Understanding the neurobiology of developmental coordination disorder: time to raise our game

Commentary

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On average, at least one child in every primary school class has dyslexia, developmental coordination disorder, or a speech and language disorder [1]. These neurodevelopmental disorders are puzzling because although they seem to affect cognitive systems selectively, they occur in the absence of obvious brain MRI abnormalities, neurological signs, or lack of opportunity. Nevertheless, they have significant negative impacts on daily life and academic achievement.

Developmental coordination disorder (DCD) is one of the most prevalent, yet one of the least researched [1]. Investigation of its MRI neural basis is an emerging field. Wilson and colleagues' systematic review [2] reports only 11 MRI articles published since 2011-a disproportionately small number when compared to research on adult-onset motor disorders.

The review gives us a comprehensive update on research in the area of DCD, and provide converging behavioural evidence towards reduced automatization, poor predictive control, and greater reliance of slow feedback control systems. As observed for other developmental disorders, co-occurring deficits in executive function are also prevalent. In other words, phenotypes of children with DCD are now extensively characterised. So which brain differences could explain these profiles?

Behavioural research has provided us with hypotheses regarding which brain circuits may develop atypically in children with DCD. They include cerebellar, fronto-parietal, striato-cortical, sensori-motor, interhemispheric, and "mirror neuron" networks. Unfortunately, neuroimaging findings are inconsistent. Anomalies in the primary motor pathways, thalamic radiations, corpus callosum or parietal cortex have rarely been replicated. In addition,

numerous functional and structural anomalies have been found in brain regions that are seemingly unrelated to motor functions. Worryingly, this lack of consensus on MRI markers is also seen for neurodevelopmental disorders that co-occur with DCD, namely speech and language disorders [3].

The MRI findings reviewed by Wilson et al. also point to methodological limitations, indicating we need to raise our game if we wish to understand the neurobiology of DCD. Firstly, accurate sample characterization is crucial. If co-occurring deficits are present, they must be quantified rather than be based on diagnostic cut-offs or questionnaires. Indeed, "hidden" impairments, affecting language or intellectual abilities for instance, may be missed by referring clinicians. Similarly, early medical history (e.g. preterm birth) must be documented as it could indicate perinatal complications and brain lesions. Secondly, modest sample sizes (mostly <18) in available MRI studies raise the question of whether findings are representative of the broader DCD population. The third issue relates to reporting bias. We need to examine a-priori hypothesized regions of interest/networks, but also regions outside these ("control regions"). Without this approach, we take the risk of only finding differences where we expect them to be, based on (often adult) theoretical or neurobiological models. We know that intrinsic genetic differences may result in a range of adaptation and compensation mechanisms during brain development [4]. Compensatory systems is what we may be observing, rather than MRI anomalies that "cause" DCD. Finally, studies should statistically control for MRI global measures, to disentangle region-specific vs. general maturational differences between groups with and without DCD.

Identifying brain correlates of DCD, combined with precise phenotyping, will provide us with another level of description of this condition. Indeed, there are probably several

developmental trajectories to DCD [5], whereby similar phenotypes may arise from distinct neurobiological pathways.

The good news is the existence of an international panel of experts from different disciplines that monitors advances in the field of DCD research. In the future, the fields of neurosciences, genetics, and pharmacology may provide complementary information. DCD deserves high quality cross-disciplinary research. Hopefully, this approach will help identify novel therapeutic targets and design interventions that will reduce the burden of this lifelong condition.

References

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