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## Exposure to Audiovisual Media and Its Role in Toddlers' Language Development

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**Author Contributions:** Ms. Novikova had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

**Concept and design:** All authors.

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**Drafting of the manuscript:** Novikova.

**Critical review of the manuscript for important intellectual content:** All authors.

**Statistical analysis:** Novikova.

**Administrative, technical, or material support:** Su, Morini.

**Supervision:** Su, Morini.

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**Abstract:**

**Aim** This study examined (i) whether the amount of audiovisual media exposure predicts child language use, language input, and language interaction, and (ii) the role of the media program type (child-oriented educational, child-oriented entertainment, adult-oriented) in relation to parent-child language.

**Methods** Using Language Environment Analysis (LENA) recorders, we collected day-long language recordings in homes of families with children in the U.S. Human coding of entire recordings was used to capture the amount of total media exposure and program type for child language environment. Automated measures of language (child vocalizations, adult word count, conversational turns) were obtained from LENA recordings. The study included 29 children (12 girls [41.38%]; mean [SD] age 25.28 months [3.01]).

**Results** Regression analyses showed that higher total audiovisual media time was associated with lower child language use, language input, and language interaction. Higher child-oriented entertainment media time was also associated with lower child language use, language input, and language interaction, while adult-oriented media time was associated with lower child language use and language interaction.

**Conclusion** It is recommended that practitioners communicate the importance of caregiver-child interactions as well as media timing and content management to families with young children.

**Key notes:**

1. We used full-day recordings to code audiovisual media amount and program type in households of 21- to 30-month-old children in the U.S.
2. Total media time was negatively associated with measures of parent-child language.
3. Higher exposure to child-oriented entertainment media and adult-oriented media was associated with lower parent-child language.

**Key words:** language use, language environment, early childhood, audiovisual media, television

**Abbreviations**

|        |                                                                      |
|--------|----------------------------------------------------------------------|
| CI     | Confidence Interval                                                  |
| SES    | Socioeconomic Status                                                 |
| LENA   | Language Environment Analysis                                        |
| STROBE | Strengthening the Reporting of Observational Studies in Epidemiology |

**Data Availability Statement**

Numeric data on the amount of media exposure and parent-child language are available from the authors upon request.

## **Exposure to Audiovisual Media and Its Role in Toddlers' Language Development**

### **Introduction**

According to a 2020 report, two- to four-year-old children in the U.S. on average watch about two hours of video content per day, while children under two years of age average 45 minutes.<sup>1</sup> At the same time, the American Academy of Pediatrics<sup>2</sup> recommends that parents refrain from introducing screen media until children reach 18-24 months and that they limit media use to one hour for children aged two to five years. Research on the effects of audiovisual media on child language development generally shows that higher amount of media exposure is negatively associated with measures of parent-child language in young children—defined as expressive properties of parents' and children's language individually and in mutual interactions. Studies using both longitudinal and cross-sectional data suggest that as the amount of media exposure increases, there is a decrease in children's vocalizations, adult word count, and caregiver-child conversational turns.<sup>3-5</sup> Other aspects of child language—such as expressive vocabulary—were also shown to have a negative association with media exposure time.<sup>6,7</sup> These findings are particularly alarming, since the early years are crucial for subsequent child development, including language outcomes.<sup>8,9</sup>

It is worth noting that the effect of media time on parent-child language appears to be moderated by the type of programs that children are exposed to. Educational programs have been found to benefit children's language outcomes—particularly, receptive vocabulary,<sup>10,11</sup> which could be explained by the abundance of ostensive cues that indicate the word meaning and attention-directing cues that draw children's attention to the target words.<sup>12</sup> In turn, child-oriented entertainment and adult-oriented programs are

negatively related to child receptive vocabulary. This could be attributed to content that is too fast-paced and not developmentally appropriate for young children (e.g., complex vocabulary).<sup>10,11</sup> There is some research indicating that more caregiver-child verbal interactions take place during educational programs compared to non-educational and adult-oriented media.<sup>13</sup> Similarly, fewer instances of caregiver reading practices were found with higher exposure to child-oriented entertainment programs.<sup>14</sup> Considering the importance of early experiences for child developmental outcomes and the dearth of evidence on the links between exposure to different media program types and parent-child language, further research is necessary to contribute to a comprehensive investigation of this relationship—particularly, using direct measures of media exposure.

