical t values and alpha levels to aid in making decisions about which effects are statistically and meaningfully significant and interpretable, especially with moderate to small sample sizes. In addition, we reported actual effect sizes (i.e., Cohen's d where small $d = 0.20$, medium $d = 0.50$, large $d = 0.80$; Cohen, 1988; Kramer & Rosenthal, 1999).

For the t tests used to evaluate coefficients in the HLM analyses, we assumed a moderate effect size of 0.25, total sample size of 51, $df = 46$, and beta/alpha ratio = 1 (i.e., assumed the relative risk of Type I and Type II errors was equally important). Using these criteria, the revised critical t equals 0.90 and alpha level equals 0.19, maintaining power at 0.81.

RESULTS

INFANTS' AND TODDLERS' TELEVISION VIEWING PATTERNS

Parents reported that infants first showed interest in watching television at 9.02 months ($SD = 5.1$ months, range = 2 to 23 months). Number of minutes of total viewing was modeled with age as the x -axis. Total television viewing, centered at 30 months of age, assumed a quadratic function. The intercept at 30 months was 398.30 minutes of total viewing (6.81 hours), increasing at 25.74 minutes per month with an additional acceleration (as indicated by the quadratic) of 0.40 minutes per month. Figure 1 displays total viewing and viewing broken into content categories including Disney movies.

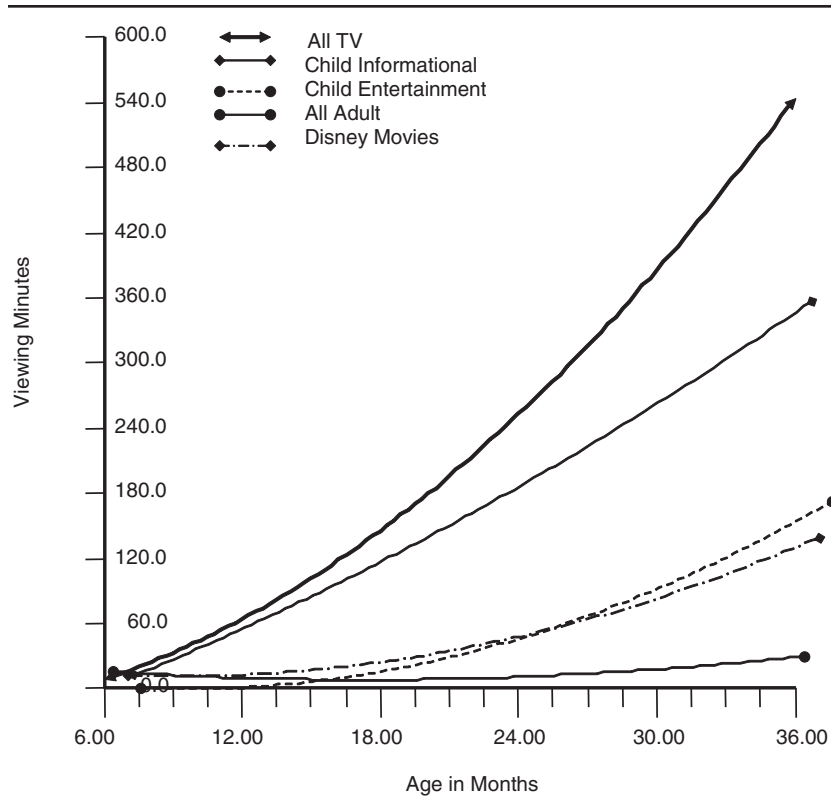


Figure 1: Growth Curves Modeling Minutes of Viewing All Television, Child Educational, Child Entertainment, Adult Programming, and Disney Movies

When broken into content categories, number of minutes of child informative, child entertainment, and adult programming grew with time. Total viewing minutes associated with specific programs also grew with time for combined *Arthur/Clifford* viewing, combined *Blue's Clues/Dora the Explorer* viewing, *Barney & Friends*, and *Dragon Tales*. Minutes of viewing *Teletubbies* and *Sesame Street* both displayed a curvilinear function, growing from 6 months to about 21 months with viewing then dropping off. Figure 2 displays the curves for each of the six combined or single programs used in later analyses.

