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Title: Defining Expressive Language Benchmarks for Young Children with Down Syndrome

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Introduction: Down syndrome (DS) results from an extra full or partial copy of chromosome 21 and is the most common neurogenetic syndrome associated with intellectual disability. Expressive language is an area of particular challenge for children with DS. Indeed, language delays are observed in nearly all individuals with DS and are often more severe than the language delays associated with other neurogenetic syndromes. Because language plays a critical role in supporting long-term outcomes by positively shaping social functioning, academic achievement, cognitive development, and daily living skills, it is a key area of focus for research and a high priority treatment target. Tager-Flusberg et al. (2009) outlined a framework for defining expressive language benchmarks (ELBs) that can be used to describe children's current language level and to facilitate monitoring progress over time. No studies have characterized the ELBs of young children with DS using this approach. In the present study, we examined the range of ELBs observed in a sample of young children with DS. In addition, we considered the association between ELBs and (1) language metrics not utilized in the classification process and (2) other developmental characteristics known to relate to language ability, such as chronological age (CA), nonverbal cognitive ability, and autism spectrum disorder (ASD) symptomatology.

Method: The expressive language skills of 40 children with DS (20 males, 20 females; M_{CA} = 4.61 years, *SD* = 1.47, range: 2.50 – 7.99 years) were evaluated. Using the procedures outlined by Tager-Flusberg et al. (2009), three aspects of children's expressive language ability (Phonology, Vocabulary, and Grammar) were assessed based on performance on an articulation screener (children who produced 4 consonants and 5 words were administered the full phonology assessment) and/or the Goldman Fristoe Articulation Test-3 (GFTA-3), MacArthur-Bates Communicative Development Inventories (CDI) number of words produced, Differential Ability Scales-II (DAS-II) Naming Vocabulary subtest, and Preschool Language Scale-5 (PLS-5). The participants were classified in terms of ELB achieved using the criteria in Table 1. In addition, independent metrics of language were derived from the DAS-II Verbal Comprehension ability score, Vineland-3 Expressive Communication growth score value, and the CDI Sentence Complexity score. Finally, measures of nonverbal cognition (DAS-II Picture Similarities ability score) and ASD symptomatology (Social Responsiveness Scale-2) were also considered. Spearman rank-order correlations were used to assess associations between variables.

Table 1. Expressive Language Benchmarks Minimum Criteria.

	Benchmark			
Domain	**Prelinguistic[a] (<15-month AE)**	**First Words (~15-month AE)**	**Word Combinations (~24-month AE)**	**Sentences (~36-month AE)**
Phonology	Screener: <4 consonants	Screener/GFTA-3: 4 consonants	GFTA-3: 10 consonants	GFTA-3: 36-months AE
Vocabulary	CDI: <20 words	CDI: 20 words	CDI: 297 words	DAS-II Naming Vocab: 36-month AE
Grammar	PLS-5 EC-GSV: <362		PLS-5 EC-GSV: 363 + observed combination	PLS-5 EC-GSV: 424 + observed 4+ word sentence

[a]Prelinguistic criteria defined as scores below First Words criteria

Results: The numbers of participants who met criteria for each ELB as a function of Domain and Overall are presented in Table 2. Analysis of the individual ELB profiles across domains indicated that only 22.5% of our sample achieved the same benchmark across all three domains; the remaining 77.5% of the sample achieved variable benchmarks across the three domains, with five different patterns of variation across domains observed. Despite this variability, significant associations were observed across the Phonology, Vocabulary, and Grammar ELBs (*r*s: .60 - .74, *p*s < .001).

Table 2. Expressive Language Benchmarks Participant Classifications (n = 40)

	Benchmark			
Domain	**Prelinguistic**	**First Words**	**Word Combinations**	**Sentences**
Phonology[a]	13	4		20
Vocabulary	3	24	7	6
Grammar	20		16	4
OVERALL	13	15	8	4

[a]3 participants excluded due to partial GFTA-3 data (lowest ELB = Word Combinations)

Next, we computed correlations between the Overall and Domain-Level ELBs and the language metrics that were not utilized in children's ELB assignments. Significant positive associations were observed with all language metrics (*r*s: .55 - .80, *p*s < .001), except for the association between the Phonology ELB and CDI Sentence Complexity score (*r* = .36, *p* = .09). Finally, we computed correlations between the Overall and Domain-Level ELBs and CA, nonverbal cognition, and ASD-symptom severity. Results from

these analyses demonstrated significant associations between the Overall and Domain-Level ELBs and age (*r*s: .34 - .50, *p*s: .03 - .001) and nonverbal cognition (*r*s: .53 - .60, *p*s ≤ .001). ASD-symptom severity was not significantly associated with either the Overall or Domain-Level ELBs.

Discussion: Results from the present study suggest the procedures outlined by Tager-Flusberg et al. (2009) for defining ELBs are a potentially useful tool for describing the language abilities of young children with DS. Although variable benchmarks were often observed across the three domains, significant associations were observed between the different ELBs and language metrics that were not used in the classification process, as well as with age and nonverbal cognitive ability. Variation in the assessment tools used as the foundation for defining the ELBs will likely influence ELB outcomes; therefore, it is vital that studies provide thorough descriptions of the methods used to establish ELBs and consider the potential impact of assessment tool choice on ELBs. Theoretical and clinical implications of the different profiles across domains will be discussed.

References: Tager-Flusberg H., Rogers S., Cooper J., Landa R., Lord C., Paul R., … Yoder P. (2009). Defining spoken language benchmarks and selecting measures of expressive language development for young children with autism spectrum disorders. Journal of Speech, Language, and Hearing Research, 52, 643–652.

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