

Institution: Oxford Brookes University
Unit of Assessment: 4 - Psychology, Psychiatry and Neuroscience
Title of case study: Improving identification and support of individuals with handwriting and movement difficulties through development of two tests: Movement ABC-2 and DASH
1. Summary of the impact (indicative maximum 100 words)
The Movement ABC-2 Test is internationally recognised as 'the gold standard' for identifying children with motor difficulties. Prof Anna Barnett's revision and development has provided health and education professionals with a reliable assessment tool, improving the support for children and their families. This test is recommended in the latest European guidelines on Developmental Coordination Disorder (DCD) - a condition recognised as having a major impact on the lives of children - and has also been translated into several languages for global use. The parallel development of specific tests for handwriting (DASH and DASH17+) for children and adults has provided clinicians and teachers with the tools to help support students with their class work and written examinations.
2. Underpinning research (indicative maximum 500 words)
The Movement ABC Test has a long history and has undergone radical revision since first published in 1972 and revised as the Movement Assessment Battery for Children in 1982 (MABC; Henderson & Sugden, 1982). Anna Barnett, now Professor in Psychology, joined the original authors as project director for production of the second edition (MABC-2; Henderson, Sugden & Barnett, 2007) ¹ , published by Pearson. Barnett joined Oxford Brookes University as Senior Lecturer in Psychology in 2004. Her expertise in the fields of motor development, assessment and Developmental Coordination Disorder (DCD) in particular were crucial for the project. Barnett's sustained programme of research has ranged from the highly cited longitudinal work from her PhD ² to experimental studies ³ and issues on assessment ⁴ in DCD. Her skills and experience put her in an ideal position to lead all aspects of the project to substantially revise and re-standardise the MABC test.
The MABC-2 test (usually administered by a medical or allied health professional) assesses three areas of motor development: manual dexterity, ball skill and balance. There were substantial improvements in the MABC-2 compared to the first edition. The new test included an extended age range, updated equipment (to be more attractive and comply with new safety standards) and revised items to improve reliability. The provision of UK norms and introduction of standard scores for the first time was the most important development for clinical application of the test.
The MABC-2 is useful for the assessment of general motor competence but many teachers and therapists are also concerned with the more specific skill of handwriting, which is so important for academic progress. Children with developmental disorders, particularly those with DCD, often have severe handwriting difficulties which are associated with underachievement at school. With a special interest and expertise in the development of handwriting skill and in examining the nature of handwriting difficulties in DCD, Barnett has also developed two new handwriting assessment tools, the Detailed Assessment of Speed of Handwriting (DASH) for 9-16 year olds (published late in 2007 ⁵) and DASH17+ for 17-25 year olds (published in 2010 ⁶). These are the first handwriting tests to provide UK normative data and standard scores for students aged 9-25 years.
The production of both the MABC-2 and DASH tests required an extensive program of research. Barnett's expertise in motor development and handwriting was critical in the development of test items, aligning new content with current knowledge and appropriate theoretical frameworks. The large standardisation projects involved working with expert panels, the design of equipment and record forms, management of a team of over 150 testers across the UK (trained to use the new instruments) and production of the instruction and technical manuals. A critical aspect of this research was the recruitment of a suitable sample. This was achieved by using information from the 2001 Census and stratifying according to age, gender, geographical location, race/ethnicity and socio-economic status to ensure that a representative sample was obtained. Another crucial part of the standardisation projects was testing of the psychometric properties of the MABC-2 and DASH tests. This was achieved over the course of several studies designed, initiated and conducted by Barnett. The representational nature of the large national samples and validity and reliability of the tests is reported in the published test manuals and in international peer reviewed journals ^{7,8,9} .
Funding for these projects was obtained by Barnett from Action Medical Research (£51,301, 2003, Grant code: SP3858), Harcourt Assessment (£102,479, 2005), Pearson Assessment (£29,957,

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2009). Barnett led the research, which was conducted in collaboration with colleagues in education at other institutions (Sugden, Henderson, Scheib) and with assistance from a statistician (Schulz).