Relationships Between Viewing Patterns and Language Outcomes

Tables 1 and 2 report all intercept, slope, and where applicable, acceleration coefficients and test statistics for each growth model computed.

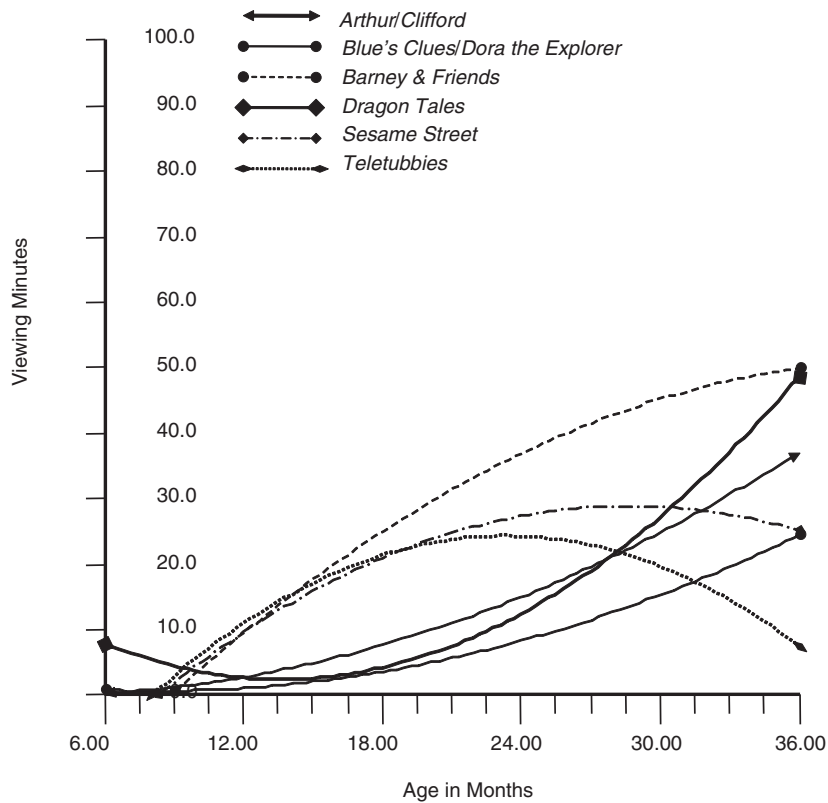


Figure 2: Growth Curves Modeling Minutes of Viewing *Arthur/Clifford*, *Blue's Clues/Dora the Explorer*, *Barney & Friends*, *Dragon Tales*, *Sesame Street*, and *Teletubbies*

Vocabulary development. The unconditional HLM–Level 1 model indicated that the average child had a parent-reported production vocabulary of 438.7 words by 30 months, increasing at an average rate of 25.2 vocabulary words per month, with no acceleration associated with this rate (intercept $d = 5.53$, slope $d = 4.36$). An examination of all cumulative television viewing indicated that total viewing across all children was related to 7.84 fewer vocabulary words at 30 months with no alteration in growth rate (intercept $d = 0.56$).

When breaking all viewing into broader content categories, child informational was negatively related to the intercept resulting in 6.53 fewer words at 30 months of age, whereas child entertainment and adult viewing were not significantly related to vocabulary (intercept $d = 0.44$).

