

Published in final edited form as:

*Infant Child Dev.* 2010 November ; 19(6): 577–593. doi:10.1002/icd.711.

## Do Verbal Interactions with Infants During Electronic Media Exposure Mitigate Adverse Impacts on their Language Development as Toddlers?

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### Abstract

The goal of this study was to determine whether verbal interactions between mothers and their 6-month-old infants during media exposure ('media verbal interactions') might have direct positive impacts, or mitigate any potential adverse impacts of media exposure, on language development at 14 months. For 253 low-income mother–infant dyads participating in a longitudinal study, media exposure and media verbal interactions were assessed using 24-hour recall diaries. Additionally, general level of cognitive stimulation in the home [StimQ] was assessed at 6 months and language development [Preschool Language Scale-4] was assessed at 14 months. Results suggest that media verbal interactions play a role in the language development of infants from low-income, immigrant families. Evidence showed that media verbal interactions moderated adverse impacts of media exposure found on 14-month language development, with adverse associations found only in the absence of these interactions. Findings also suggest that media verbal interactions may have some direct positive impacts on language development, in that media verbal interactions during the co-viewing of media with educational content (but not other content) were predictive of 14-month language independently of overall level of cognitive stimulation in the home.

### Keywords

media; infants; toddlers; parent-child interactions; language development

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A large body of interdisciplinary research has documented the importance of the home environment in impacting school readiness. Two home environmental factors with important implications for child developmental outcomes are parent–child verbal interactions and electronic media exposure (television, video and computer). Some studies suggest that these factors are likely to act in opposition, with the former associated with enhanced development and the latter often found to have adverse impacts, especially in the context of

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*Presentation:* This was presented in part at the annual meeting of the Pediatric Academic Societies in Baltimore, MD, May 2009.

*Additional Contributions:* We would like to thank many colleagues for their guidance and support, including J. Lawrence Aber, Clancy Blair, David Dickinson, Harris Huberman, Matthew Johnson, Perri Klass, MaryJo Messito, Lesley Morrow, Erin O'Connor, Cybele Raver, Catherine Tamis-Lemonda and Linda van Schaick. We would like to thank many additional individuals who contributed to this project, including Melissa Acevedo, Jenny Arevalo, Cori Green, Nina Burtchen, Daniela Romero, Jessica Urgelles, Linda Votruba, Margaret Wolff, and Brenda Woodford.

content that is not educational and not oriented towards young children (Barr, Danziger, Hilliard, Andolina, & Ruskis, 2010). In contrast, there has been limited study of potential for synergy, in which media might provide opportunities for verbal interactions. Such verbal interactions in the context of media (referred to in this report as ‘media verbal interactions’) could mitigate adverse impacts that would potentially otherwise take place in association with media exposure, and possibly have positive impacts on development independent of more traditional opportunities for verbal interactions in the home, such as shared reading and play.

Extensive literature has documented strong positive impacts of parent–child verbal interactions on early child language development, self-regulation, school readiness and later achievement (Huttenlocher, Vasilyeva, Waterfall, Vevea, & Hedges, 2007; Landry, Miller-Loncar, Smith, & Swank, 2002; NICHD Early Child Care Research Network, 2005; Tamis-LeMonda, Bornstein, & Baumwell, 2001). Verbal responsiveness, including response to and expansion on child vocalizations, and labelling, is particularly important for child language development (Hart & Risley, 1995; Shimpi & Huttenlocher, 2007). Cognitive stimulation in the home through activities, such as shared reading and play, is important for facilitating these interactions (Berkule *et al.*, 2008; Mendelsohn, 2002; Morrow & Young, 1997; Tabors, Roach, & Snow, 2001; Tamis-LeMonda, Cristofaro, Rodriguez, & Bornstein, 2006; Tomopoulos *et al.*, 2006).

An equally extensive body of literature has documented adverse impacts of non-educational media exposure in the homes of preschool and school-age children on later outcomes, including cognition, achievement and behavior (Manganello & Taylor, 2009; Ozmert, Toyran, & Yurdakok, 2002; Zimmerman & Christakis, 2005). Recent studies strongly suggest adverse impacts of media beginning in infancy, especially media that does not have educational content or is directed towards adults. As a result, the quantity of infant media exposure in the home has become an increasingly substantial public health issue (Barr *et al.*, 2010; Rideout, Vandewater, & Wartella, 2003). A study conducted in our research lab (Tomopoulos, Dreyer, Berkule-Silberman, Fierman, Brockmeyer, & Mendelsohn, *in press*) of 6-month-old low socioeconomic status (SES) infants found that longer total duration of media exposure, in particular media oriented towards adults, was associated with reduced 14-month language development; in that analysis, 60 min of exposure represented an important cut-point for predicting adverse impacts. The adverse impacts of media exposure may be particularly significant for low SES children, as they have the greatest amount of exposure (Certain & Kahn, 2002; Rideout & Hamel, 2006) and are also at risk for reduced parent–child verbal interactions and for consequent disparities in language development and school readiness (Aber, Jones, & Cohen, 2000; Hart & Risley, 1995; Mendelsohn, 2002; Shonkoff & Phillips, 2000). While adverse impacts of infant media exposure are often found, evidence suggests variability of impact depending on the media content. A longitudinal study by Barr, Lauricella, Zack, & Calvert (*in press*) showed that adult, but not child-oriented, content was associated with later cognitive deficits at age 4. Furthermore, research suggests that exposure to some educational content, even in infancy, may have positive impacts on language development (Linebarger & Walker, 2005).