One of the ways to directly measure the amount of media exposure is the Language Environment Analysis (LENA) system,<sup>15</sup> a digital recorder that captures the amount of exposure to television in addition to language measures. While the device allows for a quick processing of large amounts of audio recording data, the automated LENA TV/Electronics measure has several limitations. The measurement accuracy varies when compared to human coding, with higher reliability in some studies compared to others. Comparing human coding and LENA TV/Electronics measures showed that among human-coded TV/Electronics segments, 71% were coded as such by LENA, while only 33% of LENA-coded TV/Electronics segments were identified as belonging to the same category by human coders.<sup>4</sup> In another study, the agreement on the TV/Electronics segments between the LENA output and human coders was 46%, with the majority of the TV/Electronics segments misclassified by LENA attributed to the Overlap category (when child or adult speech co-occurs with television or

electronics sounds).<sup>16</sup> The LENA TV/Electronics measure also captures both audiovisual and audio electronics such as children's musical toys, radio, and loud speaker phone calls,<sup>17</sup> which do not fall under the definition of audiovisual media in our study. Another limitation associated with using automated analyses of LENA recordings is that the system does not differentiate between types of audiovisual media programs which children are exposed to.

This study uses human coding of day-long recordings to examine (i) whether the *amount* of audiovisual media exposure associates with child language use, language input, and language interaction, and (ii) the role of media program *type* in relation to parent-child language. Based on prior research,<sup>3-5,10-14</sup> we hypothesized that higher total media exposure time will associate with lower parent-child language. As for the program type, we hypothesized that higher child-oriented entertainment and adult-oriented media time will relate to decreased parent-child language, whereas the relationship between child-oriented educational media time and parent-child language measures will be positive.

## **Methods**

This study used data from a larger project which involved 117 families (67 monolingual and 50 bilingual) with typically developing children aged 21-30 months from across the U.S. The sample for the current study included monolingual English-speaking children whose caregivers consented to the audio recordings being listened, which at the initiation of this study included 31 participants. Two participants who did not wear the vest with the recording device and who had insufficient recording length were excluded. The final sample included 29 children (12 girls [41.38%]; mean [SD]

age 25.28 months [3.01]; Table 1). Despite the small sample size, the use of whole-day recordings (rather than ten-minute or one-hour language samples) allows for a more comprehensive examination of children's language and media environment. A post hoc power analysis for the sample size indicated that the power is 0.74.

Participants included in the sample were recruited from the third author's laboratory Registry primarily through online outreach efforts; the data were collected between March 5, 2021, and April 29, 2022. The study was approved by the University of Delaware and the University of Texas at Dallas Institutional Review Board committees. A written consent was obtained from participating caregivers, including the consent for researchers to listen to the recordings. We followed the STROBE reporting guidelines.

As part of the study, children wore Language Environment Analysis (LENA)<sup>15</sup> recorders for one to two days for up to 16 hours (mean 15.80). Families were asked to complete home recordings on days that were typical for the child. A trained coder (first author) listened to 458.13 hours of day-long recordings and identified 428.15 hours (mean 14.76) as child awake time. The coder listened to recordings in ten-second intervals to identify presence of media, and once detected, manually coded audiovisual media exposure time for subsequent calculation of total media time per child. Exposure time to each program type (child-oriented educational, child-oriented entertainment, adult-oriented) was coded simultaneously following a pre-developed codebook based on prior research<sup>11,18</sup> (Supplemental Table 1). A second coder coded 20% of the recordings to establish inter-coder reliability ( $\kappa=0.85$ ). Automated LENA-generated measures—child vocalizations, adult word count, conversational turns—were used to measure child



language use, language input, and language interaction respectively. Demographic characteristics were obtained from caregiver reports (Table 1). Since child age and household income (*\$75,000 and less* versus *more than \$75,000*) were associated with dependent variables in the correlation analyses, they were included in the regression analyses as covariates. Consequently, six regression analyses were conducted to test the relationship between (i) total media exposure and the three language outcomes (i.e., three models) and (ii) all three media types included together as independent variables for each of the three language outcomes (i.e., three models). Benjamini-Hochberg<sup>19</sup> procedure was used to adjust the  $p$  value and CI due to multiple testing.