(text continues on p. 637)

TABLE 1: Intercept, Slope, and Acceleration Parameters and Standard Errors for Expressive Language Production Growth Curve Models

	Unconditional Model		Total TV Viewing	Broader Content Categories ^a	Arthur & Clifford ^b	Clues & Dora the Explorer ^b	Barney & Friends ^b	Dragon Tales ^b	Disney Movies ^b	Sesame Street ^b	Teletubbies ^b
Intercept	25.60*** (1.98)	23.10*** (4.67)	23.15*** (4.63)	21.64*** (2.59)	22.07*** (2.93)	25.60*** (3.28)	23.14*** (2.81)	26.26*** (7.11)	29.76*** (2.74)	26.55*** (2.96)	
Parent composite		-1.31 (1.09)	-1.30 (1.08)	-1.43 (1.10)	-1.15 (1.01)	-1.34 (1.10)	-1.36 (1.10)	-1.27 (1.07)	-1.13 (0.96)	-1.30 (1.07)	
Viewing 1		0.21 (0.31)	0.17 (0.35)	1.10*** (0.47)	1.78*** (0.97)	-0.03 (0.58)	1.07* (0.77)	-0.20 (1.63)	-1.49*** (0.49)	-0.41 (0.50)	
Viewing 2			0.07 (0.40)	-0.01 (0.19)	0.03 (0.35)	0.29 (0.40)	-0.07 (0.43)	0.15 (0.37)	0.97*** (0.37)	0.58 (0.51)	
Viewing 3			0.15 (0.67)	0.23 (0.38)	0.02 (0.30)	0.11 (0.39)	0.06 (0.40)	0.37 (1.24)	0.13 (0.37)	0.11 (0.39)	
Slope	2.38*** (0.26)	1.79*** (0.56)	1.56*** (0.55)	2.19*** (0.39)	1.96*** (0.35)	2.03*** (0.40)	2.31*** (0.38)	2.29*** (0.72)	2.73*** (0.36)	2.62*** (0.36)	
Parent composite		-0.22** (0.12)	-0.21** (0.11)	-0.22 (0.12)	-0.20** (0.11)	-0.20* (0.12)	-0.21** (0.12)	-0.22** (0.12)	-0.20** (0.11)	-0.22** (0.11)	
Viewing 1		0.05* (0.04)	0.03 (0.05)	0.05 (0.08)	0.22*** (0.10)	0.09* (0.06)	0.03 (0.11)	0.02 (0.17)	-0.13** (0.06)	-0.10* (0.06)	
Viewing 2			0.03 (0.05)	0.01 (0.02)	0.02 (0.05)	-0.00 (0.05)	0.03 (0.05)	0.03 (0.05)	0.11** (0.06)	0.12** (0.07)	
Viewing 3			0.15*** (0.07)	0.06 (0.04)	0.04 (0.04)	0.05 (0.05)	0.05 (0.05)	0.06 (0.12)	0.05 (0.05)	0.05 (0.04)	

TABLE 2: Intercept and Slope Parameters and Standard Errors for Vocabulary Growth Curve Models

