

## The Psychomotor domain of the IDS-2: A new measure of motor performance

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The IDS-2 is a broad developmental assessment for 5- to 20-year-olds containing subtests across six domains: *Intelligence*, *Executive functions*, *Psychomotor skills*, *Social-emotional skills*, *Scholastic skills*, and *Motivation and attitude*. The original Intelligence and Development Scales (IDS; Grob, et al., 2009) was designed for children aged 5-10 years. The IDS-2 (Grob & Hagmann-von Arx, 2018) expanded the age range and the domains included in the test battery, and has been adapted and standardised in many countries including Germany, Italy, the Netherlands and Poland.

The UK standardisation (IDS-2; Grob et al., 2021) involved testing 1367 children and adolescents across the UK. The sample was stratified according to ethnicity and highest level of maternal education, with appropriate weighting to achieve a representative match to the 2011 UK Census data. The IDS-2 is designed to be used in a modular fashion, selecting different domains depending on the purpose and focus of the assessment. In this article, we outline the *Psychomotor skills* domain of the IDS-2.

Standardised tests of psychomotor performance are an important component of neuro-developmental assessment. Motor competence is a fundamental aspect of general development, facilitating and interacting with cognitive, social and emotional development through the lifespan (Adolph & Hoch, 2019). Robust assessments are also needed to aid in the identification and description of motor difficulties, including Developmental Coordination Disorder (DCD; Blank et al., 2019). Although well understood as a condition in childhood, the persistence of motor difficulties into adulthood has also been recognised (Barnett et al., 2019), although there is a lack of tests suitable for adults. The IDS-2 measures gross motor, fine motor and visual motor skills. Gross motor skills are assessed only in 5- to 10-year-olds; fine motor and visual motor skills are assessed at all ages of the test, from 5 to 20 years.

Gross motor control involves whole body balance and limb coordination. There are three tasks in the *Gross motor skills* subtest of IDS-2. *Balancing* requires the child to walk heel-to-toe along a 3m rope laid straight on the floor; this is performed with eyes open and then with eyes closed. *Jump sideways* requires the child to jump to-and-fro over the rope as many times as they can in 10 seconds. For *Catching and throwing* the child stands at one end of the rope and attempts to catch and throw a small foam ball (five times) with the examiner at the other end. The quality of performance is assessed by the number of errors (e.g. stepping off the rope when walking, dropping the ball when attempting a catch) and the level of coordination observed (e.g. well-coordinated action for throwing). Points for each task are summed to give a total gross motor score.

Fine motor control involves movement and coordination of the hands and fingers to manipulate small objects. The *Fine motor skills* subtest includes two tasks performed across all ages. In *Nuts and bolts* the time taken to screw a nut off and then back onto a bolt is recorded; this is done for three different sized bolts. In *Threading beads*, the time taken to thread six spherical beads onto a string is recorded; this is done with three sets of beads (small, medium and large). Points for completion time are summed to give a total fine motor score for 'time'. The quality of performance is also assessed by recording execution errors (e.g. dropping a bolt). Points from the two tasks are summed to give a total fine motor score for 'quality'.

Visual motor control involves eye-hand coordination to use a visual stimulus to guide movement of a pen. These skills are used in everyday 'graphic' skills such as drawing and handwriting, which are commonly impacted in motor disorders such as DCD. For the *Visual motor skills* subtest, respondents

perform three drawing tasks, *Drawing between lines*, *Copying images* (copying shapes of increasing complexity) and *Completing images* (drawing mirror images of shapes of increasing complexity). These are presented as a series of items in a booklet, with instructions to draw quickly and accurately; the items vary across age. Points for completion time are summed to give a total visual motor score for 'time'. The quality of performance is also assessed by counting drawing errors and points are summed to give a total visual motor score for 'quality'. Scoring templates for *Copying images* and *Completing images* allow for the objective scoring of drawing errors.