Emerging evidence indirectly suggests the possibility that reduced verbal interactions might represent an important pathway for adverse impacts often associated with media exposure in young children. Interactions have been found to be generally limited in the context of media exposure (Mendelsohn *et al.*, 2008; Schmitt, 2001). Christakis *et al.* (2009) documented reduced audible language and Kirkorian Pempek, Murphy, Schmidt, and Anderson (2009) documented reduced parent engagement of the child in the presence of exposure. In addition, increased overall media exposure may be associated with reduced parent–child shared reading and playing together with toys and therefore reduced opportunity for verbal

responsivity (Huston & Wright, 1999; Tomopoulos *et al.*, 2007b). Conversely, verbal interactions may also represent a pathway for possible benefits of exposure to educational content. Mendelsohn *et al.* (2008) showed that interactions were more frequent in the context of media that was young-child oriented with educational content, compared with media that was young-child oriented but did not have educational content or media intended for older children or adults. In an ethnographic study, Lemish and Rice (1986) documented quality interactions taking place in the context of educational content.

To date, there has been no study of the degree to which media verbal interactions either have direct positive impacts, or represent a buffer against potential negative impacts of media exposure. There are two possible mechanisms by which these interactions might operate with regard to language development. First, media verbal interactions might have a direct impact on language development, independent of other opportunities for verbal responsivity such as shared reading and play. Second, media verbal interactions might act as a moderator variable, with exposure having reduced adverse impact in the context of these interactions. A third alternative is that media verbal interactions simply signal better interactions more globally, not just in the context of media exposure; if this were the case, such interactions would merely represent a marker for other parenting behaviors rather than a buffer *per se*. Better understanding of the impact of media verbal interactions, including the degree to which they are independent of overall cognitive stimulation and verbal responsivity in the home, is critical to the design and refinement of strategies to enhance early development and school readiness in at-risk, low SES children.

In this study, we sought to answer two overarching questions. First, is there a direct positive impact (i.e. main effect) of media verbal interactions on child language development, and does this positive impact counterbalance any potential negative impacts of media exposure? Second, do media verbal interactions have a moderating effect, with attenuation of negative impacts of media exposure on language development? In addition to these main effects, it was also important to test whether impacts of media verbal interactions were independent of cognitive stimulation measured more generally in the home. Therefore, we tested whether media-specific verbal interactions moderated the impact of media exposure on child language development independent of cognitive stimulation. Finally, we sought to explore whether impacts of interactions varied depending on media content.

To answer these questions, we conducted a longitudinal analysis of mother–infant dyads participating in the Bellevue Project for Early Language, Literacy and Education Success (BELLE), a study assessing the role of primary care interventions in promoting child development through enhanced shared reading and play (Mendelsohn *et al.*, 2005; Mendelsohn *et al.*, 2007; Mendelsohn, Huberman *et al.*, 2010).

## METHOD

### Participants

The present analysis included 253 mother–infant dyads that had been enrolled in the BELLE Project from 23 November 2005 through 30 April 2008. Enrollment of consecutive eligible mother–infant dyads was performed in the post-partum unit of Bellevue Hospital Center, New York City, an urban public hospital serving low SES families. Inclusion criteria were intention to receive pediatric primary care at our institution for at least 3 years, English or Spanish as the primary language, uncomplicated full-term delivery, no Early Intervention eligibility, mother as primary caregiver, ability to contact the mother, mother’s age at least 18 years, and no significant medical complications as described previously (Mendelsohn, Huberman *et al.*, 2010). Of 575 mother–newborn dyads enrolled during this period, 407 (70.8%) were evaluated at 6 months old. 388 of the 407 dyads (95.3%) reported that their

infant had media exposure on the last typical day. 253 of the 388 dyads (65.2%) who reported exposure had a developmental assessment at 14 months, and constitute the sample analysed in this study. We obtained written informed consent from parents prior to participation. Approval for studies involving human subjects was obtained from the New York University School of Medicine Institutional Review Board and Bellevue Hospital Center Research Committee.

## Design

Predictor variables were presence of media verbal interactions and duration of media exposure at 6 months. Outcome variables were measures of child language development at 14 months. Potential confounders were also assessed, including cognitive stimulation and associated parent–child verbal interactions in the home, family sociodemographic characteristics, and maternal depressive symptoms.

