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Using the DASH-2 to Identify Dysgraphia

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Abstract

To support the validity and clinical utility of the DASH-2 for identifying individuals with dysgraphia, the results from five studies are reported. Findings suggest that both Copy Best and Copy Fast are sensitive to identifying handwriting difficulties consistent with dysgraphia, with relatively greater impairment exhibited on Copy Fast. Results from the reported studies using the first edition of the DASH are applicable to the DASH-2 because the first and second editions are highly similar. These studies provide evidence to support the use of the DASH-2 as part of a screening or evaluation process for identifying dysgraphia among children and young adults.

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Contents

The *Detailed Assessment of the Speed of Handwriting* (2nd ed.; DASH-2; Barnett et al., 2024a) is a reliable measure of handwriting speed and legibility for children and young adults ages 8–25. The DASH-2 includes four core tasks (Copy Best, Alphabet Writing, Copy Fast, and Free Writing) and a Graphic Speed task. Data from the DASH-2 can be used to identify individuals with handwriting difficulties, support eligibility determination for extra supports or accommodations, provide a detailed description of handwriting performance, monitor and evaluate progress and intervention effectiveness, and aid research.

A growing body of research in the United States has accumulated support for the clinical utility of the first edition of the DASH (Barnett et al., 2007) and DASH 17+ (Barnett et al., 2010), with a focus on the Copy Best and Copy Fast tasks, in identifying individuals with dysgraphia. Copy Best requires the examinee to copy a sentence, which includes all the letters of the alphabet, in their best handwriting for two minutes. Copy Fast requires the examinee to copy the same sentence quickly for two minutes. The examinee can use either manuscript or cursive or a combination of these. This report summarizes the results of five studies that reported clinical group performance on the DASH Copy Best and/or Copy Fast measures as one aspect of the research.

Clinical validity evidence using the DASH is applicable to the DASH-2 because the first and second editions are highly similar. As cited in the DASH-2 manual (Barnett et al., 2024b), the corrected correlation coefficients between the tasks across the two instruments are high, ranging from .75 (Graphic Speed) to .84 (Copy Fast), indicating that they measure similar constructs. Similarly, the correlation for the Total Standard Score was high (.89) with a negligible effect size.

For determining impairment in letter production, individual tasks within a norm-referenced handwriting assessment, such as the DASH-2, can be used to measure speed and legibility of handwriting. However, a single test, or even a pair of tests such as the DASH-2 copying tasks, is not sufficient to identify or diagnose dysgraphia. A diagnosis of dysgraphia is based on a convergence of evidence gathered from multiple sources, including observation, review of completed work, and norm-referenced assessment data. A comprehensive evaluation may be required in some settings. For example, IDEA legislation allows for use of the term *dysgraphia* if it is supported by a comprehensive evaluation for a specific learning disability (Yudin, 2015).

Characteristics of Dysgraphia

Dysgraphia, in this context, refers to handwriting difficulties. Dysgraphia is a specific learning disability with impairments in legible and automatic letter production by hand and executive functions for attention regulation, both of which interfere with written composing (Dunn et al., 2020). According to an evidence-based framework for differential diagnosis of specific learning disabilities (SLDs), dysgraphia is an impairment at the subword level of language by hand (writing letters and word parts), whereas dyslexia involves a word-level language impairment (decoding and spelling), and oral and written language learning disability (OWL-LD), which is also commonly referred to as developmental language disorder (DLD; Bishop et al., 2017), involves impairment with syntax, morphology, and text-level discourse (Berninger, 2015; Silliman & Berninger, 2011). Individuals can be impaired in more than one level of language. Specifically, individuals with dyslexia can have word and subword level impairments, and individuals with OWL-LD can have syntax, word, and subword level impairments (Berninger, 2015). Dysgraphia can coexist with other learning difficulties, such as dyslexia or a specific reading disorder, OWL-LD/DLD, developmental coordination disorder, attention-deficit/hyperactivity disorder (ADHD), and autism spectrum disorders. The clinical group studies described in the following section utilize this framework for identifying dysgraphia.

Three types of dysgraphia were originally described by Deuel (1995) and more recently by Chung et al. (2020). The first, *language-based dysgraphia,* refers to a specific learning disability with an impairment in written expression, which includes deficits in spelling, grammar, and/ or clarity or organization of written expression. Copying text is typically intact. Within the evidence-based framework for differential diagnosis of SLDs described by Berninger and colleagues (Berninger, 2015; Silliman & Berninger, 2011), language-based dysgraphia is not consistent with a dysgraphia diagnosis because the impairments are not at the subword level of language. Rather, impairment with syntax, morphology, and text-level discourse are referred to as OWL-LD/DLD within this framework.