## Results

On average, children were exposed to 3.84 [2.33] hours of media. Of the total amount of media time, child-oriented educational media accounted for 30.95%, child-oriented entertainment media comprised 49.40%, while 19.65% was adult-oriented media. The average percentage of program type was 32.41% [29.48%] for child-oriented educational media, 46.67% [30.71%] for child-oriented entertainment media, and 20.92% [23.03%] for adult-oriented media. Multivariable regression analyses showed that higher total audiovisual media time predicted lower child language use ( $b=-0.39$ , 99%  $CI$   $-0.71$  to  $-0.07$ ,  $p=.02$ ,  $\eta_p^2=.27$ ), language input ( $b=-2.86$ , 99%  $CI$   $-5.29$  to  $-0.43$ ,  $p=.01$ ,  $\eta_p^2=.28$ ), and language interaction ( $b=-0.13$ , 99%  $CI$   $-0.24$  to  $-0.02$ ,  $p=.02$ ,  $\eta_p^2=.26$ ; Figure 1), confirming the first hypothesis. Upon testing the second hypothesis, higher child-oriented entertainment media time was also associated with lower child language use ( $b=-0.46$ , 99%  $CI$   $-0.87$  to  $-0.05$ ,  $p=.03$ ,  $\eta_p^2=.23$ ), language input ( $b=-3.79$ , 99%  $CI$   $-7.14$  to  $-0.44$ ,  $p=.002$ ,  $\eta_p^2=.28$ ), and language interaction ( $b=-0.21$ , 99%

$CI$   $-0.36$  to  $-0.06$ ,  $p=.04$ ,  $\eta_p^2=.36$ ; Figure 1; Table 2). Higher adult-oriented media time was associated with lower child language use ( $b=-0.74$ , 99%  $CI$   $-1.46$  to  $-0.02$ ,  $p=.03$ ,  $\eta_p^2=.21$ ) and language interaction ( $b=-0.24$ , 99%  $CI$   $-0.49$  to  $-0.01$ ,  $p=.04$ ,  $\eta_p^2=.21$ ).

## Discussion

This study showed that higher total audiovisual media time was associated with lower child language use, language input, and language interaction, providing support to our first hypothesis. Additionally, higher child-oriented entertainment media time was associated with lower child language use, language input, and language interaction, while higher adult-oriented media time showed a negative association with child language use and language interaction—which to an extent supported our second hypothesis. Our findings confirm prior research on the amount and type of audiovisual media exposure.<sup>3-5,11</sup> In terms of the negative association for total media time and child language use, it is possible that media viewing displaced other activities that facilitate language use such as imaginative play and book reading. Indeed, studies demonstrate that even in the presence of background media, the duration and complexity of toy play deteriorates<sup>20,21</sup> and so does the amount of caregiver language input during play.<sup>5</sup> Since play serves as a key context for the development of social and linguistic skills,<sup>21</sup> it is important to encourage caregivers to practice media-free play.

The negative association for total media and language input and language interaction could be due to caregivers leaving children in front of a screen device by themselves. Another possibility is that the caregivers are present but do not engage in conversations due to unwillingness to interfere with the media program or simultaneously using another screen device. Higher media time is also connected to

activities throughout the day—there is evidence that increased screen time is associated with lower frequency of literacy activities in families with young children.<sup>22,23</sup> With studies emphasizing the importance of caregiver-child language interaction during the media viewing as a facilitator of language development<sup>3-5,24</sup> and the demonstrated links between caregiver language input and later child language outcomes,<sup>9</sup> it is recommended that practitioners encourage caregivers to engage in media content-related conversations with children. Additionally, caregivers could be equipped with strategies and prompts to discuss media content with children—e.g., open-ended questions, labeling, and narrating—and extend the discussions into play and other activities beyond the screens.