**Media exposure**—Electronic media exposure in the home was assessed when infants were 6 months old using a 24-hour recall diary based on an interview with the mother, a widely used method (Singer & Singer, 1980; Tomopoulos *et al.*, 2007a; Wright *et al.*, 2001). Mothers were asked to provide information about all electronic media (television, videos/DVDs, movies, and games) on the most recent typical day for which the infant had been present and awake, from the infant’s awakening in the morning until going to sleep for the night. The name and length (in minutes) of each program/exposure was obtained. Duration of media exposure was calculated by summing length of each individual program. In addition, media verbal interactions were assessed for each program/exposure on the basis of answers to the following question: ‘Did you talk to the child about the program during it or was it mostly for watching?’ The mother was asked to select a response from among ‘mostly for watching’, ‘some talking’, ‘a lot of talking’, ‘not together with child during program’, ‘background noise’, and ‘other’ (Mendelsohn *et al.*, 2008).

Based on information obtained from the diary, the two variables were calculated:

1. Presence of media verbal interactions: As in prior analyses (Mendelsohn *et al.*, 2008), interactions were considered present for *each program/exposure* if the mother reported either ‘some talking’ or ‘a lot of talking’. Infants with media verbal interactions in association with at least one program were compared with those with no interactions for any program.
2. Dichotomized duration of media exposure: Media exposure was dichotomized to compare infants with 60 min or more exposure to those with less than 60 min. This was based on our prior analysis (Tomopoulos *et al.*, in press), in which media exposure was analysed as a continuous variable and found to have a non-linear association with child development. In that analysis, the reduction in language score was greatest in association with the first 60 min of media exposure (approximately 1/3 standard deviation (S.D.) reduction), with lesser reductions associated with further exposure. Infants with 0 min of exposure were excluded from analyses, as interactions would not have been possible in the absence of exposure.

In addition, for each program, content was classified as either educational young child oriented, other (including non-educational young-child oriented, older child, or adult oriented), or unknown, based on coding systems described in prior work (Mendelsohn *et al.*, 2008; Tomopoulos *et al.*, 2007a).

**Language measures**—Language development was assessed when infants were 14 months old by research assistants masked to prior media exposure using the Preschool

Language Scale-4 (PLS-4) (Zimmerman, Steiner, & Pond, 2002). The PLS-4 consists of a Total Score, and two subscales assessing receptive language (Auditory Comprehension) and expressive language (Expressive Communication); analyses of all three were performed. The PLS-4 provides a standard score with mean 100 and S.D. 15.

*Cognitive stimulation* and associated parent–child verbal interactions in the home were assessed using the StimQ. StimQ is performed utilizing a structured interview with the child’s caregiver (Dreyer, Mendelsohn, & Tamis-LeMonda, 2010). It is validated for use in low SES populations in English and Spanish (Dreyer, Mendelsohn, & Tamis-LeMonda, 1996). StimQ has good internal consistency (Cronbach’s  $\alpha = 0.88$ ), test–retest reliability (intraclass correlation coefficient = 0.93), and criterion-related validity (correlation with HOME Inventory:  $r = 0.55$ ). It also has good concurrent ( $r = 0.45$ ) and predictive ( $r = 0.38$ ) validity with measures of child development. The StimQ infant version (StimQ-I) consists of four subscales, which are summed together for a total score (range 0–43). ALM (Availability of Learning Materials) assesses learning materials such as toys (infant, manipulative, and symbolic) provided by the parent in the home. READ (Reading Activities) assesses number and diversity of books read to the child, frequency of reading activities, and associated interactions. PIDA (Parental Involvement in Developmental Advancement) assesses parent teaching and play activities, such as naming objects or beginning to teach the child to play with toys. PVR (Parental Verbal Responsivity) assesses parent–child verbal interactions such as talking while feeding and making sounds together.

*Sociodemographic data* was obtained through maternal interviews conducted during the post-partum period and at 6 months. Information obtained included mothers age, education, marital status, ethnicity, and risk factors related to low SES (financial problems, history of homelessness). Child sociodemographic data obtained included gender and birth order.

*Maternal depressive symptoms* were also assessed, given the high prevalence of maternal depression in low SES families (Pachter, Auinger, Palmer, & Weitzman, 2005; Zuckerman & Beardslee, 1987) and the strong relationship of maternal depression to parent–child verbal interactions (Field, 1998; McLearn, Minkovitz, Strobino, Marks, & Hou, 2006). Symptoms were assessed using the Patient Health Questionnaire-9, which has good sensitivity (75%) and specificity (90%); (Spitzer, Kroenke, & Williams, 1999). A cut-off of 5, corresponding to ‘mild depression’, defined presence of depressive symptoms.