	Unconditional Model		Total TV Viewing	Broader Content Categories ^a	Arthur & Clifford ^b	Blue's Clues & Dora the Explorer ^b	Barney & Friends ^b	Dragon Tales ^b	Disney Movies ^b	Sesame Street ^b	Teletubbies ^b
Intercept	438.72***	(23.13)	532.98***	541.37***	414.99***	419.77***	489.32***	464.88***	383.20***	446.00***	474.59***
Parent composite			(55.39)	(52.14)	(32.95)	(31.53)	(34.66)	(32.55)	(75.19)	(32.81)	(30.69)
Viewing 1			19.16***	19.11***	16.35***	20.04***	16.95***	18.94***	16.18***	18.07***	18.25***
Viewing 2			(4.91)	(4.99)	(4.66)	(5.38)	(4.25)	(5.02)	(6.30)	(5.40)	(4.91)
Viewing 3			7.84***	-6.53***	8.60**	13.30*	-11.68***	-8.48	17.95	0.02	-10.18*
			(4.15)	(4.49)	(4.81)	(8.29)	(4.87)	(9.72)	(20.40)	(6.41)	(6.98)
				-6.29	-4.21**	-7.41**	-2.94	-6.14*	-5.40	-10.09**	-4.25
				(5.76)	(2.21)	(4.40)	(6.13)	(4.20)	(4.63)	(5.28)	(5.88)
				-3.11	-3.99	-6.89*	-5.23	-5.86	-22.22*	-5.58	-5.86
				(8.51)	(4.79)	(4.39)	(4.83)	(4.80)	(13.71)	(4.35)	(5.02)
Slope											
Intercept	25.15***	(1.68)	30.45***	30.29***	23.47***	23.10***	26.62***	27.21***	20.95***	25.50***	27.27***
Parent composite			(4.13)	(3.79)	(2.51)	(2.39)	(2.52)	(2.44)	(5.93)	(2.49)	(2.36)
Viewing 1			1.24***	1.22***	1.03***	1.27***	1.11***	1.21***	1.03***	1.16***	1.13***
Viewing 2			(0.38)	(0.39)	(0.38)	(0.37)	(0.35)	(0.39)	(0.47)	(0.42)	(0.39)
Viewing 3			-0.43	-0.20	0.61*	1.35***	-0.24	-0.65	1.35	0.05	-0.58
			(0.33)	(0.33)	(0.37)	(0.58)	(0.37)	(0.77)	(1.56)	(0.51)	(0.51)
				-0.54	-0.15	-0.29	-0.11	-0.08	-0.13	-0.35	0.03
				(0.46)	(0.17)	(0.32)	(0.44)	(0.31)	(0.34)	(0.39)	(0.45)
				-0.20	-0.34	-0.53	-0.42	-0.48	-1.50	-0.46	-0.47
				(0.78)	(0.41)	(0.36)	(0.41)	(0.39)	(1.12)	(0.38)	(0.42)

a. Viewing 1 = child informational; Viewing 2 = child entertainment; Viewing 3 = adult programming.

b. Viewing 1 = specific program; Viewing 2 = all other child informational; Viewing 3 = child entertainment + adult programming.

* $p < .19$. ** $p < .10$. *** $p < .05$.

Relationships between specific programs and vocabulary produced different patterns depending on the show. Combined *Arthur* and *Clifford* viewing was related to 8.60 more vocabulary words at 30 months as well as an increase in the vocabulary growth rate of 0.61 words per month when compared with nonviewers (intercept $d = 0.55$, slope $d = 0.50$). Combined *Blue's Clues* and *Dora the Explorer* viewing resulted in 13.30 more vocabulary words at 30 months as well as an increase in the rate of growth in vocabulary words of 1.35 words per month compared with nonviewers (intercept $d = 0.49$, slope $d = 0.71$, acceleration $d = 0.50$).

Barney & Friends and *Teletubbies* viewing were negatively related to vocabulary acquisition. Watching *Barney & Friends* was associated with 11.68 fewer words at 30 months when compared with nonviewers (intercept $d = 0.73$). Viewers of *Teletubbies* knew 10.18 fewer words at 30 months of age when compared with nonviewers (intercept $d = 0.45$). Finally, watching *Dragon Tales*, *Sesame Street*, or Disney movies was unrelated to vocabulary acquisition across both growth curve parameters (i.e., intercept and slope).

Expressive language production. The unconditional HLM–Level 1 model indicated that at 30 months of age, the average child used 25.60 single- and multiple-word utterances during the 6-minute naturalistic play session, growing at a rate of 2.38 single- and multiple-words per month with an additional acceleration of .05 words per month (intercept $d = 3.65$, slope $d = 2.62$, acceleration $d = 1.74$). An examination of all cumulative television viewing indicated that total viewing was unrelated to the intercept; however, total viewing was related to the expressive language growth rate, adding an additional .05 utterances per month as well as an additional acceleration of the growth rate of .002 utterances per month (slope $d = 0.39$, acceleration $d = 0.40$).