3. References to the research (indicative maximum of six references)

1. Henderson, S.E., Sugden, D.A. & **Barnett, A.L.** (2007). The Movement Assessment Battery for Children – 2nd Edition Manual. London: Pearson. ISBN: 9780749136017. The Movement ABC-2 manual includes instructions for administration and scoring of the Test, standard scores for children aged 3 to 16 years and information on reliability and validity of the test.
2. **Losse, A.**, Henderson, S.E., Elliman, D., Hall, D. Knight, E. Jongmans, M. (1991) Clumsiness in children - do they grow out of it? a ten year follow up study. *Developmental Medicine and Child Neurology*, 33, 55-68. DOI: 10.1111/j.1469-8749.1991.tb14785.x. Published from Barnett's PhD and in her maiden name, this is one of the most highly cited articles on DCD, with 445 citations to date.
3. Wilmut, K., Byrne, M. & **Barnett, A. L.** (2013) Reaching to throw compared to reaching to place: a comparison across individuals with and without Developmental Coordination Disorder. *Research in Developmental Disabilities*, 34(1) 174-182. DOI: 10.1016/j.ridd.2012.07.020 Submitted to REF2014, Oxford Brookes University, UoA4-Psychology, Psychiatry and Neuroscience, REF2, AL Barnett, Output identifier 9070.
4. **Barnett, A. L.** (2008) Motor assessment in DCD: from identification to intervention. *International Journal of Development, Disability and Education*, 55 (2), 113 – 129. DOI: 10.1080/10349120802033436.
5. **Barnett, A.**, Henderson, S.E., Scheib, B. & Schultz, J. (2007). *The Detailed Assessment of Speed of Handwriting* (DASH). London: Harcourt Assessment. ISBN: 9780749136406 The DASH manual includes instructions for administration and scoring of the test, standard scores for children aged 9 to 16 years and information on the psychometric properties of the test.
6. **Barnett, A.**, Henderson, S.E., Scheib, B. & Schultz, J. (2010). *The Detailed Assessment of Speed of Handwriting 17+* (DASH 17+). London: Pearson Assessment. ISBN: 9780749149253. The DASH17+ manual includes instructions for administration and scoring of the test, standard scores for students aged 17 to 25 years and information on the psychometric properties of the test. Submitted to REF2014, Oxford Brookes University, UoA4-Psychology, Psychiatry and Neuroscience, REF2, AL Barnett, Output identifier 5950.
7. **Barnett, A.L.**, Henderson, S.E., Scheib, B. & Schulz, J. (2009) Development and standardisation of a new handwriting speed test: the DASH. *British Journal of Educational Psychology Monograph Series II*, 6, 137-157, DOI:10.1348/000709909X421937. ISSN: 1476-9808. This paper outlines the development of the DASH and justification for inclusion of a range of writing tasks. Age effects on the tasks are reported.
8. **Barnett, A.L.**, Henderson, S.E., Scheib, B. & Schulz, J. (2011) Handwriting difficulties and their assessment in young adults with DCD: Extension of the DASH for 17-25 year olds. *Journal of Adult Development*, 18 (3), 114-121, DOI: 10.1007/s10804-011-9121-3. This paper outlines the development of the DASH17+ and provides a case study illustrating its use in supporting students. Age effects on the tasks are reported.
9. Schulz, J., Henderson, S.E., Sugden, D.A. & **Barnett, A. L.** (2011) Structural validity of the Movement ABC Test – 2nd Edition. *Research in Developmental Disabilities*, 32(4), 1361-1369. DOI:10.1016/j.ridd.2011.01.032. It presents a detailed examination of the factor structure of the test, based on data collected as part of the standardisation process. The findings demonstrate the validity of the test structure, supporting division into the three component parts: manual dexterity, balls skills and balance. Submitted to REF2014, Oxford Brookes University, UoA4-Psychology, Psychiatry and Neuroscience, REF2, AL Barnett, Output identifier 7471

4. Details of the impact (indicative maximum 750 words)

Research expertise in motor development and assessment issues have led to benefits for health and education professionals through provision of reliable assessment tools that improve support for children and their families. The MABC-2 and DASH tests make an impact by:

- (1) providing reliable and valid tools with which health and educational professionals can identify individuals with handwriting and motor difficulties; and by
- (2) opening up access to resources and intervention to help those identified as having handwriting or motor difficulties and to enable optimal support from parents and professionals to be planned. With this access, those who struggle can gain extra teaching support, 'reasonable adjustments' for assessments and understanding from teachers to boost their learning and self confidence.

