Symposium Title: A Developmental Perspective of Literacy and Language Development in Down Syndrome

Chairs: Susan J. Loveall\textsuperscript{1} & Laura J. Hahn\textsuperscript{2}

Discussant: Frances A. Conners\textsuperscript{3}

Overview: Individuals with Down syndrome (DS) exhibit unique reading and language profiles, and often struggle with these skills even relative to individuals with other intellectual and developmental disabilities (e.g. Abbeduto, Warren, & Conners, 2007). Language and literacy are also interrelated—language is integral to reading, and reading helps foster language development (e.g. Cunningham & Stanovich, 1998; NICHD, 2000). However, there is a lack of research on the connection between these skills in DS. The purpose of this symposium is to bring together current research on the intersection between language and literacy in DS across different ages and developmental periods. The first presentation examines the home literacy environment of infants and toddlers with DS and how this impacts early word learning both concurrently and 6 months later. The second presentation moves onto preschool and school age children with DS to identify the relationships between vocabulary, letter-sound knowledge, and phonological awareness. The third presentation explores the impact of language comprehension and word identification on reading comprehension success in adolescents and adults with DS. Finally, the fourth presentation takes an important step in promoting literacy in DS by testing the efficacy of a vocabulary intervention, DSL+, to improve language outcomes in first graders with DS by using picture books to engage the children in literal and inferential talk while exposing them to target words. Together, these presentations document how language and reading intersect and develop in DS from infancy through adulthood with a focus on clinical relevance and intervention.

Key References/Citations:

\begin{itemize}
\end{itemize}

\textsuperscript{1} University of Nebraska – Lincoln
\textsuperscript{2} University of Illinois – Urbana-Champaign
\textsuperscript{3} University of Alabama

Paper 1 of 4

Paper Title: Home-Literacy Environments and Language Development in Infants and Toddlers with Down syndrome

Authors: Madison S. Dulin\textsuperscript{1}, Susan Loveall\textsuperscript{1,2}, Laura Hahn\textsuperscript{3}, & Laura J. Imming\textsuperscript{3}

Introduction: Rich home-literacy environments (HLEs), such as providing regular access to books and engaging in parent-child shared storybook reading, have a positive impact on children’s language and literacy development (e.g. Bus et al., 1995). However, despite the well-documented difficulties with speech and language in individuals with DS (e.g. Abbeduto et al., 2007), only a few studies have examined the HLEs of children with DS. The research that is available suggests that pre-school age children with DS are not exposed to as rich of HLEs as school-age children with DS or typically developing preschoolers (Ricci, 2011). However, there has been little research focusing on HLEs in infants and toddlers with DS or how HLEs relate to language outcomes in this population. The present study, therefore, aimed to: 1) characterize HLEs for infants and toddlers with DS, and 2) examine if richness of the HLE, child engagement in shared book reading, and exposure to language in the home environment predicted child word learning outcomes concurrently (Time 1) and six months later (Time 2).
**Methods:** Participants included infants and toddlers with DS (n=13; 69% male) and their mothers. At study entry, children were between 11-29 months ($M=17.69$ $SD=5.38$). As part of a larger assessment battery, mothers completed a *Home Literacy Environment Questionnaire* (HLE; adapted from Boudreau, 2005; Peeters, 2009) at Time 1, which was used to characterize the HLE and to calculate two composite variables: richness of the HLE and child engagement in shared book reading. Also at Time 1, the home language environment was captured using a *LENA Recorder DLP* worn by the child over a 16-hour timeframe (LENA Research Foundation, 2018). The LENA automatically calculates several variables, including adult word count (AWC), which was used in data analysis to represent the home language environment. Finally, at both time points, mothers completed the *MacArthur-Bates Communicative Development Inventories* (CDI; Fenson et al., 2007), and the words understood variable was used as the dependent variable. We examined words understood in this study instead of words produced because very few children were using spoken language. One participant did not have LENA data due to recorder error, and one participant’s data is currently being processed.

**Results:**

**Aim 1** On the HLE questionnaire, all mothers reported that they began reading to their child between 0-12 months of age, and half had a designated reading time with their child. When asked about the past week, mothers reported that they read a total of 1 to 11+ books with their child across 3 to 11+ reading sessions. Mothers also reported they had many books in the home (children’s books: $M=128.33$, $SD=101.16$, range=30-300; adult books: $M=128.33$, $SD=72.72$, range=20-200). When asked about interactions during shared book reading, a majority of mothers reported that they point out important details from the story that are outside of the written text ($n=12$), relate the story events to their child’s everyday experiences ($n=11$), teach the names of the letters in the alphabet and/or alphabet sounds when reading ($n=10$), and ask their child questions about the story and follow-up with answers ($n=7$).