Spatial dysgraphia involves problems with spatial perception, difficulty with spacing of letters, copying or composing text, and drawing ability. *Motor dysgraphia* involves problems with the fine motor skills needed to produce letters or numbers; finger tapping is a primary impairment and indicators may include poor pencil grasp, poor posture, and slow and illegible handwriting. Some practitioner guidelines simplify classification into motor-based dysgraphia, which includes motor or spatial difficulties at the subword level of language impairment, and language-based dysgraphia, which includes word-level and connected text levels of impairment [DOT(WA), 2019].

The clinical group studies described in the following section demonstrate how the DASH/DASH-2 can be used to identify impairments in the speed and/or legibility of copying text, which is a symptom of both motor and spatial dysgraphia, as shown in Table 1.

Table 1 Primary Impairments in Dysgraphia

Dysgraphia	Spontaneous handwriting	Copying text	Drawing	Finger tapping
Spatial	Impaired	Impaired	Impaired	
Motor	Impaired	Impaired	Impaired	Impaired

Special Group Studies

The following five studies, published in peer-reviewed journals between 2015 and 2018, report clinical group performance on the DASH Copy Best and/or Copy Fast measures as one aspect of the research.

Study 1: Alstad et al. (2015)

Study 2: Richards et al. (2015)

Study 3: Beers et al. (2017)

Study 4: Abbott et al. (2017)

Study 5: Nielsen et al. (2018)

The group performance results reported in these studies are relevant for supporting the clinical utility of the DASH, although this was not a primary objective in the studies.

In addition to a control group, all five studies included a dysgraphia group and a dyslexia group, and three of the studies (Studies 1, 4, 5) included an OWL-LD/DLD group.

In all five studies, participants were assigned to groups using the same basic criteria for differential diagnosis, which are based on two decades of interdisciplinary research (Berninger, 2015; Silliman & Berninger, 2011). The diagnostic procedures were based on profiles or patterns of skills, never a single score, and problems evidenced by test scores were consistent with developmental and educational history and persisted over time despite intervention.

Criteria for each of the groups were as follows:

- All groups: A standard score of 80 (–1 1/3 *SD*s) or higher on the WISC–IV Verbal Comprehension Index (Wechsler, 2003) was required for participation.
- Dysgraphia group: Participants showed no signs of reading or oral language impairment and scored below the 25th percentile (90 standard score or 8 scaled score) on at least two of three handwriting measures: DASH Copy Best and Copy Fast, and a test of alphabet writing from memory. In addition, their parents had to report a history of persistent and ongoing difficulties with legible and automatic handwriting but not with word reading, reading comprehension, or oral language. As these criteria exemplify, results from the DASH are not used as the sole criteria for identification but are used in conjunction with information obtained from multiple sources of information, including parent interviews, qualitative observations, and other test scores.
- Dyslexia group: Participants in Studies 1–3 had to score below the 25th percentile on two or more spelling and word reading measures and have a parental report of persisting word reading/decoding and spelling problems. Studies 4 and 5 also permitted scores on at least two spelling and/or word reading/decoding measures that were below the population mean and at least 1 *SD* below their Verbal Comprehension Index score. Impaired listening comprehension or oral expression were exclusionary criteria for the dyslexia group.
- OWL-LD/DLD group: Participants had to score below the 25th percentile on two or more measures of syntax-level oral and/or written language measures of comprehension and/or expression, and have a parental report of preschool history of oral language problems and persisting problems in listening comprehension, reading comprehension, oral expression, and/or written expression.
- Control (typical language learning) group: Participants had to score at or above the 25th percentile on all measures of language by ear (listening), by mouth (speaking), by eye (reading), and by hand (paper-and-pencil writing) and have no reported past or current history of oral and/or written language learning problems.

Candidates for the clinical group studies were screened for exclusionary criteria that could possibly affect test performance, such as autism spectrum disorder, medical conditions, and significant hearing loss or visual impairment. However, ADHD was permitted as a common co-occurring disorder with the clinical groups of interest.

The demographic characteristics of the overall samples are presented in Table 2, including percentages of sample representation by education level, race/ethnicity, and sex.

