**Title:** The Impact of the Early Language Environment on Language Development in Toddlers with Down Syndrome

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**Introduction:** Individuals with Down syndrome (DS) characteristically struggle with spoken language, with delays noted as early as 2 months. Toddlers with DS say their first words around 18 months (Martin et al., 2009) whereas typically developing infants demonstrate these skills around 12 months. In contrast, receptive language appears to be a strength for individuals with DS starting in toddlerhood. Despite the importance of early communication and its relevance for intervention in DS, the limited investigations of these skills in infants and toddlers with Down syndrome (prior to 2 years of age) makes it difficult to discern the feasibility, timing, and specific abilities to target for language intervention. This study explores the early language environment of toddlers with DS, including child-parent communication interaction behaviors and exposure to expressive vocabulary, and how this environment relates to concurrent and later expressive and receptive language abilities (Gilkerson, et al., 2017; Hoff, 2002; Huttenlocher, et al., 1991). Understanding the early language profile in Down syndrome can help to determine the roots of the expressive language deficits in later development (Fidler et al., 2007; Luyster et al., 2011), as well as, identify areas for early language interventions in this population.

**Method:** Participants were 13 infants and toddlers with DS. At time 1, infants were between 11-26 months, and at time 2, they were between 16-28 months. As part of a larger battery, infants were administered the Mullen Scales of Early Learning (MSEL; Mullen, 1995), child vocalizations during a normal day were recorded using a Language Environmental Analysis (LENA) recorder, and mothers completed the MacArthur-Bates Communication Inventory (CDI; Fenson et al., 2006), and the Vineland Adaptive Behavior Scales-3 (VABS; Sparrow et al., 2016). For this study, data recorded from the LENA at time 1 was used to predict later CDI scores. Specifically, from the LENA child vocalizations count, conversational turn count, and adult word count were used. Additionally, an age-standardized automatic vocalization assessment (AVA) score was calculated using LENA to compare the complexity of children’s vocalizations with a database of typically developing children around their same age (LENA Research Foundation, 2018). We examined the association between the LENA variables (at Time 1) and the child’s language development at both time points as measured by the MSEL, VABS, and CDI. We chose to examine language from these three measures to account for developmental language (MSEL), functional language (VABS), vocabulary (CDI), and nonverbal communication behaviors (gestures; CDI). We also examined the association between the LENA variables and the child’s overall development (MSEL Early Learning Composite).

**Results:** Results indicate that child vocalizations were positively correlated with MSEL receptive language raw scores ($r = .64, p = .04$), VABS receptive language raw scores ($r = .64, p = .09$), and CDI early gestures ($r = .55, p = .08$), CDI late gestures ($r = .52, p = .10$), and CDI total gestures ($r = .56, p = .08$) at Time 1. Conversational turn count was positively correlated with MSEL receptive language raw scores ($r = .74, p = .02$) at Time 1. Children’s AVA scores were positively correlated with the MSEL Early Learning Composite ($r = .70, p = .04$) at Time 1. At Time 2, child vocalizations were positively correlated with CDI words understood ($r = .77, p = .04$), CDI late gestures ($r = .70, p = .08$); and CDI total gestures ($r = .69, p = .09$). Conversational turn count was positively correlated with CDI words understood ($r = .81, p = .03$), CDI later gestures ($r = .76, p = .047$), CDI total gestures ($r = .74, p = .06$), and VABS receptive language subdomain raw scores ($r = .91, p = .10$) at Time 2. Children’s AVA scores were positively correlated with MSEL expressive language raw scores ($r = .94, p = .06$) and MSEL Early Learning Composite ($r = .98, p = .02$). Adult word count was not correlated with any language measures at Time 1 or Time 2.

**Discussion:** Preliminary evidence supports a relationship between the early language environment for children with DS and their concurrent and later expressive and receptive language abilities. However, these relations vary by the type of language being measured. Both child vocalizations and conversational turns between a child and their caregiver showed consistent positive correlations with communicative gestures and receptive language scores over time. Interestingly, adult word count was not correlated with any language measures. One possibility is that a lot of the adult word count captured by the LENA may not be directed towards the child (i.e., it is in their environment, but is to other adults or other children). While this can provide a rich language environment, children with DS may not be as attentive to the language that is not directed to them, given what is
known about attention in DS. These findings suggest the importance of child-parent interactions in early language acquisition for children with DS and may provide implications for early intervention programs to create more naturalistic opportunities for parents to elicit or respond to child vocalizations and gestures. Future research should continue to examine the child-parent dyad and early language environments to determine the extent to which frequency and type of communicative input (e.g. gestures, vocalizations) relates to expressive and receptive language development in children with DS.

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