**Aim 2** Multiple linear regression was used to examine the contributions of richness of HLE, child engagement in book reading, and home language environment to child word learning. At Time 1, the total variance explained by the model was 78%, $F (3, 7) = 12.75$, $p = .003$. Child engagement, $\beta = .87$, $t = 5.17$, $p = .001$, uniquely contributed 59% of the variance, and adult word count, $\beta = -.46$, $t = -2.85$, $p = .03$, contributed another 18%. Richness of HLE was nonsignificant. At Time 2, the total variance explained by the model was 95%, $F (3, 3) = 37.39$, $p = .007$. Child engagement again emerged as the strongest predictor, $\beta = .85$, $t = 7.41$, $p = .005$, uniquely contributing 48% of the variance to the full model. Adult word count and richness of the HLE were nonsignificant.

**Discussion:** Results suggest rich HLEs for infants and toddlers with DS and that child engagement in shared book reading is related to child word learning. The more engaged mothers reported that their child was in book reading, the stronger the child’s receptive vocabulary, both concurrently and 6 months later. Interestingly, the home language environment, measured by adult word count in the home environment, was not linked to improved receptive vocabulary. In our model, for every increase in child word learning there was a .46 decrease in adult word count. It is possible that as children gain greater understanding of words—more receptive language—parents do not talk as much because they are not providing additional linguistic mapping. For example, if a parent knows their child does not know the word ball, they may provide a lot of linguistic mapping (“Ball! You want the ball. Here is the ball!”). Once they know that their child knows the word ball they may simply say, “Here’s the ball”.

Understanding the impact HLEs have on language development can help parents and practitioners promote a language-rich environment.

**References/Citations:**

Paper 2 of 4

Paper Title: Reading Skills in Preschool and School Age Children with Down Syndrome

Authors: Andrea Barton-Hulsey

Introduction: Linguistic skills of vocabulary comprehension and phonological awareness are particularly important for reading development. Phonological awareness is children’s explicit knowledge regarding the sound structure of spoken words. The lexical restructuring model (Metsala & Walley, 1998) proposes that phonological awareness develops as an outgrowth of children’s vocabulary knowledge. The psycholinguistic grain size theory suggests that letter-sound knowledge is necessary for development of phonological awareness (Ziegler & Goswami, 2005). Research to date has found that children’s phonological awareness skill remains a strong influence in reading development over IQ, and children use this knowledge to successfully learn to read (NICHD, 2000). It remains unclear the extent to which intrinsic factors of vocabulary knowledge, letter-sound knowledge and speech ability contribute to the development of phonological awareness in children with Down syndrome (DS). It is suggested that children with DS have specific difficulty with the development of phonological awareness compared to other early literacy skills (Naess, 2016). This study identifies the relationship between vocabulary knowledge, letter-sound knowledge, and phonological awareness in children with DS compared to a group of children with autism spectrum disorder (ASD), and a group with heterogeneous etiologies of developmental disability (DD).

Methods: A total of 57 children, 42 children in preschool (mean age = 56.74 months) and 15 children in K – 3rd grades (mean age = 89.40 months) with developmental disabilities and a range of speech ability participated. Eight children had DS, 21 had a parent reported diagnosis of ASD, and 27 children had DD with a range of etiologies including Fragile X syndrome, Phelan McDermid syndrome, Smith-Magenis syndrome, and Angelman syndrome. The 42 children in preschool were matched for age ($F[3, 39] = 1.09, p = .419$), developmental skill as assessed by the Mullen Scales of Early Learning (MSEL, 1995; $F[3, 39] = 2.875, p = .068$), and shared literacy experiences at home ($F[2, 35] = 0.68, p = .513$) and at school ($F[2, 29] = 0.13, p = .875$). Exploratory data will be presented from two children with DS in K – 3rd grades. All children completed standardized assessments of vocabulary and early reading skills. An experimental task of phonological awareness that did not require speech ability was additionally used.

