Title: Profiles of preschool children with Down syndrome at 12-month follow up after early language intervention

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Introduction: Individuals with Down syndrome (DS) often demonstrate language and adaptive functioning weaknesses which persist throughout development (Jacola, Hickey, Howe, Esbensen, & Shear, 2014; Prasher & Chung, 1996; Will, Caravella, Hahn, Fidler, & Roberts, 2018). Language delays are observed within both expressive and receptive language domains. Some toddlers with significant developmental delays (including children with DS) can enhance their vocabulary skills with augmentative and alternative communication (AAC) intervention (Romski et al., 2010, Romski et al., in preparation). The current study explored whether a subsample of children with DS, assessed 12 months after a parent-coached language intervention, belonged to distinct clusters of adaptive behavior and language ability. Specifically, we asked: 1) Did the children with DS cluster into groups that were significantly different in terms of adaptive behavior and language ability; 2) Did the clusters differentiate in terms of whether they did or did not have access to AAC during the intervention?

Method: This study employed 12-month follow up data from 16 children with DS (*M*age = 39.43 months) who participated in one of two larger longitudinal, parent-implemented communication interventions (Romski et al. 2010, Romski et al., in preparation). Original study inclusion criteria included an expressive language score of less than 12 months on the *Mullen Scales of Early Learning* (MSEL; Mullen, 1995), no more than 10 spoken words, and adequate gross motor skills to manipulate a speech generating device (SGD). All children participated in a 24-session, parent-implemented language intervention that focused on either spoken language or augmented language including a SGD. Hierarchical cluster analysis was employed to identify groups that demonstrated similar variability around scores on the *MacArthur-Bates Communicative Development Inventory* (MCDI; Fenson et al., 2007), the *Vineland Adaptive Behavior Scales* (VABS; Sparrow, Cicchetti, & Balla, 2005) and the *Sequenced Inventory for Communication Development* (SICD; Hendrick, Prather, & Tobin, 1984)).

Results: A hierarchical cluster analysis using Ward's method (Ward, 1963) found that three clusters best explained the variance for these participants. Clusters were defined by MCDI receptive vocabulary abilities: Cluster 1: high (n = 6), Cluster 2: moderate (n = 6), and Cluster 3: emerging (n = 4). Children in Cluster 1 comprehended 256 to 390 words (M = 333.83) and expressed 185 to 390 words as reported by their parents (M = 292). Their overall Adaptive Behavior Composite (ABC) on the VABS was 68.67 with a relative strength in the Socialization domain (Mean SS = 82). Children in Cluster 2 understood 145 to 287 words (M = 221) and produced 34 to 257 words (M = 163.17) as reported by their parents. Their average VABS ABC score was 63.33. Cluster 2 exhibited relatively stable linguistic and adaptive behavior skills across measures. Children in Cluster 3 comprehended 20 to 72 words (M = 48.50) and produced 221 to 348 words (M = 289.50) as reported by their parents. Expressive language was a relative strength for these children. This cluster exhibited an average VABS ABC score of 67 and demonstrated a relative weakness in the Socialization domain (M = 57.75). To examine internal validity of the clusters, univariate ANOVAs were conducted. The number of words comprehended and produced, as measured on the MCDI, were significantly different across the clusters, $F(2,13) = 5.12$, $p = .02$ and $F(2,13) = 46.17$, $p < .001$, respectively. SICD expressive language scores were also significantly different between groups: $F(2,13) = 6.90$, $p = .01$. Across the three clusters (1, 2, and 3), 80%, 80%, and 100% of children had access to a SGD during intervention, respectively.

Discussion: This exploratory cluster analysis identified three unique profiles for language and adaptive behavior skills among preschoolers with DS. Receptive language was not consistently higher than expressive language across the clusters, which was unexpected based on the characteristics of children with DS described in the literature. Moreover, differences in receptive language skills across the clusters were robust within our modest sample which suggested that this skill may be variable across children with DS. Cluster 3, which had relatively high expressive vocabulary and the lowest receptive vocabulary skills, demonstrated the lowest Socialization scores on the VABS. This finding suggested that language comprehension may have played an important role in how children with DS are able to interact socially with others, which is in line with prior research (Barnett, Gustafsson, Deng, Mills-Koonce, & Cox, 2012; Brei, Klein-Tasman, Schwarz, & Csnar, 2014). Generally, lack of variability in VABS

composite scores across the preschoolers, potentially due to small sample size, may have led to less robust differences among the three clusters. When access to AAC during the intervention was examined, the majority of the children in this study participated in intervention conditions utilizing a SGD. Thus, further investigation of how different profiles of children with DS progress with and without AAC interventions may be warranted. In conclusion, these findings suggest that although children with DS often have similar genotype and phenotype, strengths and weaknesses in language and adaptive behavior may vary across individuals with DS.

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