Table 2 Demographics of Overall Samples

	Study 1: Alstad et al.	Study 2: Richards et al.	Study 3: Beers et al.	Study 4: Abbott et al.	Study 5: Nielsen et al.
N	88	40	54	94	155
Grade range	4–9	4–9	4–9	4–9	4–9
Age					
Mean in years	—	12:3	12:0	—	11:11
Range	—	9–15	9–14	—	9–15
Education					
0–12 years of school, no diploma	—	—	—	2.1, 2.1	0.7, 2.2
High school diploma or equivalent	2.2, 4.4	—	—	4.2, 6.4	2.8, 2.9
Some college or technical school, associate degree	3.3, 7.8	—	—	10.4, 25.5	5.6, 10.8
Bachelor's degree	89.9, 77.8	—	—	83.3, 66.0	91.0, 84.2
Race/ethnicity					
African American	1.1	—	—	1.1, 1.1	1.3
Asian	3.4	—	—	2.1, 5.6	3.2
Hispanic	—	—	—	3.2, 2.2	1.9
Other	17.1	—	—	3.2, 3.4	22.0
White	78.4	—	—	90.5, 87.6	71.6
Sex					
Female	33.0	37.5	25.9	40.4	39.4
Male	67.0	62.5	74.1	59.6	60.6

Note. Percentages separated by commas represent participants' mothers first and then fathers. Percentages for race/ethnicity without commas represent the participants.

All five studies present data for participants in Grades 4–9 living in the Western region of the United States, near the University of Washington. Means and *SD*s for age were reported for three of the five studies. For consistency, demographic data are reported according to standard census categories, which may differ slightly from those used in the studies. Studies 2 and 3 did not report education or race/ethnicity information. Studies 2, 3, and 5 reported sex by group, as shown in Tables 4, 5, and 7. Except for those data, demographic information was reported for the overall samples only.

The mean performance of the clinical groups and their corresponding control groups are reported in Tables 3–7 for Studies 1–5, respectively.

Table 3 Alstad et al. (2015)

DASH measures	Control *n* = 10 *M (SD)*	Dysgraphia *n* = 27 *M (SD)*	Dyslexia *n* = 40 *M (SD)*	OWL-LD/DLD *n* = 11 *M (SD)*	Clinical group comparisons
Copy Best	11.45 (2.46)	8.63 (3.16)	9.10 (3.73)	9.27 (3.88)	–
Copy Fast	11.09 (1.87)	6.41 (2.90)***	6.93 (3.32)**	7.09 (3.96)*	ns

Note. *p < .05, **p < .01, ***p < .001 for post-hoc results comparing each clinical group with the control group; *ns* = no significant difference between clinical groups.

Table 4 Richards et al. (2015)

DASH measures	Control *n* = 9 5 female *M (SD)*	Dysgraphia *n* = 14 3 female *M (SD)*	Dyslexia *n* = 17 7 female *M (SD)*	Clinical group comparisons
Copy Best	11.33 (3.64)	6.64 (3.32)**	7.53 (3.20)*	ns
Copy Fast	9.83 (3.12)	5.07 (2.20)***	6.20 (2.93)**	ns

Note. *p < .05, **p < .01, ***p < .001 for post-hoc results comparing each clinical group with the control group; *ns* = no significant difference between clinical groups.

Table 5 Beers et al. (2017)

DASH measures	Control *n* = 15 6 female *M (SD)*	Dysgraphia *n* = 19 3 female *M (SD)*	Dyslexia *n* = 20 5 female *M (SD)*	Clinical group comparisons
Copy Best	11.30 (2.06)	8.05 (3.42)*	8.30 (3.44)*	ns
Copy Fast	10.80 (2.25)	5.84 (2.77)***	6.15 (3.08)***	ns

Note. *p < .05, ***p < .001 for post-hoc results comparing each clinical group with the control group; *ns* = no significant difference between clinical groups.

Table 6 Abbott et al. (2017)

DASH measure	Control *n* = 18 *M (SD)*	Dysgraphia *n* = 21 *M (SD)*	Dyslexia *n* = 40 *M (SD)*	OWL-LD/DLD *n* = 14 *M (SD)*	Clinical group comparisons
Copy Best	12.62 (2.36)	8.67 (3.32)**	8.79 (3.25)***	9.53 (3.48)*	ns

Note. *p < .05, **p < .01, ***p < .001 for post-hoc results comparing each clinical group with the control group; *ns* = no significant difference between clinical groups.