When breaking all viewing into broader content categories, child informational and child entertainment viewing were not significantly related to expressive language production. In contrast, adult programming was positively related to both rate of growth and acceleration of this rate; that is, the growth rate associated with viewing adult programs was 0.15 utterances per month with an additional acceleration of the growth rate of .007 utterances per month (slope $d = 0.64$, acceleration $d = 0.88$).

As with vocabulary, relationships between specific programs and expressive language production were differentially related to programs viewed. Combined *Arthur* and *Clifford* viewing was positively related to the intercept, with viewers using 1.10 more single- and multiple-word utterances at 30 months when compared with nonviewers (intercept $d = 0.70$). Combined *Blue's Clues* and *Dora the Explorer* viewing was associated with 1.78 more single- and multiple-word utterances at 30 months, increments in the growth rate of 0.22 utterances per month, and an acceleration of the growth rate at 0.006 utterances per month when compared with nonviewers (intercept $d = 0.55$, slope $d = 0.62$, acceleration $d = 0.49$). Watching *Dragon Tales* was associated with using 1.07 more

words at 30 months when compared with nonviewers (intercept $d = 0.41$). *Barney & Friends* viewing was associated with increases in both the growth rate and acceleration of the growth rate for expressive language production (0.09 and .005 utterances per month, respectively) when compared with nonviewers (slope $d = 0.44$, acceleration $d = 0.68$).

Negative relationships between expressive language production and *Sesame Street* and *Teletubbies* viewing were observed. Specifically, watching *Sesame Street* was associated with using 1.49 fewer single- and multiple word utterances at 30 months as well as decrements in the growth rate of 0.13 words per month when compared with nonviewers (intercept $d = 0.76$, slope $d = 0.59$). Viewing of *Teletubbies* was associated with a reduction in the growth rate of -0.10 utterances per month when compared with nonviewers (slope $d = 0.48$, acceleration $d = 0.48$). Finally, watching Disney movies was unrelated to single- or multiple-word utterances across all three growth curve parameters (i.e., intercept, slope, and acceleration).

DISCUSSION

The infants in our sample began to pay attention to television relatively early in life, on average, at about 9 months of age. Total minutes of viewing reported in viewing logs were relatively stable until about 18 months of age when viewing began to accelerate. Most viewing consisted of educational content followed by Disney movies. These broader content categories grew at different rates; educational viewing was growing the fastest, followed by total entertainment viewing, and then total Disney movie viewing minutes. Viewing of adult content grew at a much smaller rate (about 1 minute per month), with approximately 18 minutes watched per week at 30 months of age.

We found that relationships between viewing and language outcomes were most pronounced for individual programs when compared with total viewing or broader content categories. These relationships either supported or inhibited children's development in powerful ways. In most cases, these relationships were positive; however, there were some notable exceptions, in particular *Teletubbies*, *Sesame Street*, and *Barney & Friends*. Moreover, these differential relationships provide additional evidence for content-based theories as outlined by Anderson et al. (2001).

Most experiments using a televised stimulus across a variety of outcomes provide little evidence of learning from television (e.g., Anderson & Evans, 2001; Anderson & Pempek, 2005 [this issue]; Barr et al., 2003; Barr & Hayne, 1999; Grela et al., 2003; Schmitt & Anderson, 2002). We believe that the relationships between viewing and language described here are, in part, the result of accumulated experience in the home where television use is pervasive, part of a routine, and available during regular periods of time. There is evidence that early environmental experience in the form of adult linguistic stimulation is

differentially related to language trajectories and that these differences are maintained as late as third grade (Hart & Risley, 1995; Walker et al., 1994). Early environmental experience in the form of televised stimuli at age 2 has been found to be a better predictor of later school readiness and vocabulary outcomes than concurrent viewing (Wright et al., 2001). If these trajectories were maintained, then it would be expected that early positive viewing experience would relate to later positive developmental outcomes, a finding that has been supported in some longitudinal work (Anderson et al., 2001).