## STATISTICAL ANALYSIS

Analyses of associations between media verbal interactions, media exposure and child language development were conducted utilizing hierarchical multiple regression models, referred to as Models 1, 2 and 3. In Model 1 analyses, unadjusted standardized estimates ( $\beta$ , associated standard error [S.E.]) for differences in 14-month language score in relation to media verbal interactions and media exposure were obtained based on simple regression models without inclusion of potential confounders. In Model 2 analyses, partially adjusted estimates of this difference were obtained based on multiple regression models including all potential confounders (maternal education, marital status, age, ethnicity, depressive symptoms, financial difficulties, homelessness, child birth order, gender, participation in study interventions) *except for* overall cognitive stimulation in the home. In Model 3 analyses, fully adjusted estimates were obtained based on multiple regression models with all potential confounders *including* overall cognitive stimulation in the home. Separate analyses were performed predicting total, receptive and expressive language.

For the first study question, two sets of analyses were performed. The first set of analyses was designed to determine whether media verbal interactions had a direct positive impact on

language development. In these analyses, the predictor variable was media verbal interactions, while the outcome variable was child language (with separate analyses for total, receptive and expressive). Related analyses were performed to assess whether associations between media verbal interactions and child language varied by content. These analyses were considered exploratory, as samples were limited to those children actually exposed to the content for which interactions were assessed. The second set of analyses was designed to determine whether positive impacts of media verbal interactions counterbalanced negative impacts of media exposure. First, analyses were performed in which the predictor variable was media exposure (considered separately from media verbal interactions) and the outcome variable was child language, in order to provide estimates directly comparable to those obtained for the impact of media verbal interactions. Second, analyses were performed in which media verbal interactions and media exposure were included simultaneously as the predictor variables, in order to directly compare impacts on child language. Steiger's Z-test for correlated samples (Meng, Rosenthal, & Rubin, 1992) was utilized to compare the magnitude of impact on child language development for media verbal interactions and media exposure based on unadjusted estimates derived from these analyses.

For the second study question, we performed analyses to assess whether media verbal interactions moderated impact of media exposure on language development. We analysed moderation through inclusion of a predictor variable calculated by multiplying together the dichotomous variables defined for media verbal interactions and media exposure. Additional descriptive analyses related to moderation were conducted utilizing independent samples *t*-tests in order to compare the impact on language score associated with increased media exposure, in the presence and absence of media verbal interactions.

## RESULTS

### Descriptive Data

Table 1 shows descriptive data for the sample. Most mothers were Latina; mean education level was below tenth grade. Mean (S.D.) total duration of media exposure at 6 months was 158.6 (122.4) min. 87.7% of infants were exposed to at least 60 min of media per day. Media verbal interactions were reported for at least 1 program by 39% of mothers.

### Research Question 1: Direct Positive Impact of Media Verbal Interactions on Language

Analyses were first performed to determine whether media verbal interactions had a direct positive impact on language development. As shown in Table 2, media verbal interactions considered separately were associated with enhanced total language in both unadjusted analysis (Model 1;  $\beta = 0.15, p < 0.05$ ) and after adjustment for all potential confounders except for cognitive stimulation (Model 2;  $\beta = 0.16, p < 0.05$ ). However, after adjusting for cognitive stimulation, media verbal interactions were no longer associated with total language (Model 3;  $\beta = 0.07, p = \text{NS}$ ). Similar findings were present for expressive language. No significant associations were present for receptive language.

Additional exploratory analyses suggested differences in associations between media verbal interactions and language development, depending on content of exposure. When the data set was restricted to those with exposure to educational content oriented towards young children ( $n = 97$ ), media verbal interactions during educational content were associated with total language development, both in Model 1 unadjusted analysis ( $\beta = 0.22, p = 0.03$ ) and in Model 3 analysis adjusting for all potential confounders including cognitive stimulation ( $\beta = 0.23, p = 0.03$ ). In contrast, when the data set was restricted to those with exposure to all other content (non-educational young-child, and older child/adult;  $n = 206$ ), interactions

during other content were associated with language development before (Model 1;  $\beta = 0.14$ ,  $p = 0.04$ ) but not after (Model 3;  $\beta = 0.04$ ,  $p = 0.55$ ) adjusting for cognitive stimulation.

Analyses were next performed to determine whether positive impacts of media verbal interactions counterbalanced negative impacts of media exposure. Two sets of analyses were conducted: First, analyses were performed of associations between media exposure considered separately and language development. As shown in Table 3, media exposure at 6 months was associated with reduced total language at 14 months in unadjusted analysis (Model 1;  $\beta = -0.18$ ,  $p < 0.01$ ), in analysis adjusting for potential confounders (Model 2;  $\beta = -0.19$ ,  $p < 0.01$ ), and in analysis also adjusting for cognitive stimulation (Model 3;  $\beta = -0.13$ ,  $p < 0.05$ ). Media exposure was associated with reduced receptive language (e.g.  $\beta = -0.20$ ,  $p < 0.001$ , in unadjusted analysis); however, significant associations were not found for expressive language.