Table 7 Nielsen et al. (2018)

DASH measures	Control *n* = 42 21 female *M (SD)*	Dysgraphia *n* = 29 6 female *M (SD)*	Dyslexia *n* = 65 28 female *M (SD)*	OWL-LD/DLD *n* = 19 6 female *M (SD)*	Clinical group comparisons
Copy Best	11.59 (2.24)	8.62 (3.16)**	9.17 (3.60)**	9.07 (3.97)*	ns
Copy Fast	10.88 (2.29)	6.42 (2.90)***	7.33 (3.37)***	6.64 (3.77)***	ns

Note. *p < .05, **p < .01, ***p < .001 for post-hoc results comparing each clinical group with the control group; *ns* = no significant difference between clinical groups.

One-way analyses of variance (ANOVAs) were conducted using the means and *SD*s reported in the studies. Study 1 shows a significant (p < .01) main effect of group on Copy Fast but not Copy Best. All other studies show a significant (p < .01) main effect of group for the DASH measures, and Tukey HSD post-hoc analyses were conducted to determine which groups differed. In each of the tables, the last column shows post-hoc results for differences between the clinical groups. No statistically significant mean differences are observed between the dysgraphia, dyslexia, and OWL-LD/DLD groups.

Several consistent findings emerge across studies. The control groups show similar (i.e., not statistically different) mean scores for Copy Best and Copy Fast; the means are generally close to or above the mean. For Copy Best, the five dysgraphia groups show similar mean scores in the Average to Low Average ranges. For Copy Fast, the four dysgraphia groups show similar mean scores in the Low Average to Very Low ranges. The dysgraphia, dyslexia, and OWL-LD/DLD clinical groups exhibit greater impairment on Copy Fast relative to Copy Best.

Another consistent finding across studies is that the mean performance of the dysgraphia, dyslexia, and OWL-LD/DLD groups on the DASH measures are not significantly different. This finding may reflect the framework for differential diagnosis that was used in all five studies whereby participants with dyslexia and participants with OWL-LD/DLD can have subword level impairments in addition to their primary level of language impairment (word-level for dyslexia and syntax-level for OWL-LD/DLD). Hence, handwriting impairments may be common in all three clinical groups. Another possible contributing factor is that supervisory attention (focusing, switching, and sustaining attention) in working memory, which tends to be impaired in all three of these clinical groups (Berninger, 2015), may hinder performance on copying tasks.

Limitations

These clinical group studies have several limitations for supporting the clinical utility of the DASH Copy Best and Copy Fast measures. First, the clinical samples were not randomly selected but were recruited based on availability. Second, the samples were relatively small and cover only a portion of the DASH age range. Third, only group performance is reported. For these reasons, the data from these samples are presented as examples and are not intended to be fully representative of the populations with dysgraphia, dyslexia, and OWL-LD/DLD. Finally, the samples were not designed to be representative of the school-age population in terms of region, race/ethnicity, and parent education level. Of the studies that reported on these demographic variables, there was an overrepresentation of participants with a White racial/ethnic background, participants with high parent education levels, and participants who identified as male. In Abbott et al. (2017), the researchers explain that, although most participants were White, in the authors' research and clinical experience, the diagnostic procedures used in these studies have been found to identify dysgraphia, dyslexia, and OWL-LD/DLD across racial/ethnic groups. Each of the samples included more male than female participants, which is common for dysgraphia samples. As explained in Dunn et al. (2020), although dysgraphia occurs across genders, it is identified more frequently in the male population.

Implications

Results from Studies 1–5 suggest that both Copy Best and Copy Fast are sensitive to identifying handwriting difficulties consistent with dysgraphia, with relatively greater impairment exhibited on Copy Fast.

As exemplified in these studies, the Copy Best and Copy Fast tasks can provide clinically useful information for the identification of handwriting difficulties while minimizing administration time in certain contexts, such as an initial screening process or for research purposes. Administering the full DASH-2 is recommended for a comprehensive handwriting evaluation. The DASH-2 includes five tasks to measure the speed at which handwriting is produced across a range of activities.

Studies 1–5 were conducted in the United States using norms developed in the United Kingdom for the DASH. A post-publication regional comparison study (Breaux & Munsell, 2025) found no significant differences in performance on the DASH-2 between the U.S. sample and in the UK/Australia/New Zealand sample, indicating that the DASH/DASH-2 norms are appropriate for use in the United States as well. The findings from Studies 1–5 provide further support for the clinical utility of the DASH/DASH-2 across regions.

It is expected that future investigations utilizing the DASH-2 in research, clinical, and school settings will provide additional evidence of the test's utility for contributing to an overall approach to the identification of dysgraphia and furthering our understanding of handwriting difficulties.

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