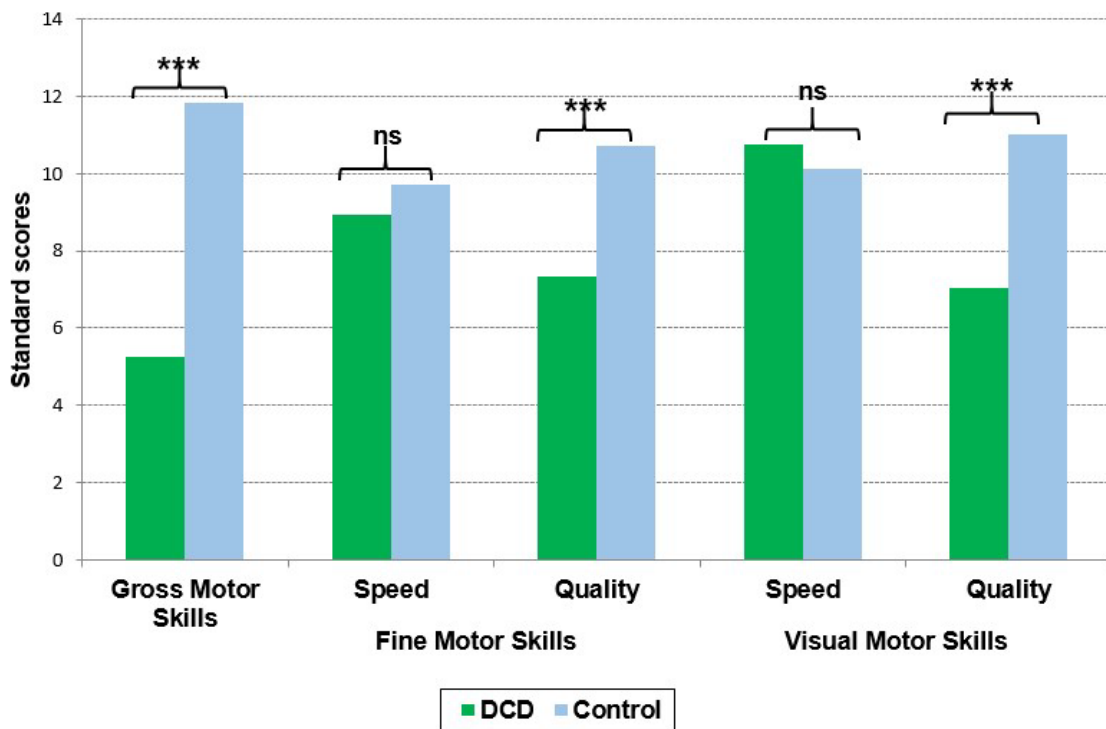
Administration time for the *Psychomotor* domain is approximately 15-20 minutes depending on age and ability. A particular feature of the IDS-2 *Psychomotor* domain is the separate scoring for speed and quality, allowing the tester to distinguish these different aspects of performance for *Fine motor skills* and *Visual motor skills*, giving a detailed profile of performance and helping to better understand motor difficulties.

The IDS-2 has an online scoring system and the calculation of standard scores (Mean=10, SD=3) was carried out using a continuous standardisation method (Hogrefe, 2018). A profile of scores across the *Psychomotor skills* domain can be established, with standard scores for each subtest, plus a total score. Extensive evidence for different aspects of reliability and validity has been gathered from previous versions of the IDS-2 from Germany, The Netherlands and Italy. There are unlikely to be major differences in motor development across these countries and it is therefore reasonable to assume that this psychometric information is also relevant to the UK. Nevertheless, similar aspects of reliability and validity of the *Psychomotor skills* domain were also examined as part of the UK IDS-2 standardisation project.

The *Fine motor skills* and *Visual motor skills* subtests each contain a number of similar tasks, so for these it was possible to examine internal consistency using data from the whole UK standardisation sample. This demonstrated reliabilities (Cronbach's Alpha) for *Fine motor skills* and *Visual motor skills* of .79 and .80 for younger (5-10 years) and .66 and .76 for older (11–20 years) respondents. In a separate sub-study test-retest reliability was assessed for *Gross motor skills*, re-testing 49 children (63% male, aged 5:1–10:9) after a mean interval of 16 days to give a reliability coefficient of .89.