As expected, higher exposure to child-oriented entertainment media was associated with lower parent-child language. Such entertainment programs often prioritize simplified narratives, saturated visuals, and fast-paced actions, which can limit opportunity for rich, back-and-forth parent-child conversation and deep engagement. Coupled with findings that even short periods of fast-paced children’s media exposure hinder executive function,<sup>25</sup> guidelines on selecting high-quality programming need to be provided to caregivers. Specifically, parents could look for programs that are slower paced, contain rich vocabulary, offer topics that could promote a conversation, and come in shorter segments to facilitate monitoring of media timing. Similarly, the negative association between adult-oriented media and parent-child language uncovered in the study could stem from adults attending to the program at the expense of interacting with children. This finding emphasizes the need for informing parents about the importance of caregiver-child interactions for child language outcomes and providing strategies for

parents' own media viewing (including the amount of media viewing by parent when child is present).

The non-significant findings for child-oriented educational media time in our study could be due to a need for within-category differentiation for child-oriented educational media programs.<sup>26</sup> Another explanation for the non-significant results is the potential lack of caregiver-child interactions during educational media exposure. Since caregivers often rely on educational media as a valuable tool for their children's learning,<sup>27</sup> it is possible that they entrust child education to the media program and do not interact with children in the process of media viewing. Additionally, considering that prior research has mostly uncovered significant associations for child vocabulary,<sup>10,11</sup> this domain of child language could be benefitting from educational media to a larger extent than parent-child language.

A noteworthy finding is the amount of media exposure in households in our study that averaged 3.84 hours a day and ranged from 0.68 hours to as much as 8.63 hours across households. This number is in line with other reports of young children being exposed to media in volumes that exceed the American Academy of Pediatrics' recommendations for their age,<sup>2</sup> which warrants closer attention in the context of often negative developmental outcomes of high media exposure times.<sup>3-5</sup> Findings from this study prompt policymakers and practitioners to consider both the *amount* and the *types* of audiovisual media young children are exposed to. However, media is an essential part of an individual's functioning<sup>28</sup> that cannot be eliminated from a family's everyday life. Considering the complexity of screen time and parenting, it is important to provide actionable guidelines for conscious media use that include timing, program content, and

caregiver facilitation of media viewing. We highlight the importance of making sure caregivers are informed about this topic. While exposing young children to audiovisual media can be used to provide short breaks for caregivers, children do not appear to benefit from continuous exposure, even when media content is child-oriented. Given the success of interventions directed at reducing media viewing and increasing caregiver language input,<sup>29,30</sup> future research might target the development and testing of programs that promote positive media use in families with children.

This study adds to the limited research that used human coding with entire day-long home recordings.<sup>3,4</sup> This allows for a more detailed estimate of the amount of audiovisual media time and type than automated algorithm-generated media time or parent reports. Limitations of the study include small sample size and cross-sectional design, making this study a stepping stone for future efforts to measure the media program type effects. Additionally, while we used human coding—a more direct measure of media exposure compared to parent reports—it still could be prone to error due to individual interpretation in identifying audiovisual media. The study participants were recruited through online outreach, which could have contributed to limited variability in SES. It is also important to acknowledge that the data collection was conducted while the COVID-19 pandemic was still ongoing, and therefore, the children could have been spending more time at home exposed to media than during the post-COVID period. Another limitation is that audio recordings did not allow to account for whether the child was actively watching media or the media was playing in the background, which would be possible to discern with the presence of video.

## **Conclusion**

This study showed that higher audiovisual media exposure was associated with lower child language use, language input, and language interaction in a sample of 29 21-30-month-old monolingual children. In terms of program type, higher child-oriented entertainment media exposure was associated with lower child language use, language input, and language interaction, whereas higher adult-oriented media was linked to lower child language use and language interaction. Since the early years are pivotal for child development—including the language domain—strategies to ensure optimal media use while also considering overall family well-being need to be developed.