Second, analyses were performed of media exposure and media verbal interactions considered together in simultaneous multiple regression models. As shown in Table 4, prior to adjustment (Model 1), media exposure and media verbal interactions had opposing associations ( $\beta = -0.17$ ,  $p < 0.01$ , and  $\beta = 0.14$ ,  $p < 0.05$ , respectively) of comparable magnitude (Steiger's  $Z = 0.37$ ,  $p = 0.71$ ) with total language. Estimates of betas were similar following adjustment for all confounders except cognitive stimulation (Model 2;  $\beta = -0.18$ ,  $p < 0.01$ , and  $\beta = 0.14$ ,  $p < 0.05$ , respectively). As with analyses of media verbal interactions considered separately, media verbal interactions were no longer associated with total language following adjustment for cognitive stimulation. For receptive language, negative impacts of media exposure were greater than positive impacts of media verbal interactions ( $\beta = -0.20$ ,  $p < 0.001$ , and  $\beta = 0.07$ ,  $p = \text{NS}$ , respectively, in unadjusted analysis). For expressive language, the reverse was found; positive impacts of media verbal interactions were greater than negative impacts of media exposure ( $\beta = 0.016$ ,  $p < 0.05$ , and  $\beta = -0.09$ ,  $p = \text{NS}$ , respectively, in unadjusted analysis). In all analyses, cognitive stimulation was a strong predictor of language (e.g.  $\beta = 0.27$ ,  $p < 0.001$ , for association with total language in the fully adjusted Model 3).

## Research Question 2: Moderation of Associations Between Media Exposure and Language

Analyses were performed to determine whether media verbal interactions moderated associations between media exposure and child language. As shown in Table 5, 6-month media exposure was associated with a 6.9-point reduction ( $p < 0.01$ ) in 14-month total language for dyads with media exposure but no media verbal interactions, but only 1.5 points ( $p = \text{NS}$ ) for dyads with at least some media verbal interactions. The test for moderation was not significant in unadjusted analysis ( $\beta$  for moderation =  $-0.30$ ,  $p < 0.10$ ), but was significant following adjustment for potential confounders including cognitive stimulation ( $\beta = -0.40$ ,  $p < 0.05$ ). Differences in impact of media exposure depending on presence or absence of media verbal interactions are shown graphically in Figure 1.

Similar findings were present for receptive language, with significant reductions in language found in association with media exposure when media verbal interactions were absent (8.7 points,  $p < 0.001$ ) but not when interactions were present (1.7 points,  $p = \text{NS}$ ); the test for moderation was significant in all three models, including after adjustment for cognitive stimulation ( $\beta$  for moderation =  $-0.44$ ,  $p < 0.05$ ). For expressive language, findings had similar patterns but with smaller magnitude, with a 3.6-point reduction in association with media when interactions were absent and a 1.1-point reduction when interactions were present; neither these differences nor tests for moderation reached statistical significance.

## DISCUSSION

This study found evidence of a possible role for media verbal interactions in relation to language development in infants of low-income, immigrant families. First, we found evidence that media verbal interactions moderate adverse impacts of media exposure, with adverse associations found in the absence of interactions but not in their presence. Second, we found evidence that media verbal interactions may have direct positive impacts on language development. While these impacts were at least in part confounded by cognitive stimulation, independent impacts were found for interactions related to educational content.

To our knowledge, there have been no prior reports directly assessing the role of media verbal interactions by parents in young children's language development. However, two recent studies have shown that specific interactions related to media content enhance attention to programs and potentially enhance learning. Barr, Zack, Muentener, & Garcia (2008) showed that verbal interactions such as questions and labelling produced by parents during media exposure at 12–18 months were associated with increased attention towards the screen. Roseberry, Hirsh-Pasek, Parish-Morris, and Golinkoff (2009) showed that children under age 3 years learned nonsense verbs from video when supported by live interactions with an experimenter in which the actions defined by the words were labelled and demonstrated. In addition, a number of studies have been performed related to 'family mediation' of media exposure (Barkin *et al.*, 2006). These studies have suggested that 'instructional' mediation (e.g. parent discussion of content) may be associated with enhanced comprehension of media for school-aged children (Desmond, Singer, Singer, Calam, & Colimore, 1985) and reduced impacts on aggressive attitudes and behavior for media with violent content prior to adolescence (Nathanson, 1999; Nathanson & Yang, 2003).

Our study assessed whether parent–child verbal interactions related to media exposure were associated with child language outcomes. Although we found evidence of direct positive impacts of media exposure on language development, addition of cognitive stimulation to models eliminated statistical significance for these interactions as an independent predictor. This suggests that overall cognitive stimulation may be an important confounder for verbal interactions related to media exposure. Despite being confounded to some degree by general cognitive stimulation, two important independent relationships were found for media verbal interactions. First, media exposure was associated with reduced language development in the absence of media verbal interactions but not in their presence, suggesting a role for media verbal interactions as a moderator. This suggests the possibility that enhancement of media verbal interactions may represent a potential strategy for reducing negative impacts of media on young children. Second, direct positive impacts for media verbal interactions were found in association with educational content in exploratory analyses. This suggests the possibility that interventions to promote interactions around educational content might have beneficial impacts; however, whether such benefits would exceed adverse negative impacts of media exposure would need further study before such interventions should be recommended. Our finding of impacts independent of overall cognitive stimulation add to those of Zimmerman *et al.* (2009), who showed that reduced exposure to interactional language generally may account for adverse associations between media exposure and language development, but who did not study interactions specifically related to media exposure.

