



## Receptive vocabulary analysis in Down syndrome



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### ABSTRACT

The present study is an in-depth examination of receptive vocabulary in individuals with Down syndrome (DS) in comparison to control groups of individuals of similar nonverbal ability with typical development (TD) and non-specific etiology intellectual disability (ID). Verb knowledge was of particular interest, as it is known to be a predictor of later syntactic development. Fifty participants with DS, aged 10–21 years, 29 participants with ID, 10–21 years, and 29 participants with TD, 4–9 years, completed measures of receptive vocabulary (PPVT-4), nonverbal ability (Leiter-R), and phonological memory (Nonword Repetition subtest of the CTOPP). Groups were compared on percentage correct of noun, verb and attribute items on the PPVT-4. Results revealed that on verb items, the participants with ID performed significantly better than both participants with DS and TD, even when overall receptive vocabulary ability and phonological memory were held constant. Groups with DS and TD showed the same pattern of lexical knowledge, performing better on nouns than both verbs and attributes. In contrast, the group with ID performed similarly on nouns and verbs, but worse on attributes.

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## 1. Introduction

Down syndrome (DS) is caused by a triplication of all or part of chromosome 21 (Jacobs, Baikie, Court Brown, & Strong 1959; Lejeune, Gautier, & Turpin, 1959; Pangalos et al., 1994) and is the leading genetic cause of intellectual disability (ID), affecting 1 in every 691 live births (Parker et al., 2010). Particularly striking in individuals with DS is poor speech and language abilities, with impairments that exceed nonverbal IQ expectations (Abbeduto et al., 2003; Kernan & Sabsay, 1996; Vicari, Caselli, Gagliardi, Tonucci & Volterra, 2002). Not all aspects of language appear equally impaired, however, and researchers have begun to study the extent and nature of the language profile in DS (for reviews see Abbeduto, Warren & Connors, 2007; Chapman, 2003; Chapman, Schwartz, & Kay-Raining Bird, 1991; Chapman, Seung, Schwartz, & Kay-Raining Bird, 1998; McDuffie, Chapman, & Abbeduto, 2008). A nuanced approach to examining how various aspects of language develop in this population is imperative for the long-term goal of developing more targeted treatments to improve language and communication. In the present study, we examined receptive vocabulary in individuals with DS, typical development

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(TD) and non-specific etiology ID. Of particular interest was the development of verb knowledge, which is known to be a predictor of later syntactic development (e.g., Gleitman, 1990).

Broadly speaking, expressive language is delayed in DS relative to receptive language and nonverbal cognitive ability (Chapman, 1998; Chapman, Kay-Raining Bird, & Schwartz, 1990; Chapman et al., 1991, 1998) and is especially impaired in the areas of speech intelligibility, syntax, and grammatical morphology (Chapman & Hesketh, 2000; Chapman, 1998, 1999, 2003; Abbeduto & Chapman, 2005). In contrast, receptive vocabulary has been found to be on par with nonverbal cognitive abilities (Abbeduto et al., 2003). However, individuals with DS perform below their developmental level in receptive, as well as expressive, syntax (Abbeduto et al., 2003; Kernan & Sabsay, 1996; Vicari et al. 2002). Phonological memory, a predictor of vocabulary knowledge in DS (Laws & Gunn, 2004), is also especially impaired (Cairns & Jarrold, 2005; Jarrold, Baddeley & Phillips, 1999; Naess, Lyster, Hulme, & Melby-Lervåg, 2011; Naess, Melby-Lervåg, Hulme, & Lyster, 2011). Despite extensive research on language abilities in DS, basic research on the pattern of lexical comprehension, including differences in the acquisition of word categories (e.g., nouns versus verbs), has yet to be fully examined in this population.

There is considerable evidence that in TD, verb acquisition, in contrast to other categories of words such as nouns, is particularly important to later syntactic development (Bassano, 2000; Bates & MacWhinney, 1982, 1987; Bresnan, 1978, 1982; Chapman et al., 1992; Gleitman, 1990; Gropen, Pinker, Hollander, & Goldberg, 1991). Although nouns represent objects, persons, and things and function as subjects or objects of verbs, verbs are more complex and abstract. Verbs contain both semantic and syntactic information, represent actions, mental states, or changes of state and function as predicates, establishing properties of tense and agreement. They are also responsible for linking other words in the sentence together, thereby expressing relational meanings between those words.