Results: For children in preschool, a one-way ANOVA revealed significant differences between groups for letter knowledge ($F[3, 39] = 4.88, p = .013$). Children with ASD had greater letter knowledge than children with DS (mean difference = 6.09). There were no significant differences between groups for phonological awareness, vocabulary knowledge or letter-sound knowledge. Children with ASD had strengths in letter-sound knowledge that were significantly related to phonological awareness ($r_s = .56, p = .019$), but in children with DS, no significant correlations were found between letter-sound knowledge and phonological awareness ($r_s = .11, p = .836$). Significant relationships between vocabulary comprehension and phonological awareness were not found in either group. Children with DD had significant, positive correlations between letter-sound knowledge and phonological awareness ($r_s = .65, p = .003$), and vocabulary comprehension and phonological awareness ($r_s = .67, p = .002$) as would be
expected in typically developing children. When examining relationships between phonological awareness and word reading in children in K – 3rd grades, one child with DS had stronger phonological awareness than word reading skills, another child with DS had stronger word reading skills than phonological awareness. Across all 15 K – 3rd grade participants, there was a large, significant correlation between a standardized tool of phonological awareness, the Phonological and Print Awareness Scale, and the experimental task of Phonological Awareness that did not require speech ability (r = .953, p < .001).

Discussion: Findings represent an important step in understanding the relationship between factors of vocabulary and letter-sound knowledge that may support the development of phonological awareness in children with DS, ASD and DD during preschool. Opportunities for increased instruction in phonological awareness that capitalize on children’s strengths in each group will be discussed. Additionally, this study highlights the need to account for limitations in speech production early on in children with DS during both reading assessment and intervention. Findings suggest that the experimental task of phonological awareness used in this study may be a feasible alternative to assessment tools that require spoken language.

References/Citations:

- National Institute of Child Health and Human Development. Report of the National Reading Panel. Teaching Children to Read: An Evidence-Based Assessment of the Scientific Research Literature on Reading and Its Implications for Reading Instruction.; 2000.
Results: When examining the reading comprehension cluster, 16 participants were reading at either the first or second-grade level. One participant was reading below the first-grade level. Multiple regression was used to assess the contribution of word identification and phonological decoding (basic skills cluster) and language comprehension to reading comprehension success. The total variance explained by the model was 49%, $F(2, 14) = 8.74, p = .003$. Language comprehension emerged as the only statistically significant predictor, $\beta = .79, t = 2.84, p = .01$, uniquely contributing 26% of the variance to the full model. The basic skills cluster was not a statistically significant predictor, $\beta = -.07, t = -.23, p = .82$, and only uniquely contributed less than 1% of the variance to the full model.

Discussion: Listening comprehension appears to be particularly important to reading comprehension success for adolescents and adults with DS, at least for individuals who have achieved basic levels of word identification and decoding ability. This pattern of results is consistent with Roch and colleagues (e.g. Roch & Levorato, 2009) in suggesting that the Simple View may apply differently to readers with DS than the general population. Future research should further explore language comprehension subskills, such as vocabulary and syntax, to see how these contribute to reading comprehension in DS.

References/Citations:


1 University of Tennessee Health Sciences Center
2 University of Nebraska—Lincoln
3 University of Alabama
4 University of Mississippi

Paper Title: DSL+ - An effective vocabulary intervention?

Authors: Kari-Anne B. Næss1, Silje Hokstad1, Liv Inger Engevik1,2, and Liz Smith1,3
**Methods:** A two-wave national sample of first graders in Norway were invited to participate. In total, 104 families accepted the invitation and were randomly assigned to either DSL+ intervention or “business as usual”. The children were tested with both direct and transfer effect measures at three time points during the intervention: before, midway, and after. In addition, log data from all individual sessions were collected, including audio files from all expressive tasks. The teachers who delivered the intervention received a written training manual with detailed descriptions of the intervention and scripts to guide the picture book dialogues. They were also required to participate in a two-day online training course before the intervention started.

**Results:** A mixed methods approach is being used. Quantitative data is currently being analyzed in MPlus, to investigate the direct and indirect effects of the intervention on expressive and receptive vocabulary. Qualitative data are analyzed with respect to the relationship between literal and inferential teacher questions and the adequacy of children’s responses during intervention sessions, as well as other in-depth investigations of scaffolding qualities. The preliminary findings from both quantitative and qualitative data show optimistic results. Child-related and contextual explanations for variability in outcomes will be further investigated.

**Discussion:** These preliminary results provide some initial evidence that first graders with DS can improve their language skills through the DSL+ intervention, and that the intervention is suitable for implementation among children with DS. These findings are important with respect to future research needs (replication in different contexts, e.g. languages and ages), as well as theoretical understanding of the learning processes and educational needs of pupils with DS.

**References/Citations:**


---

1 University of Oslo
2 Western Norway University of Applied Sciences
3 Cardiff University