In these analyses, findings relating to cognitive stimulation in the home were strong and consistent. Cognitive stimulation in the home was associated with direct positive impacts on child language development of comparable or greater magnitude than the negative impacts found for media exposure. This suggests that enhancement of reading, teaching, and play activities might have the potential to counterbalance adverse impacts of media on child



language development. Findings supporting cognitive stimulation as a counterbalance to media exposure are especially important given the increase in media exposure despite long-standing recommendations by the American Academy of Pediatrics for significant restriction of exposure in early infancy (American Academy of Pediatrics, 1999, 2001). Findings provide indirect support for programs seeking to promote cognitive stimulation beginning in very young children, including home-based interventions such as Playing and Learning Strategies (Landry, Smith, & Swank, 2006; Landry, Smith, Swank, & Guttentag, 2008) and pediatric primary care based interventions such as Reach Out and Read (Klass, Needlman, & Zuckerman, 1999; Mendelsohn *et al.*, 2001; Needlman, Toker, Klass, Dreyer, & Mendelsohn, 2005; Reach Out and Read, 2010; Sharif, Reiber, & Ozuah, 2002) and the Video Interaction Project (Mendelsohn *et al.*, 2005; Mendelsohn, Huberman, *et al.*, 2010; Mendelsohn *et al.*, 2007). Interestingly, recent analyses of the Video Interaction Project, showing that it led to reduced electronic media exposure (Mendelsohn, Dreyer *et al.*, 2010), by way of enhancing cognitive stimulation (Mendelsohn, Huberman *et al.*, 2010), suggest that there is potential to address both of these issues simultaneously.

There are several important limitations to these findings. First, information regarding media exposure and media verbal interactions was collected using recall diaries. Such diaries have the potential to underestimate overall media exposure, and recall and social-desirability bias may have influenced responses regarding media verbal interactions (Anderson, Field, Collins, Lorch, & Nathan, 1985; Koolstra & Lucassen, 2004; Vandewater & Lee, 2009). Second, a single question was used to assess talking to the child about each program. The use of this single question does not allow for quantifying the amount of time that verbal interactions actually occurred during programs, leaving the possibility that significant variability exists in amount of interaction among mothers reporting interactions. This single question also could not capture qualitative aspects of these interactions, therefore making their nature difficult to discern. Additional study is needed to better understand the nuances of these interactions and their relationship to development. Third, findings were based on observational rather than experimental methods. Although we adjusted for many important confounders related to child development, experimental studies would facilitate greater control for confounders and would be useful in confirming findings. Fourth, our results apply to exposure among infants primarily from low-income, Latino immigrant families, and may not be generalizable to children in families with other sociodemographic characteristics. Finally, analyses related to content were limited due to small sample size and were therefore considered exploratory.

In conclusion, this study found that verbal interactions between low-income parents and their infants during media exposure moderated associations between media exposure and language development. In addition, exploratory analyses suggested that interactions related to media exposure with educational content were associated with enhanced language development, independent of other cognitive stimulation in the home. Additional study is needed to determine whether interventions to enhance the home environments of low SES children should target media verbal interactions as a separate entity or as part of a concerted effort to enhance cognitive stimulation considered more broadly.

## Acknowledgments

*Funding/Support:* This study was supported by grant R01 HD047740 from the National Institutes of Health/ National Institute of Child Health and Human Development and by the Tiger Foundation, the Marks Family Foundation, the Rhodebeck Charitable Trust, Children of Bellevue, Inc., and KiDS of NYU Foundation, Inc.