Helping clinicians to identify and assess children and adults with handwriting and movement difficulties

Only some clinicians using the MABC-2 test engage in research and publication, so any citation indices will be an underestimate of the test's use. However, according to the citation database 'Publish or Perish'¹⁰, the MABC-2 test has been used in 192 published studies since 2008, including 51 in 2013. This includes clinical work with different groups of children with movement difficulties including those born prematurely, those with medical conditions (e.g. haemophilia, hypothyroidism) or with developmental disorders (e.g. Developmental Coordination Disorder, ADHD, Specific Language Disorder).

The test is very popular in the field of Developmental Coordination Disorder (DCD), and at the 2013 International DCD conference in Brazil over 80% of the presented studies on DCD used the MABC-2 for identification and assessment. Many of these studies were undertaken by research practitioners, publishing work emanating from their clinical practice. Statements from clinicians and teachers provide further evidence of impact of the test¹⁰:

A Paediatrician at Stanford University, USA says "*The MABC-2 is an extremely important and robust tool for both care providers and investigators in long-term neurodevelopmental outcomes among high risk infants. We are using it in our School Age Follow Up study of extremely premature infants in the Neuroimaging and Neurodevelopmental Outcomes Cohort*".

The Head Occupational Therapist at West Lothian Children's OT Service, Scotland says "*As part of our redesign work around assessment for children with DCD, the MABC-2 was considered the tool of choice for the assessment of motor skills. This not only allowed occupational therapists and physiotherapists to gather information about the child's motor skills, but also provided information that could contribute towards potential diagnosis*".

Children and their families also benefit from test results. For example, the mother of a child with DCD says "*A thorough assessment of her motor skills using the Movement ABC-2 confirmed her persistent motor difficulties and diagnosis of DCD. These reports were invaluable in helping both me and my daughter understand the areas which were causing such difficulties and allowed her and her school to put into place strategies to help. She also received 25% extra time in all public exams and this enabled her to reach her potential*"

External recommendation of the tests

The MABC-2 Test has been specifically recommended for use in the European Guidelines on DCD (Blank et al., 2012)¹². The guidelines were produced by an independent body of experts in the field, using research-based criteria to decide on the most suitable tools to use in the clinical setting. A Professor in the School of Rehabilitation Science, McMaster University, Canada says "*The MABC-2 has become the gold standard that is now used around the world for measuring and describing the severity of children with motor impairment*".

The SpLD Assessment Standards Committee (SASC)¹³ for the assessment of specific learning difficulties (SpLD) in Further and Higher Education in the UK, have recommended the MABC-2 and DASH tests for use by specialist assessors and tutors for the assessment of handwriting and motor difficulties in students. The DASH tests are the first handwriting assessment with valid UK norms and demonstrated reliability. The DASH tests thus provide the key evidence base with which children and adults with handwriting difficulties can gain access to special arrangements in education through primary, secondary, further and higher education.

The DASH tests are also included in the list of resources recommended by the Joint Council for Qualifications (JCQ) and by Patoss (The Professional Association of Teachers of Students with Specific learning difficulties (SpLD))¹⁴ that give guidance to teachers applying for Access Arrangements for their pupils during written examinations (such as extra time). A specialist tutor at a college of further education says "*we regularly use the DASH with our students with dyslexia, as part of the application for extra time in GCSE exams*"¹¹.

