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Children assessed for Autism Spectrum Disorder: Developmental delay and change over time in BDI-2 developmental quotients

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ABSTRACT

Individuals with Autism Spectrum Disorder (ASD) often have overall developmental delays and delays in developmental domains outside of the core ASD symptoms. Research results have been mixed regarding the stability of level of functioning over time in young children with ASD symptoms. Elements that influence development over time in young children with ASD symptoms are an important area of research. Early assessment and intervention is critical to improving prognosis, though effectiveness of intervention depends on a number of factors with some researchers suggesting IQ or overall functioning may influence the degree or rapidity of treatment effects. Using the Battelle Developmental Inventory, this study investigates the effect of overall developmental quotient (DQ) at first assessment on subsequent DQ scores, including scores in communication and adaptive domains in a sample of toddlers evincing significant ASD symptoms.

The developmental trajectory of infants and toddlers with Autism Spectrum Disorder (ASD) is heterogeneous, as individuals with ASD vary tremendously in symptom presentation and symptom severity (Ben-Itzchak & Zachor, 2007; Corsello, 2005; Fenske, Zalenski, Krantz, & McClannahan, 1985; Fodstad, Matson, Hess, & Neal, 2009; Horovitz & Matson, 2010; Matson, 2007). In addition to the core features of ASD, which include impairments in communication and socialization, and presentation of repetitive and restricted behaviors, individuals with ASD generally experience delays in overall development and across a number of developmental domains (Kozlowski, Matson, Horovitz, Worley, & Neal, 2011; Matson, Kozlowski, Hattier, Horovitz, & Sipes, 2012; Matson & Rivet, 2008; Matson & Wilkins, 2009; Smith & Matson, 2010; Worley & Matson, 2012). Additionally, comorbid psychopathology and challenging behaviors also commonly co-occur with ASD (LoVullo & Matson, 2009; Matson, Hess, & Boisjoli, 2010; Matson, Mahan, Hess, Fodstad, & Neal, 2010). Furthermore, multiple physical and adaptive problems are commonly observed (Matson, Dempsey, & Fodstad, 2009a; Matson, Dempsey, & Fodstad, 2009b; Matson, Rivet, Fodstad, Dempsey, & Boisjoli, 2009). As a result of the wide diversity in manifestation of the disorder, designing and implementing treatment for ASD has to be done on an individual basis.

Early identification and intervention is crucial in improving prognosis (Kozlowski, Matson, & Worley, 2012; Sipes, Matson, Worley, & Kozlowski, 2011; Virues-Ortega, Rodriguez, & Yu, 2013; Zwaigenbaum, Bryson, & Garon, 2013). Researchers have found that if appropriate interventions are identified and applied early, outcomes for individuals with ASD

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are significantly improved (Matson, Mahan, & Matson, 2009; Matson, Tureck, Turygin, Beighley, & Rieske, 2012). However, some early intervention programs have been found to be more beneficial than others (Baghdadli et al., 2007; Eldevik, Eikeseth, Jahr, & Smith, 2006; Gabriels, Hill, Pierce, Rogers, & Wehner, 2001; Jónsdóttir, Saemundsen, Antonsdóttir, Sigurdardóttir, & Ólason, 2011; Sallows & Graupner, 1999; Smith, Eikeseth, Levstrand, & Lovaas, 1997). Personal characteristics also play a role in prognosis. Factors which contribute to the effectiveness of treatment include age, time of symptom onset, intelligence quotient (IQ), and functioning level (Perry et al., 2008; Perry, Blacklock, & Dunn Geier, 2013).