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**Table 1**

Sample characteristics (N=29)

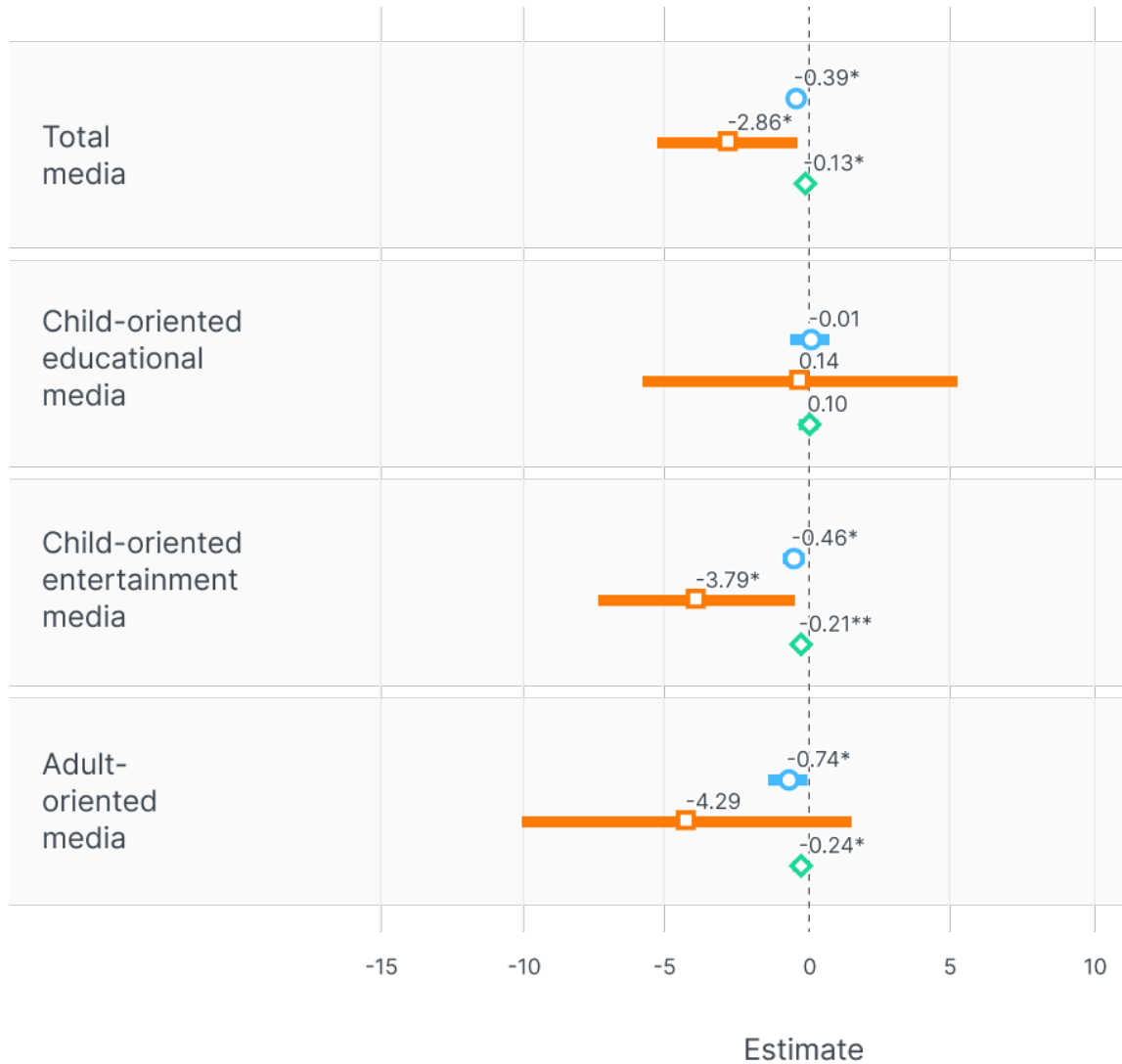
| Characteristics                              | Mean / n | SD / % | Range       |
|----------------------------------------------|----------|--------|-------------|
| Child's race                                 |          |        |             |
| Asian                                        | 1        | 3.45%  | NA          |
| Black or African American                    | 1        | 3.45%  | NA          |
| White                                        | 22       | 75.86% | NA          |
| Biracial                                     | 5        | 17.24% | NA          |
| Child is Hispanic                            | 1        | 3.45%  | NA          |
| Number of children in the household          | 1.72     | 1      | 1-4         |
| Child's age, months                          | 25.28    | 3.01   | 21-30       |
| Both parents work full time                  | 21       | 72.41% | NA          |
| Child attends group child care               | 13       | 44.83% | NA          |
| Child is male                                | 17       | 58.62% | NA          |
| Annual household income                      |          |        |             |
| \$35,000-\$45,000                            | 2        | 6.90%  | NA          |
| \$65,000-\$75,000                            | 2        | 6.90%  | NA          |
| More than \$75,000                           | 25       | 86.20% | NA          |
| Recording length, hrs                        | 14.76    | 1.72   | 10.55-16    |
| Recording made on a weekday                  | 14       | 48.28% |             |
| Total media time, hrs                        | 3.84     | 2.33   | 0.68-8.63   |
| Child-oriented educational media time, hrs   | 1.19     | 1.21   | 0-4.27      |
| Child-oriented entertainment media time, hrs | 1.89     | 1.65   | 0-5.65      |
| Adult-oriented media time, hrs               | 0.75     | 0.95   | 0-3.18      |
| Child Vocalizations <sup>a</sup>             | 4.29     | 1.72   | 1.47-8.36   |
| Adult Word Count <sup>a</sup>                | 27.86    | 12.55  | 12.06-62.70 |
| Conversational Turns <sup>a</sup>            | 1.26     | 0.59   | 0.37-2.43   |