In addition to a child's experience with televised stimuli, each of the programs had particular strategies embedded in its curricula that have been found to promote or inhibit expressive language production and vocabulary acquisition (Walker et al., 2003; e.g., speaking directly to the viewer, providing opportunities to respond, using and defining vocabulary words). Support for relationships between televised stimuli and word learning has been found with toddlers. For example, toddlers were able to learn novel words from a televised model better if the model used strategies known to support language learning in live situations (e.g., televised model vocalized to obtain the child's attention and then labeled a particular object; Grela et al., 2003). Programs such as *Blue's Clues* and *Dora the Explorer*, where onscreen characters speak directly to the child, actively elicit participation, label objects, and provide opportunities to respond, were positively related to expressive language production and vocabulary in our sample.

Programs such as *Arthur*, *Clifford*, and *Dragon Tales* may support language development given their storybook-like nature. These programs have a strong narrative, are visually appealing, and contain opportunities to hear vocabulary words and their definitions, see the visual representation of the vocabulary word, and see interactions between characters modeled. There is a substantial body of literature that reports positive relationships between vocabulary and language production and reading storybooks (for a review, see Whitehurst & Lonigan, 1998). Although some might argue that watching a televised story is insufficient to support language in that it does not provide the right types of stimuli as would in vivo parent-child interaction, the data reported here suggest that storybook-type programs may be effective supports for these aspects of language development. In addition, other parallels between print and televised stories have been found for comprehension skills (Kremer, Lynch, van den Broek, & Wenner, 2001) and television has been found to support both emergent and later literacy skills (Linebarger, 2001; Linebarger & Gilman-Caplovitz, 2003; Linebarger, Kosanic, Greenwood, & Doku, in press). Alternatively, children, especially those whose parents read stories to them frequently, may prefer these types of programs because of the similarity to book reading. Therefore, increases in vocabulary and expressive language may be a function of the children's greater print experience.

In contrast, *Sesame Street* and *Teletubbies* were found to be negatively related to child language outcomes. It is not clear why *Sesame Street* was

negatively related to expressive language use. A substantial body of research demonstrates positive relationships between *Sesame Street* viewing and a variety of other outcomes (i.e., school readiness, vocabulary; see Fisch & Truglio, 2001) with children as young as 2 years of age. It may be that the loose narrative structure of the program and the changing vignettes do not provide enough supports for comprehension of the content or learning of new vocabulary words for infants and toddlers. The data in this study were collected prior to substantial changes in the structure and format of *Sesame Street*. These changes include a more coherent and integrated narrative structure and greater attention to cohesiveness across the content in each episode. In addition, there may be other positive effects that were not captured with our measures of expressive language and vocabulary. This would be consistent with our contention that specific components of the embedded curricula affect various outcomes in different ways and perhaps at different times across development.

Viewing *Teletubbies* was negatively associated with both vocabulary acquisition and expressive language use. Research exploring the impact of *Teletubbies* on novel word use (Grela et al., 2003) and visual attention to and comprehension of randomly edited bits (Anderson, 2004) also finds negative impacts. Grela et al. (2003) found that children were unable to learn novel words when inserted into a *Teletubbies* clip, speculating that the multiple forms of input, including music, visual stimulation, and language, were too difficult and complex to enable word learning. We also believe that the loose narrative structure and poor language models (i.e., the characters use mainly “baby talk” with very few words) work to inhibit expressive word use in play situations. We did an analysis of vocalizations and *Teletubbies* viewing to examine this possibility and found that viewers were more likely to use vocalizations than nonviewers, providing additional evidence that children will model or imitate what they see on television (Barr & Hayne, 1999).