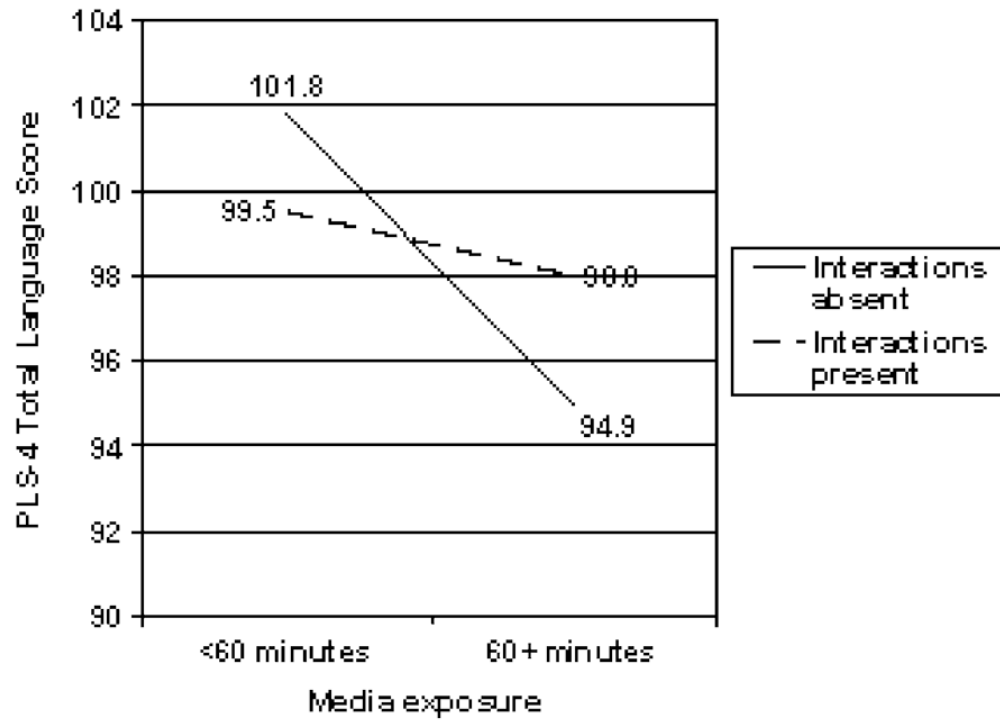
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**Figure 1.** Language score by media exposure moderated by presence of media verbal interactions.

**Table 1**

## Descriptive data for 253 families

	Mean (S.D.) or <i>n</i> (%)
Mother	
Mean (S.D.) age, yrs	27.8 (5.3)
Mean (S.D.) education completed, yrs	9.9 (3.6)
Married or living with partner	219 (86.7%)
Latina	237 (93.7%)
Serious financial problems in prior 12 months	37 (14.6%)
Ever homeless	8 (3.2%)
Depressive symptoms	64 (25.3%)
Mean (S.D.) cognitive stimulation (StimQ)	18.2 (7.0)
Child—Sociodemographics	
Female	135 (53.4%)
First born	98 (38.7%)
Child—6-month media exposure	
Total daily duration of media viewed by child (min)	158.6 (122.4)
Educational/young child oriented content (mins)	23.5 (40.0)
Other content (non-educational, and older child/adult)(mins)	101.3 (88.2)
Unknown content (mins)	33.8 (82.0)
Media exposure at least 60 min/day	222 (87.7%)
Media verbal interactions present	99 (39.1%)
Total daily duration of media viewed with interactions present (mins)	28.6 (52.6)
Child—14-month language	
Mean (S.D.) Total Language Score (PLS-4)	96.7 (8.7)
Mean (S.D.) Auditory Language Score (PLS-4)	90.4 (9.1)
Mean (S.D.) Language Expressive Language Score (PLS-4)	103.3 (9.1)

**Table 2**  
Fourteen-month language score, in relation to whether media interactions were present at 6 months

Area of language assessed	Predictor variable: 6-Month media interactions	n	Outcome variable: 14-Month language score (Mean [S.D.])	Model 1 <sup>a</sup> $\beta$ (S.E.) [R <sup>2</sup> ]	Model 2 $\beta$ (S.E.) [R <sup>2</sup> ]	Model 3 $\beta$ (S.E.) [R <sup>2</sup> ]
Total language	Interactions absent	154	95.7 (9.3)	0.15 (0.06) [0.02]*	0.16 (0.06) [0.12]*	0.07 (0.06) [0.19]
	Interactions present	99	98.2 (7.4)			
Receptive language	Interactions absent	154	89.8 (9.7)	0.08 (0.06) [0.01]	0.09 (0.06) [0.10]	0.03 (0.07) [0.14]
	Interactions present	99	91.3 (8.0)			
Expressive language	Interactions absent	154	102.1 (9.5)	0.17 (0.06) [0.03]**	0.17 (0.06) [0.10]**	0.10 (0.06) [0.16]
	Interactions present	99	105.2 (8.1)			

\*  $p < 0.05$ ;

\*\*  $p < 0.01$ ;

\*\*\*  $p < 0.001$ ;  $p < 0.10$ .

<sup>a</sup> See statistical analysis section for Model definitions.



