



Sensory-motor deficits in children with developmental coordination disorder, attention deficit hyperactivity disorder and autistic disorder

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Abstract

Children who have been diagnosed with any one developmental disorder are very likely to meet diagnostic criteria for some other developmental disorder. Although comorbidity has long been acknowledged in childhood disorders, little is understood about the mechanisms that are responsible for the high level of comorbidity. In a series of studies, we have investigated the link between sensory-motor deficits and developmental disorders. Poor sensory-motor integration has long been implicated as a cause of motor problems in developmental disorders such as developmental coordination disorder (DCD), and our recent research has also investigated sensory-motor deficits in children with attention deficit hyperactivity disorder (ADHD) and autistic disorder. Based on a critical examination of relevant literature and some of our recent research findings, we

argue that the importance of poor sensory-motor functioning in discriminating children with different disorders has been underestimated. Poor sensory-motor coordination appears to be linked to DCD, but not ADHD. Also, sensory-motor deficits in children with DCD and autistic disorder may provide insight into some of the social difficulties found in these groups of children. This research will increase our understanding of why children with one developmental disorder typically also have problems in other areas.

Introduction

The term 'developmental disorder' is used to describe a disorder that appears early in an individual's life, specifically in infancy, childhood or early adolescence (American Psychiatric Association, 1994). Developmental disorders are generally defined in terms of patterns of poor or deviant development in particular behaviours or constructs. For example, children with developmental coordination disorder (DCD) have poor motor control, whereas children with attention deficit hyperactivity disorder (ADHD) have behavioural difficulties defined by symptoms of inattention and/or hyperactivity and impulsivity. Although these two disorders seem quite distinct in terms of their description, our recent research (e.g., Dyck et al., 2004, Piek et al., 1999) has indicated that these different types of problems are related. For example, Piek et al. noted that inattention was related to poor motor ability, particularly fine motor ability. Dyck et al. investigated five ability constructs, namely IQ, language ability, motor ability, empathic ability and attentional control in a representative sample of 390 children. All five constructs were significantly correlated with each other (except language and attention). Also, children with low ability scores (more than one standard deviation below the mean) on one measure were also likely to obtain significantly lower scores on other ability measures. Therefore, it is not surprising that most disorders are comorbid given they are generally defined by one or more of these ability constructs. Nonetheless, most research on developmental disorders has appeared to assume that the disorders are discrete phenomena with specific aetiologies.

Comorbidity has long been recognized in children with developmental disorders such as autistic disorder, ADHD, DCD and language disorders (e.g., Gillberg, 1995, Watson et al., 2003). Gillberg described a neurodevelopmental dysfunction syndrome, called deficits in attention, motor control and perception (DAMP). Primarily a syndrome that includes

children with DCD and ADHD, Gillberg also noted that these children often have empathy deficits associated with pervasive developmental disorders such as autistic disorder. Other researchers, such as Kaplan and colleagues (Kaplan, Wilson, Dewey, & Crawford, 1998), also noted comorbidity between developmental disorders, but have suggested a generalized neurodevelopmental explanation which reflects some underlying neurological abnormality. They argued that discrete syndromes were the exception to the rule. Hill (2001) also suggested that the overlap between specific language impairment and DCD could be due to a neuromaturational delay.

The fact that developmental disorders are typically comorbid implies: (a) that disorders have overlapping causes, or (b) that the direct causes of one disorder affect the mechanisms that cause some other disorder. However, little research has investigated underlying causes of these comorbidities. Rutter and Sroufe (2000) outline several reasons why such research is important. Without knowledge of the different mechanisms affected in comorbid conditions, research results may be confounded if these mechanisms are quite distinct for different disorders. Also, mechanisms must be understood in order to develop appropriate intervention programs. In this paper, we address this important issue by reviewing past literature and current research in order to investigate underlying mechanisms in several developmental disorders, namely DCD, ADHD and autistic disorder. In particular, we investigate the link between visual-spatial organisation and motor control in order to determine whether sensory-motor dysfunction can distinguish one disorder from another.

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Sensory-motor deficits and DCD

DCD is diagnosed when a child's motor ability is significantly lower than would be

expected given the child's age and intellectual ability (American Psychiatric Association, 1994). Children who have DCD may display a wide range of motor problems including delays in achieving motor milestones such as walking and sitting, dropping things, and poor performance in sports or poor handwriting. For children to be diagnosed with DCD, their motor impairment needs to be "sufficient to produce functional

Can sensory-motor deficits distinguish ADHD from DCD?

Children with ADHD are characterised by persistent symptoms of inattention and/or hyperactivity-impulsivity that are not consistent with their developmental level and are maladaptive (American Psychiatric Association, 1994). Three subtypes of ADHD have been identified by the DSM-IV, namely ADHD-Predominantly Inattentive type (ADHD-PI), ADHD-Predominantly Hyperactive-Impulsive (ADHD-HI), and ADHD-Combined type (ADHD-C) (i.e., combined inattentive and hyperactive/impulsive symptoms).

An

Can sensory-motor deficits distinguish autistic disorder from DCD

A child is diagnosed with autistic disorder on the basis of qualitative impairments in social interaction skills, communication skills, and repetitive or restricted behaviour and/or interests (American Psychiatric Association, 1994, p. 65). Autistic disorder is also associated with quantitative underachievement in language (Eisenmajer et al., 1998, Howlin, 2003), motor coordination (Ghaziuddin and Butler, 1998, Szatmari et al., 1990), empathic abilities (Baron-Cohen et al., 1985, Dyck et al.,

Neural basis of comorbidity

Recent developments in brain imaging techniques have provided clues to the brain structures that are disrupted in developmental disorders. Considerable research has been carried out on children with ADHD and Autism, although there are limited studies on children with DCD.

Several studies have used cranial ultrasound scans at birth to identify haemorrhages or periventricular densities in preterm infants, and then assessed these children at age 6 years (Jongmans et al., 1993, Jongmans et al., 1998

Conclusions

Poor visual-spatial organisation appears to be a distinct mechanism associated with children with DCD, impacting on their motor ability and also with potential consequences for their social interaction. It is therefore important to identify DCD in children with comorbid disorders such as ADHD and autistic disorder. This is particularly important for children with autistic disorder, as symptoms are more severe when perceptual organisation is also disrupted. We need to consider whether children

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