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## Effect of Ability to Cross Midline on Performance of Handwriting

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# Effect of Ability to Cross Midline on Performance of Handwriting

Lindsey Richmond and Michaela Marks

## Background

In the school setting, occupational therapists work with students to develop or improve handwriting skills, such as letter legibility, to support educational participation (Case-Smith, 2002). Handwriting is comprised of many essential skills and clinicians focus specifically on areas including motor planning, upper extremity range of motion, and bilateral integration (Giroux, Woodall, Weber, & Bailey, 2012) which are related to the ability to cross midline. Crossing body midline is the ability to reach across the center of one's body, which is essential for many everyday tasks.

### 1 Ask: Research Question

How does the ability to cross midline impact handwriting skills?

### 2a Acquire: Search Terms

**Databases:** SCOPUS, Pubmed, Proquest, ClinicalKey

**Search Terms:** midline, hemispace, handwriting, pediatrics, school occupational therapy, midline crossing, legibility, hand preference

### 2b Acquire: Selected Articles

**Shaw (2011):** *Quasi-experimental study.* Compared the effects of two handwriting approaches (i.e. D'Nealian, Sunform) which are used to promote kindergartner's ability to form letters and develop handwriting skills.

**Hill & Khanem (2009):** *Correlational design.* Investigated the development of hand preference and the effects of extrinsic handwriting task demands.

**Kim (2016):** *Correlational design.* Identified factors influencing handwriting based on the international classification of functioning, disability and health (ICF) for participants with cerebral palsy.

### 3a Appraise: Study Quality

**Shaw (2011):** *Level III.* n=174; kindergartener participants were assigned to either Sunform experimental group (n=133) or the D'Nealian control group (n=41) which differed in administration and style (crossing midline vs. not). Teachers who administered the different writing styles had different years of experience and education level; schools differed in demographics.

**Hill & Khanem (2009):** *Level IV.* n=100; participants divided within four age groups. Study collected participant data using handedness inventory, midline crossing assessment, and peg moving tasks. Study occurred in London and did not directly include a traditional handwriting assessment to supplement findings. Procedure and methods were thoroughly described; variables were clearly operationally defined.

**Kim (2016):** *Level IV.* n=96; utilized valid and reliable assessment tools that were appropriate for children. However, administration procedures for assessments were not discussed. Assessments related to handwriting included tactile test, MMT, dynamometer, pinch meter, sitting balance, and Korean alphabet writing assessment. The study occurred in Korea and did not include thorough summary of results generated by statistical analysis that were used to draw conclusions.

### 3b Appraise: Study Results

**Shaw (2011):** Children trained in the Sunform group (required midline crossing) (M = 9.70; SD = 10.37) had significantly higher scores on all but three letters of the alphabet. Children trained in the D'Nealian



("How to Improve Your Kid's Handwriting?", 2019)

method (M = 8.48; SD = 10.35) scored significantly lower with missing strokes, distortions, or open letters.  $F(1, 170) = 119.75, p < .001$ . The Sunform group performed 57.9% better than the D'Nealian group. Letters such as 'v' that did not challenge midline crossing were scored the highest across both groups.

**Hill & Khanem (2009):** Task demands were found to influence the choice of hand when reaching into contralateral and ipsilateral spaces. The number of midline crossings performed was greater when reaching near the body midline,  $F(2, 184) = 25.98, p < .001$ . In addition, a child's age and peg-moving speed had a significant influence ( $p < .05$ ) on the likelihood of using their preferred hand to point and reach across midline. The authors concluded there is importance in arranging environments to support midline crossing.

**Kim (2016):** Results revealed a significant relationship between wrist lateral deviation and upper-extremity speed;  $VIF = 1.001, p < .05$ . Crossing midline was noted as a skill directly related to bilateral coordination. The authors concluded that diagnoses which prevent or limit midline crossing can potentially affect the capacity for participants to travel into the hemispaces required for handwriting and result in difficulty establishing hand dominance.

**4 Apply: Conclusions for Practice** Crossing midline is a component of handwriting that contributes to the development of hand preferences, ability to form letters, and capacity to travel into hemispaces necessary for writing on both horizontal and vertical surfaces. The inability to cross midline can be disruptive to a child's capability to perform handwriting and can cause delays in their educational advancement. Various approaches to handwriting assessment and intervention place emphasis upon crossing into midline which enables occupational therapists to guide development of this skill. Through understanding the effects of midline crossing, clinicians are better prepared to help promote the occupations important to students or clients developing handwriting.

## References:

Case-Smith, J. (2002). Effectiveness of school-based occupational therapy intervention on handwriting. *The American Journal of Occupational Therapy: Official Publication of the American Occupational Therapy Association, 56*(1), 17-25.

Giroux, P., Woodall, W., Weber, M., & Bailey, J. (2012). Occupational Therapy Practitioners' Perceptions of Important Competencies for Handwriting Evaluation and Intervention in School-Aged Children. *Physical & Occupational Therapy In Pediatrics, 32*(1), 66-79.

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Midline crossing was found to be essential for the development of hand preference, ability to form letters, and necessary for traveling into hemispaces required for handwriting.

