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Longitudinal predictors of early language in infants with Down syndrome: A preliminary study

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ABSTRACT

Purpose: Children with Down syndrome (DS) typically have marked delays in language development relative to their general cognitive development, with particular difficulties in expressive compared to receptive language. Although early social communication skills, including gestures and joint attention, have been shown to be related to later language outcomes in DS, knowledge is limited as to whether these factors exclusively predict outcomes, or whether other factors (e.g. perceptual and non-verbal skills) are involved. This study addressed this question.

Method: Longitudinal data for a group of infants with DS (n = 14) and a group of typically-developing (TD) infants (n = 35) were collected on measures that have been shown to predict language in TD infants and/or those with developmental delays. These included: non-verbal mental ability, speech segmentation skills, and early social communication skills (initiating and responding to joint attention, initiating behavioural requests).

Results: Linear regression analyses showed that speech segmentation and initiating joint attention were the strongest predictors of later language in the TD group, whereas non-verbal mental ability and responding to joint attention were the strongest predictors of later language for infants with DS.

Conclusions: Speech segmentation ability may not determine language outcomes in DS, and language acquisition may be more constrained by social communication and general cognitive skills.

1. Introduction

Typically-developing (TD) childrens' language acquisition is supported by general cognitive, social and perceptual skills. However knowledge is limited regarding which factors (including cognitive, perceptual and social abilities) in the first 2 years of life are important for language outcomes in children with genetic disorders. One population known to be at risk for language difficulties are individuals with Down syndrome (DS).

DS or trisomy 21 is the most common genetic cause of intellectual disability (Martin, Klusek, Estigarribia, & Roberts, 2009) with prevalence estimates of 1 in 691 live births (Parker et al., 2010). DS results from a partial or complete duplication of chromosome 21 (Epstein, 1986). Children with DS have significant expressive vocabulary deficits compared to TD children matched for nonverbal mental age (NVMA) (Næss, Lyster, Hulme, & Melby-Lervåg, 2011). Receptive and expressive syntactic skills are areas of weakness (Chapman, Schwartz, & Kay-Raining Bird, 1991; Martin et al., 2009). Lexical skills tend to be relatively stronger than grammatical

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skills (Caselli, Monaco, Trasciani & Vicari, 2008), and receptive vocabulary in particular is often reported as a relative strength (Galeote, Sebastian, Checa, Rey & Soto, 2011). Gesture production at 24 and 36 months of age has been shown to predict later vocabulary development (Zampini & D'Odorico, 2011). However, other than gesture, little is known about early predictors (prior to 24 months of age) of language outcomes. Identifying prelinguistic predictors of language is important both for enabling early identification of individuals particularly at risk of language deficits, and for enhancing our theoretical understanding of language development by revealing the factors that underpin language acquisition (Watt, Wetherby, & Shumway, 2006).

We first review the early social communication, speech segmentation and general cognitive skills that have been shown to predict language outcomes in TD children.

1.1. Early social communication skills

Early social communication skills, such as initiating and responding to joint attention and initiating behavioural requests have long been known to be related to later language outcomes in TD children. Responding to joint attention (RJA) refers to "the child's ability to change the direction of head and eyes in response to a change in direction of adult focus" (McDuffie, Yoder, & Stone, 2005: 1081). It emerges between 6 and 12 months of age in TD infants and continues to develop until around 18 months of age (Butterworth & Jarrett, 1991; Delgado et al., 2002; Morales et al., 2000). An important progression occurs between 12 and 18 months, when infants develop the ability to follow another person's attention to a target outside of their visual field (Butterworth & Jarrett, 1991; Delgado et al., 2002). Also in this period, the child develops the ability to engage in *coordinated joint attention,* when the child can alternate their gaze back and forth between a person and an object during social interaction (Adamson, Bakeman, Deckner & Romski, 2009; Kasari, Freeman, Mundy & Sigman, 1995). The ability to respond to joint attention facilitates language development by allowing children to avoid mapping errors during word learning. Despite some variety in the methods used to assess RJA, differences in RJA in TD infants have been reported to be related to expressive and receptive vocabulary and other language measures, both concurrently and longitudinally (e.g., Carpenter, Nagell, Tomasello, Butterworth, & Moore, 1998; Delgado et al., 2002; Morales et al., 2000; Mundy & Gomes, 1998; Mundy, Kasari, Sigman, & Ruskin, 1995). Individual differences in the ability to respond to joint attention predict language ability even after controlling for initial language status (Morales et al., 2000) and initial mental and chronological age (Mundy & Gomes, 1998; Mundy et al., 1995). RJA is reported to be a unique predictor of language comprehension over and above the skills of initiating joint attention and behavioural requests (Mundy & Gomes, 1998).