Because of their complexity, verbs have been found to be more difficult than nouns for TD children to master (Rice, Buhr, & Nemeth, 1990) and they appear to be disproportionately more difficult for individuals with DS than those with TD (e.g., Hesketh & Chapman, 1998). However, the mechanisms responsible for delays in verb development in DS are not well understood. For example, Hesketh and Chapman (1998) found that individuals with DS produced fewer grammatical and lexical verbs in narrative samples and also produced more utterances that did not contain verbs relative to participants with TD matched on mean length utterance (MLU; see also Caselli, Monaco, Trasciani, & Vicari, 2008). At the same time, when the participants with DS did include verbs in their utterances, they produced a greater diversity of lexical verbs than the TD controls and performed similarly in their diversity of grammatical verbs. Hesketh and Chapman (1998) concluded that individuals with DS may have difficulty accessing rather than comprehending verbs, despite being able to access event contexts and roles associated with the verb.

Others have also reported null and mixed findings when comparing participants with DS and TD on verb development. Grela (2002) found that participants with DS produced lexical verbs as frequently as TD controls matched on MLU during mother-child interactions. However, consistent with Hesketh and Chapman (1998), participants with DS in Grela's study also produced a greater variety of verb types. In contrast, Michael, Ratner, and Newman (2012) reported that participants with DS were more likely to omit verbs in elicited narrative samples than TD participants matched on receptive vocabulary. However, on an experimental, receptive test of lexical knowledge, Michael and colleagues reported no differences between participants with DS and TD. There were also no group differences in Michael et al.'s study on experimental tasks of single verb naming and proportion of target verb responses.

Studies of fast mapping, the ability to learn new words after only one or two exposures to the word (Carey & Bartlett, 1978), have also been informative about lexical comprehension in DS, including the acquisition of verbs. These studies appear to support the hypothesis that learning new verbs is more difficult than learning new nouns for both individuals with TD and DS and may be more difficult for individuals with DS than those with TD (Chapman, 2003; McDuffie, Sindberg, Hesketh, & Chapman, 2007; Rice et al., 1990).

The fast mapping paradigm is limited, however, in explaining lexical development in DS because of confounds with expressive language and phonological memory. Participants in fast-mapping studies may be exposed to novel words in a spoken story or event, such as a magic show, acted out by the investigator. The participants are then asked to retell the story or name the novel word as a measure of production and to name or define the novel word or select its corresponding object as a measure of comprehension. In some instances, both the comprehension and production tasks require the participants to verbally produce an answer, and novel words are presented in the context of a spoken story or action performed by the investigator. It is therefore possible that comprehension in the group with DS is confounded with poor working memory (Jarrold & Baddeley, 2001) and expressive language and speech delays (Chapman & Hesketh, 2000; Chapman et al., 1998), thereby underestimating their true comprehension. A measure in which individuals with DS are tested for comprehension of different word categories without requiring verbal production would be informative. For example, the Peabody Picture Vocabulary Test, which examines knowledge of vocabulary words in isolation without requiring verbal responses by participants, would accomplish this.

The Peabody Picture Vocabulary Test, currently in its fourth edition (PPVT-4; Dunn & Dunn, 2007), is a widely used standardized test of receptive vocabulary that includes nouns, verbs, and adjectives. An experimenter presents a vocabulary word orally, and the participant is prompted to point to the one drawing out of four that depicts the meaning of the word. Because it is easy to administer and score, it has become a popular matching variable for researchers who work with samples of individuals with ID, such as DS, and researchers have reported that it is an appropriate matching variable for DS (Glenn & Cunningham, 2005; Phillips, Loveall, Channell & Connors, 2014). However, despite its wide use as a matching variable for samples with DS, researchers have not typically gone beyond using composite scores, such as total raw score,

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