Global impact the tests

The original version of the MABC was popular for many years, but had a limited scoring system and had generally become outdated. The revised MABC-2 Test has now taken its place as one of the most popular tests Worldwide for the assessment of motor competence. The MABC-2 may be purchased by individuals who are certified by a professional organisation recognised by

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Pearson (the publisher) or who have a graduate qualification relevant to their profession. In the UK most purchases are made by health and allied health practitioners (e.g. Occupational Therapists and Clinical Psychologists) working within clinics/centres. Based on their confidential sales figures¹⁵, Pearson estimates that between Jan 2008–Dec 2012 78,900 assessments have been made using the full MABC-2 kit in the UK, and a further 11,150 worldwide. Commercially available translations include German, Dutch, Spanish, Swedish, Norwegian and Danish, with translations in preparation for Hong Kong Chinese, Hebrew, Japanese, Spanish and Portuguese. Translations are provided by third parties so sales figures are unknown.

There are few competitors to the MABC-2 test. The Bruininks-Osteretsky Test of Motor Proficiency (BOT-2, 2005) is the closest competitor, with North American norms. The BOT-2 tests a similar range of motor skills but has been criticized for inclusion of inappropriate items (e.g. to test strength), which can make results hard to interpret. A similar test with Australian norms, the McCarron Assessment of Neuromuscular Development (MAND, 1997) is now outdated and has received similar criticisms to the BOT-2. The sales figures for the MABC-2 test demonstrate popularity of the test world-wide, in the USA, Canada, Australia and around Europe.

The impact of the DASH extends well beyond the UK, with sales in France, Germany, The Netherlands, Sweden, Australia, Canada and India. The test is sold mainly to teachers and educational psychologists but also to other professionals from a range of disciplines. The test has been translated into Romanian and requests also made for a Portuguese and Italian translation.

There are separate kits for the DASH and DASH17+. Confidential information from Pearson outlines the sales figures¹³:

DASH Reach Figures, for the period January 2008 to December 2012

Sale of complete DASH kits in the UK (outside UK in brackets): 3,100 (111) plus 2,076 (38) packs of record forms. Estimated number of assessments based on this = 133,125

DASH 17+ Reach Figures, for the period January 2010 to December 2012:

Sale of complete DASH17+ kits in the UK (outside UK in brackets): 921 (226) plus 226 (2) packs record forms. Estimated number of assessments based on this = 34,375

Added to this are sales of the DASH tests to other companies for selling on, adding an estimated 8,150 assessments. The total estimated number of assessments from both DASH tests is thus 167,500.

These figures, together with formal recommendations of the tests by organisations in health and education demonstrate the substantial impact in the UK and worldwide.

5. Sources to corroborate the impact (indicative maximum of 10 references)

10. Citations. Copies of print outs from Harzing, A.W. (2007) *Publish or Perish*, available from <http://www.harzing.com/pop.htm> showing publications citing use of the test using the search term 'Movement ABC-2'.
11. Corroborative statement authors 1-5. Statements from a range of professionals confirming use of the MABC-2 and DASH tests within their profession. A statement from a parent is also included.
12. European Guidelines on DCD – guidelines for clinicians recommending use of the MABC-2 Test for assessment and diagnosis in a clinical setting. Blank, R., Smits-Engelsman, B., Polatajko, H. & Wilson, P. (2011). European Academy for Childhood Disability (EACD): Recommendations on the definition, diagnosis and intervention of developmental coordination disorder (long version), *Developmental Medicine and Child Neurology*, 54 (1), 54-93.
13. List of recommended tests published by the SpLD Assessment Standards Committee (SASC) for the assessment of specific learning difficulties (SpLD) in Further and Higher Education. www.sasc.org.uk or www.patooss-dyslexia.org/SupportAdvice/DisabledStudentAllowances/
14. Jones, A. (Ed) (2011) Dyslexia: Assessing the need for Access Arrangements during Examinations. A Practical Guide 4th. Ed. Published PATOSS, Professional Association of Teachers of Students with Specific Learning Difficulties in association with the Joint Council for Qualifications (JCQ). ISBN: 0-9539315-4-4
15. Confidential sales figures and usage estimates from Pearson regarding the number of translations and status of sales of the MABC-2 and DASH tests to clinicians in the UK and overseas. Estimates are provided of the number of children assessed.