Concurrent validity was examined by comparison of performance on the Movement ABC - 2nd Edition (MABC-2; Henderson et al., 2007). This is a test of general motor competence for 3-16-year-olds, comprising three components: manual dexterity, aiming and catching, and balance. Fifty children (aged 6:2 to 10:11) were tested on both the IDS-2 *Psychomotor skills* domain and the MABC-2; a significant correlation was found between the total scores for each test (.78,  $p < .001$ ). Finally, differential validity was examined by comparing the performance of 25 children (aged 6:2 to 10:11) previously diagnosed with DCD to an age and gender-matched typically developing group (Joyce, 2021). The total *Psychomotor skills* score was significantly poorer in the DCD group (Mean=7.42, SD=1.58) compared to the typically developing group (Mean=10.87, SD=1.64). There were also significant group differences for the gross motor, fine motor and visual motor scores, as shown in Fig. 1.

*Figure 1. Comparison between children with Developmental Coordination Disorder (DCD) and typically developing (TD) children on the IDS-2 Psychomotor skills domain*



\*\*\*p<.001; ns non-significant

In summary, the *Psychomotor skills* domain of the new IDS-2 will be a useful addition to the toolkit of assessors working with children and young adults. The norms for young adults up to 20:11 allow for a detailed examination of visual motor skills, and the combination of scores on 'speed' and 'quality' of performance will provide useful information to help understand the nature of motor difficulties. In addition, the IDS-2 also offers a means of assessment across broader domains including intelligence, executive functions and general development, giving a useful profile of performance.

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### References

Adolph, K.E. & Hoch, K.E. (2019). Motor development: Embodied, embedded, enculturated, and enabling. *Annual Review of Psychology*, 70, 141-161.

Barnett, A.L., Law, C. & Stuart, N. (2019). Developmental progression in DCD. In A.L. Barnett & E. Hill (Eds.) *Understanding motor behaviour in Developmental Coordination Disorder* (pp. 28-51). Oxford: Routledge.

Blank, R., Barnett, A.L., Cairney, J., Green, D., Kirby, A., Polatajko, H., Rosenblum, S., Smits-Engelsman, B., Sugden, D., Wilson, P. & Vincon, S. (2019). International clinical practice recommendations on the definition, assessment, intervention and psychosocial aspects of developmental coordination disorder. *Developmental Medicine and Child Neurology*, 61, 242-285.

Grob, A., Meyer, C.S. & Hagemann-von Arx, P. (2009). *Intelligence and Development Scales (IDS). Intelligenz- und Entwicklungsskalen für Kinder von 5-10 Jahren*. Bern: Verlag Hans Huber.

Grob, A., & Hagemann-von Arx, P. (2018). *Intelligence and Development Scales-2 (IDS-2). Intelligenz- und Entwicklungsskalen für Kinder und Jugendliche*. Bern: Hogrefe.

Grob, A., Hagemann-von Arx, P., Barnett, A.L., Stuart, N., & Vanzan, S. (2021). *Intelligence and Development Scales for Children and adolescents — 2nd Edition (IDS-2) UK Adaptation*. Oxford: Hogrefe.

Henderson, S.E., Sugden, D.A. & Barnett, A.L. (2007). *Movement Assessment Battery for Children-2. Second Edition (Movement ABC-2) Examiner's manual*. London: Harcourt Assessment.

Hogrefe, A. (2018). *Continuous norming*. An overview. Hogrefe. Retrieved 22 June 2022 from <https://issuu.com/hogrefeltd/docs/white-paper-continuous-norming>.

Joyce, T. (2021). *Executive function in children with and without Developmental Coordination Disorder*. PhD thesis, Oxford Brookes University.