<sup>a</sup>Child Vocalizations, Adult Word Count, and Conversational Turns are measured in thousands of vocalizations/words/turns.

**Figure 1**

Confidence intervals from multivariable regression analyses for audiovisual media

exposure time and language measures in a sample of 21–30-month-old children (N = 29)



Child language use

Language input

Language interaction

*Note.* Statistical significance is assessed at the  $p < .05$  level. The analyses control for household income (\$75,000 and less versus more than \$75,000) and child's age. Benjamini-Hochberg procedure was used to adjust the  $p$  value and Confidence Interval due to multiple testing.

**Table 2**

Results of multivariable regression analyses for time of audiovisual media exposure per program type and parent-child language in a sample of 21–30-month-old children ( $N = 29$ )

| Predictors                         | Child language use |      |                |                | Language input |      |                |                | Language interaction |      |                |                |
|------------------------------------|--------------------|------|----------------|----------------|----------------|------|----------------|----------------|----------------------|------|----------------|----------------|
|                                    | b                  | SE   | 99% CI         | <i>p</i> Value | b              | SE   | 99% CI         | <i>p</i> Value | b                    | SE   | 99% CI         | <i>p</i> Value |
| Intercept                          | 5.82               | 0.53 | 4.55 to 7.09   | <.0001         | 39.93          | 3.89 | 29.66 to 50.20 | <.0001         | 1.82                 | 0.18 | 1.37 to 2.27   | <.0001         |
| Child-oriented educational media   | -0.01              | 0.31 | -0.74 to 0.74  | >.99           | 0.14           | 2.29 | -5.90 to 6.18  | .95            | 0.10                 | 0.10 | -0.14 to 0.35  | .36            |
| Child-oriented entertainment media | -0.46              | 0.17 | -0.87 to -0.05 | .03            | -3.79          | 1.27 | -7.14 to -0.44 | .02            | -0.21                | 0.06 | -0.36 to -0.06 | <.01           |
| Adult-oriented media               | -0.74              | 0.30 | -1.46 to -0.02 | .03            | -4.29          | 2.18 | -10.04 to 1.46 | .10            | -0.24                | 0.10 | -0.49 to -.01  | .04            |
| Household income                   | -0.75              | 1.09 | -3.36 to 1.86  | .60            | -13.16         | 7.98 | -34.19 to 7.87 | .14            | -0.67                | 0.36 | -1.6 to 0.23   | .09            |
| Child's age                        | 0.25               | 0.10 | 0.01 to 0.49   | .03            | 1.39           | 0.72 | -0.51 to 3.29  | .10            | 0.07                 | 0.03 | -0.01 to 0.14  | .05            |

*Note.* Statistical significance is assessed at the  $p < .05$  level. Benjamini-Hochberg procedure was used to adjust the  $p$  value and Confidence Interval due to multiple testing. Child's age is mean-centered. For household income, "more than \$75,000 per year" is the reference category.