

# Exploring the origins of developmental disorders

Developmental Coordination Disorder (DCD) is a condition affecting explicitly the motoric, physical, psycho-social, and academic spheres of approximately 8% of children and adolescents.<sup>1</sup> Considerable research has been conducted in order to understand the latent pathophysiology generating the various negative outcomes of DCD. Unfortunately, no convincing evidence exists as yet to support one particular theory.

While no study has examined germane neurochemical agents in relation to DCD, it has been suggested<sup>1</sup> that this condition bears a close resemblance to various neuropsychological disorders. A recent finding of increased left-handedness among children with DCD<sup>2</sup> provides further evidence to support this view, suggesting that the DCD-predisposing factors may be biophysical in nature. Causal theories of handedness in humans range from purely learned behavior, to neurochemical variations during the prenatal stage, or solely genetic factors. The high proportion of left-handed children with DCD, compared to norms, is congruent with the higher prevalence of DCD in males; the chemical causative agent of left-handedness being male-hormone-linked.<sup>3</sup> This further mirrors the increased prevalence of left-handedness in developmental disorders, as well as increased language disorders in males.<sup>3</sup> Nevertheless, the association of handedness and DCD has received limited attention in the literature.

Children with DCD exhibit right hemisphere insufficiency (lesion/disconnection), frequently accompanied by a dysfunctional corpus callosum.<sup>4</sup> According to leading neurophysiological theories, these abnormalities are also responsible for the occurrence of left-handedness.<sup>3</sup> Injury to the developing cortex appears to result in reorganization of both the cortical architecture and the pattern of connectivity. Enlargements in certain brain regions may result, disrupting the biochemical environment of the fetus which, in turn, results in specific cerebral abnormalities such as left-handedness.<sup>3</sup>

The generally well-accepted role of neurochemical factors in regulating behavior, based on both animal and human clinical models,<sup>5</sup> has provided the basis for several neuropsychological theories. Therefore, it can be said that a common neurochemical basis of the causative agents of various developmental disorders has been a long-standing belief.<sup>3</sup> Neurotransmitters such as dopamine are critically involved in exploratory, motor, and other 'extrapersonal' functions that are localized in the left hemisphere. Other principal monoamines such as serotonin and norepinephrine are very important in 'peripersonal' visuomanual behavior localized in the right hemisphere.<sup>5</sup> Prominent neuropsychological

disorders that may dramatically affect cognitive and social competence (e.g. Alzheimer's disease, dyslexia, autism, attention-deficit-hyperactivity disorder, Parkinson's disease) are mainly attributable to neurochemical imbalances, such as aberrant dopaminergic activity.<sup>5</sup> This imbalance may well explain various symptoms of DCD, such as difficulties in handwriting, language, motor planning, and spatial organization. Concurrently, symptoms of children with DCD closely resemble those of patients with lesions of the posterior parietal cortex, patients with attention-deficit-hyperactivity disorder, or Parkinson's disease.<sup>1</sup> Pathophysiological similarities of DCD with developmental disorders are also apparent in shared risk-factors, i.e. low birthweight and exposure to specific pharmacological agents and/or toxins during pregnancy and lactation. This may also provide an explanation for the increased prevalence of left-handedness in children with DCD,<sup>2</sup> as the developmental 'fault' causing the shift to the right hemisphere is most likely to be of chemical origin.<sup>3</sup> Yet, no study to date has directly examined the effect of specific neurochemical agents in relation to DCD. More research on DCD in the future should focus on the neurochemical level and investigate for possible biophysical causative agents.

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## References

1. Wilson P, Maruff P, Ives S, Currie J. (2001) Abnormalities of motor and praxis imagery in children with DCD. *Hum Mov Sci* 20: 135–159.
2. Flouris A, Faught B, Hay J, Vandijk A. (2003) Modeling risk factors for coronary heart disease in children with developmental coordination disorder. *Ann Epidemiol* 13: 591.
3. Geschwind N, Galaburda A. (1985) Cerebral lateralization. Biological mechanisms, associations, and pathology: I. A hypothesis and a program for research. *Arch Neurol* 42: 428–459.
4. Sigmundsson H, Ingvaldsen RP, Whiting HTA. (1997) Inter- and intrasensory modality matching in children with hand-eye coordination problems: exploring the developmental lag hypothesis. *Dev Med Child Neurol* 39: 790–796.
5. Previc F. (1999) Dopamine and the origins of human intelligence. *Brain Cogn* 41: 299–350.