**Table 3**

Fourteen-month language score, in relation to media exposure at 6 months

Area of language assessed	Independent variable: 6-month media exposure	<i>n</i>	Dependent variable: 14-month language score (Mean [S.D.])	Model 1 <sup>a</sup> $\beta$ (S.E.) [R <sup>2</sup> ]	Model 2 $\beta$ (S.E.) [R <sup>2</sup> ]	Model 3 $\beta$ (S.E.) [R <sup>2</sup> ]
Total language	<60 min	31	100.8 (9.6)	-0.18 (0.06) [0.03]**	-0.19 (0.06) [0.13]**	-0.13 (0.06) [0.20]*
	≥60 min	222	96.1 (8.4)			
Receptive language	<60 min	31	95.4 (11.7)	-0.20 (0.06) [0.04]***	-0.20 (0.06) [0.13]***	-0.16 (0.05) [0.17]**
	≥60 min	222	89.7 (8.5)			
Expressive language	<60 min	31	105.7 (8.3)	-0.10 (0.06) [0.01]	-0.11 (0.06) [0.09] <sup>t</sup>	-0.06 (0.06) [0.15]
	≥60 min	222	103.0 (9.1)			

\*  $p < 0.05$ ;\*\*  $p < 0.01$ ;\*\*\*  $p < 0.001$ ;<sup>t</sup>  $p < 0.10$ .<sup>a</sup> See statistical analysis section for Model definitions.

**Table 4**  
 Fourteen-month language score, in relation to media exposure and verbal media interaction considered in simultaneous models

Predictor Variable	Outcome variable	Model 1 <sup>a</sup>		Model 2		Model 3	
		$\beta$ (S.E.)	R <sup>2</sup>	$\beta$ (S.E.)	R <sup>2</sup>	$\beta$ (S.E.)	R <sup>2</sup>
Total language	Media exposure $\geq 60$ min	-0.17 (0.06)**	0.05	-0.18 (0.06)**	0.15	-0.13 (0.06)*	0.21
	Media verbal interactions	0.14 (0.06)*		0.14 (0.06)*		0.07 (0.06)	
	Cognitive Stimulation	N/A		N/A		0.27 (0.07)***	
Receptive language	Media exposure $\geq 60$ min	-0.20 (0.06)***	0.05	-0.20 (0.06)***	0.14	-0.16 (0.06)**	0.17
	Media verbal interactions	0.07 (0.06)		0.08 (0.06)		0.03 (0.06)	
	Cognitive Stimulation	N/A		N/A		0.20 (0.07)**	
Expressive Language	Media exposure $\geq 60$ min	-0.09 (0.06)	0.04	-0.10 (0.06) <sup>f</sup>	0.11	-0.05 (0.06)	0.16
	Media verbal interactions	0.16 (0.06)**		0.16 (0.06)*		0.10 (0.06)	
	Cognitive Stimulation	N/A		N/A		0.26 (0.07)***	

\*  $p < 0.05$ ;

\*\*  $p < 0.01$ ;

\*\*\*  $p < 0.001$ ;

<sup>f</sup>  $p < 0.10$ .

<sup>a</sup> See statistical analysis section for Model definitions.

**Table 5**  
 Fourteen-month language score in relation to 6-month media exposure, moderated by presence of media verbal interactions<sup>a</sup>

Area of language assessed	Predictor variable 1: 6-month media verbal interactions	Predictor variable 2: 6-month media exposure	N	Outcome variable: 14-month language score (Mean [S.D.])	Mean (S.E.) difference in language score for media 460 min with and without media verbal interactions present (unadjusted)	Test for whether association between 6-month media exposure and 14-month language is moderated by media verbal interactions		
						Model 1 $\beta$ (S.E.) [R <sup>2</sup> ]	Model 2 $\beta$ (S.E.) [R <sup>2</sup> ]	Model 3 $\beta$ (S.E.) [R <sup>2</sup> ]
Total language	Interactions absent	<60 min	17	101.8 (11.6)	-6.9 (2.3)**	-0.30 (0.17)[0.06] <sup>t</sup>	-0.35 (0.18)[0.17]*	-0.40 (0.17)[0.22]*
	Interactions present	≥60 min	137	94.9 (8.7)				
		<60 min	14	99.5 (6.6)	-1.5 (2.1)			
		≥60 min	85	98.0 (7.5)				
Receptive language	Interactions absent	<60 min	17	97.5 (14.5)	-8.7 (2.4)***	-0.36 (0.18)[0.06]*	-0.41 (0.18)[0.16]*	-0.44 (0.17)[0.19]*
	Interactions present	≥60 min	137	88.9 (8.5)				
		<60 min	14	92.8 (6.5)	-1.7 (2.3)			
		≥60 min	85	91.1 (8.3)				
Expressive language	Interactions absent	<60 min	17	105.3 (7.1)	-3.6 (2.4)	-0.13 (0.18)[0.04]	-0.17 (0.18)[0.11]	-0.22 (0.18)[0.17]
	Interactions present	≥60 min	137	101.7 (10.0)				
		<60 min	14	106.1 (9.8)	-1.1 (2.4)			
		≥60 min	85	105.0 (9.1)				

\*  $p < 0.05$ ;

\*\*  $p < 0.01$ ;

\*\*\*  $p < 0.001$ ;

<sup>t</sup>  $p < 0.10$ .

<sup>a</sup> See statistical analysis section for Model definitions.