Tests that evaluate IQ typically emphasize verbal, conceptual, and problem-solving skills, which involve multiple cognitive processes including attention, working memory, and processing speed (Berk, 2007; Siegal, 1989). It is difficult to evaluate cognitive functioning in young children by using tests that yield IQ, and results are generally considered unstable (Fombonne, 1999). In addition to the difficulties related to attention or compliance in young children for the types of tasks typical to IQ tests, it is difficult to measure complex cognitive processes in infants and toddlers who are still developing the basic building blocks of these skills. The development of cognitive functioning in later childhood is affected by prior development in multiple domains during early childhood; for example, language development is important for the development of reasoning skills, emotional regulation, and memory, which impact future learning and cognitive development (Berk, 2007). An attempt to measure intelligence in an infant would be primarily a measure of sensorimotor performance, which is not the principle focus of later intelligence testing (Neisworth & Bagnato, 1992). Observable infant perceptual and motor tasks which indicate development along the usual trajectory differ from those tasks given to older children and do not necessarily tap the same aspects of intelligence measured at older ages. Tests which measure observable perceptual, motor, social, and other behaviors indicative of developmental growth in young children yield scores called developmental quotient (DQ) rather than IQ (Berk, 2007). Developmental quotient is a number that, like IQ, indicates where a child's development lies on a continuum compared to other children his or her age across domains which together contribute to overall developmental growth (Berk, 2007; Newborg, 2005). DQ is assessed by investigating presence or absence of behaviors indicative of developmental growth across a number of developmental domains, such as motor, language, self-care, adaptive, and social skills (Newborg, 2005). DQ therefore serves as a better indicator of overall level of functioning in young children.

Early childhood is considered a time of significant developmental growth (American Psychological Association Task Force on Evidence-Based Practices for Young Children & Adolescents, 2008). However, research results have been mixed regarding the stability of level of cognitive and adaptive functioning over time in both typically developing children and young children with ASD symptoms, with variability seemingly impacted by a number of factors including environmental changes or family stressors, low socioeconomic status, or comorbid disability (Berk, 2007; Breslau et al., 2001) as well as the effects of various interventions (Baghdadli et al., 2007). Adverse environmental conditions or lack of opportunity to practice new skills can hinder developmental progress, whereas high-quality caregiving or intensive intervention can have a positive effect on social, language, motor, and cognitive development (Burchinal et al., 2000; Campbell, Pungello, Miller-Johnson, Burchinal, & Ramey, 2001; Nelson et al., 2007).

Some studies comparing estimates of cognitive functioning obtained from measures providing DQ scores with those obtained from standardized intelligence tests at a later date have indicated DQ measures provide a reasonable estimate of future functioning in typically developing young children (Albers & Grieve, 2007), and in young children with ASD (Delmolino, 2006; Kurita, Osada, Shimizu, & Tachimori, 2003). Lord and Schopler (1989) found that IQ and DQ scores showed little overall change in young, language-impaired children with and without ASD, with no significant differences in group means, absolute difference scores, or patterns of change across developmental domains. While significant heterogeneity exists within individuals, some researchers have found relative stability of DQ scores in young, atypically developing children and young children with ASD when studied as a group (Baghdadli et al., 2007; Lord & Schopler, 1989). It is important to note, however, that these results may have been affected by the fact that DQ/IQ scores tend to remain more stable for children with severe disabilities who are likely to continue to exhibit deficits and a slower rate of developmental progress compared to typically developing children, whose development across domains may be more variable with periods of rapid development along an overall "normal" trajectory (Bagnato & Neisworth, 1994; Maisto & German, 1986). Other researchers have found infant and toddler DQ to be a poor predictor of future IQ scores in low birth weight children who initially scored poorly on developmental assessments (Hack et al., 2005), and intensive intervention can contribute to significant change in developmental scores over time (Reed, Osborne, & Corness, 2007; Sallows & Graupner, 1999).

In older children and adults, it is estimated that up to 70% of individuals with ASD also have intellectual disability (ID) (Isaksen, Diseth, Schsølberg, & Shjeldal, 2013; Mandell et al., 2012; Matson & Kozlowski, 2011). Comorbid ID has been found to predict a poorer prognosis for those with ASD (Baird et al., 2006; Klin et al., 2007; Rojahn et al., 2009), whereas speech and overall intellectual functioning predict more positive outcomes in children with ASD (Darrou et al., 2010). However, the prognostic contribution of measuring developmental deficits in children too young for IQ assessment is unclear. Baghdadli et al. (2007) found significant variability in the developmental trajectory of young children with autism, with some improving rapidly with treatment, while others experienced slower growth and less improvement over time. Maisto and German (1986) found moderate correlations over time in cognitive and motor DQ scores on the Bayley Scale of Infant Development, but considerably variable scores for other domains. Conversely, Moyal (2010) found moderate correlations of Total DQ scores across time in children with developmental delays, but weak correlations for Cognitive DQ scores and an inconsistent relationship between overall DQ change and length of time receiving special education services. In a study of preschool aged children with ASD placed in a special day program for 10 months, Reed, Osborne, and Corness (2007) found