Alternatively, *Barney & Friends* was negatively associated with vocabulary acquisition but positively associated with expressive language production. There is some prior evidence suggesting that verb learning from *Barney & Friends* is enhanced in the presence of an adult coviewer who is able to reinforce the words seen onscreen (Singer & Singer, 1994). When preschoolers viewed *Barney & Friends* without a coviewer, they learned just 1 word (compared with 3.5 words for viewers with adult comments). However, there were positive relationships between viewing and expressive language production in play situations. These findings were consistent with a small observational study of toddlers who viewed the program each weekday for 2 weeks (Singer, Singer, Sells, & Rosen, 1995). That is, the toddlers in the Singer et al. (1995) study who viewed *Barney & Friends* demonstrated increased interaction with adults when compared with toddlers who did not view the program. Once again, specific curricular elements seem important and relevant for different child outcomes.

Our inability to detect effects associated with Disney movies reflects the need to analyze each program or movie rather than broader content categories.

We believe that the broader content categories associated with child educational and entertainment programming, adult programming, and Disney movies are less precise categories and, therefore, perhaps not as sensitive for use in detecting effects. Although some relationships between these broader categories and language outcomes were found, the coefficients and amount of variance accounted for in these models were smaller than for specific programs. Our specificity assumption would predict that Disney movies as a whole category would be less likely to be related to language given the wide range of movies that parents reported their children viewed (e.g., *Toy Story*, *The Lion King*). Instead, an analysis of each Disney movie would need to be conducted to understand these effects more clearly. Future analyses of these data will involve a more detailed analysis of these movies.

LIMITATIONS

This study is limited by several factors. First, the viewing reported in this study refers primarily to foreground exposure (television programming that the child actively views). We were unable to record secondary, or background, exposure due to the nature of the data collection efforts (see Anderson & Evans, 2001, for a discussion of foreground and background viewing). Therefore, we are probably underestimating the amount of viewing that the infants and toddlers did and any potential positive or negative effects that this background exposure may have.

Second, although we speculate about characteristics embedded in the curricula of specific programs, content analyses for each of the programs have not been done (with the exception of *Barney & Friends*). Our comments regarding the embedded language-promoting or language-inhibiting processes is based on each of these programs' identified curricula. Further research is needed to more carefully analyze and detail these embedded processes.

This research differs in many respects from more carefully controlled, experimental studies described above. This research was an examination of viewing, as reported by parents, and what, if any, relationships co-occur with expressive language development. Given the correlational nature of the project, we are not able to determine causality. Furthermore, selection effects could explain the relationships between viewing and language skills described herein. That is, infants who were more cognitively mature may pay greater levels of attention to particular programs and display more communication development by virtue of their cognitive maturity rather than viewing contributing to communication development. We did try to minimize these effects by controlling for cognitive performance at each wave of data collection as well as controlling for family and other child background characteristics; however, selection effects represent a very important and plausible explanation. Future research that uses an experimental paradigm to manipulate exposure is needed to address these questions.

CONCLUSION

The recommendation by the American Academy of Pediatrics (1999) urging parents to avoid television for children younger than 2 years old may be premature. This recommendation was based primarily on the notion that watching television would displace needed and important parent-child interactions. The results reported here suggest that appropriate, curriculum-based educational programs may have beneficial associations with expressive language production and vocabulary. That is, when specific language-promoting or language-inhibiting strategies are used with infants and toddlers in a televised format, it would be expected that these strategies would promote or inhibit communication in the same ways they have been found to in face-to-face interactions. Research is still needed to determine both causality and whether these results hold outside such a homogenous sample as the one reported in this article. Finally, as with research conducted with older children (e.g., Anderson et al., 2001; Wright et al., 2001), these results provide additional evidence that the content of television matters. In addition, given the greater magnitude of the effects associated with specific programs when compared across content categories, appropriate content may be especially critical for infants and toddlers who have a significant dearth of experience.

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