Fewer studies have explored RJA in infants with DS, although some studies include infants with DS within a mixed aetiology group. Of the studies that have measured early social communication skills in this population, Mundy et al. (1995) found that infants with DS (between 12 and 36 months, mean age 22.5 months) showed deficits in RJA compared to mental age-matched (MA) controls, but RJA was not a significant predictor of expressive or receptive language. RJA was also found not to be a significant predictor of later vocabulary skills in Italian speaking infants with DS aged 24 months (Zampini, Salvi & D'Odorico, 2015). In contrast, Sigman and Ruskin (1999) reported that children with DS (between 2 and 4 years, mean age 31.4 months) were significantly better at RJA than a MA-matched group of children with autism and their performance did not differ significantly from that of a TD group, or a group of developmentally-delayed children (also matched for MA). Although RJA was related to concurrent language ability in infants with DS, it did not predict gains in expressive language a year later.

Initiating joint attention (IJA) and initiating behavioural requests (IBRs) are the two pragmatic functions that infants most frequently use to engage in intentional communication before they can use words (Wetherby, Cain, Yonclas, & Walker, 1988). The emergence of these skills represents the development of social-cognitive processes that may provide a foundation for subsequent language development, such as the capacity for representational thought and understanding that experiences can be shared (Mundy et al., 1995). Engaging in these communicative behaviours often elicits contingent verbal responses from caregivers, thereby increasing the linguistic input to the child (Yoder & Munson, 1995; Yoder & Warren, 1993, 1998). It is therefore not surprising that IJA is both concurrently and longitudinally related to receptive and expressive vocabulary in TD infants (Bates, Thal, Whitesell, Fenson, & Oakes, 1989; Blake, 2000; Desrochers, Morissette, & Ricard, 1995; Mundy, Sigman, Kasari, & Yirmiya, 1988; Sigman & Ruskin, 1999; Ulveand & Smith, 1996; Watt et al., 2006) and children with DS syndrome (Harris, Kasari & Sigman, 1996; Mundy et al., 1995; Zampini et al., 2015). Similarly, IBRs are concurrently and longitudinally related to receptive and expressive language skills in TD children (Camaioni, Castelli, Longobardi, & Volterra, 1991; Mundy et al., 1988; Mundy et al., 1995; Smith & von Tetzchner, 1986; Ulveand & Smith, 1996) and concurrently related to language in infants with DS (Sigman & Ruskin, 1999).

Although these studies highlight clear links between IJA and IBR and language, the unique predictive value of these skills longitudinally is unclear, as not all studies control for differences in initial language status, cognitive ability, or other non-verbal communication skills (a criticism raised by Mundy & Gomes, 1998, and Yoder & Warren, 2004). Studies that have controlled for these factors report conflicting findings regarding the unique predictive value of IBR and IJA. In TD children, some studies have found IJA to account for unique variance in expressive language scores, when controlling for initial chronological age (CA), MA, and expressive language (Mundy & Gomes, 1998), or for all pre-linguistic skills correlated with expressive language outcome measures (Watt et al., 2006). However, Mundy et al. (1995) found no relationships between IBR or IJA and receptive or expressive language in a TD group when initial language, MA, motor age, and other non-verbal communication abilities (such as joint attention) were controlled for. In the same study, IBR predicted the expressive (but not receptive) language of infants with DS, and IJA was not related to language outcomes when other factors were controlled for (Mundy et al., 1995).

In summary, while responding to joint attention is clearly related to language outcomes in TD children, it is unclear whether this factor predicts language in children with DS and whether initiating joint attention and behavioural requests are related to language outcomes in either group.