

Research Support for Ohio HB 146

Research shows the importance of systematically teaching handwriting and using it to spell words and express ideas in written language, beginning in kindergarten and continuing to fifth grade, and periodic handwriting tune-ups in the upper grades. Important lessons from research for educational policy follow:

1. Teach manuscript first because most of the writing children read in books or on electronic media is in manuscript format. Research showed that teaching manuscript handwriting to first graders improved their word reading even though reading was not taught in that study. Assess whether children have developed hand dominance and adapt handwriting instruction to whether they are right or left handed.
2. Beginning in third grade teach cursive. Research showed that cursive contributes to improved spelling and composing in upper elementary and middle school grades. The connecting strokes in cursive may help link letters into word units for spelling and improve handwriting speed so it is easier to get thoughts into writing.
3. Beginning in fifth grade, teach touch typing. If children just use the index finger to press and hunt and peck, research has shown they don't write as many words or write as quickly or express as many ideas. Touch typing will also prepare them for completing written assignments at home during middle school and at school if technology is well integrated with the curriculum. Touch typing requires use of both hands, and all fingers in each hand, and alternating between both hands. Each hand sends signals to the opposite side of the brain. By fifth grade the brain structures that support communication between both sides of the brain for coordinating incoming motor processes from both hands are maturing or matured sufficiently to support learning to touch type.
4. Research has identified the developmental steppingstones for teaching handwriting and linking it to spelling and composing. At all grade levels what matters is not how much time is spent on handwriting instruction but rather the nature of the instruction and student learning activities and linking handwriting to spelling and composing (idea expression in written language).

- a. In kindergarten teach children to name lower case letters, copy lower case letters, and write named lower case letters from memory. Teach lower case letters first because they are used the most often. Once children learn those introduce naming, copying, and writing from memory the capital letters but from the beginning link capital letters to the first letter in a sentence.

- b. In first grade continue formal instruction in both lower case and upper case letters with a systematic classroom program of handwriting instruction. Letters with common strokes or features can be taught in the same lesson so that children learn how they are similar and how they are different, for example, n with one hump and m with two humps. Emphasize relative sizing (l is a longer, higher i, and h has a longer left stroke than n) and placing on lined paper (o rests on the line but p goes below it). The goal is legible letter formation others can recognize. Use arrows as visual cues to indicate the direction of component strokes to help children form the letters. Name letters during instruction and encourage

children to name them. Once all the letters are introduced, practice each of the 26 letters once in writers' warm up at the beginning of each writing lesson that also includes spelling and composing.

c. In second grade continue to practice writing letters in manuscript. Begin each writing lesson with writers' warm up and practice with each of the 26 letters once. Provide practice in writing letters from memory not just copying letters. The goal is to become automatic so that the child can think about word spelling and idea expression instead of letter formation. After warm up move on to systematic spelling instruction and composing activities to apply handwriting and spelling to idea expression. Also teach formation of capital letters and their application to signaling the beginning of a sentence and names of people, places, and things.

d. In third grade introduce formation of cursive letters using a systematic classroom program of handwriting instruction. The goal is to teach formation of legible letters others can recognize. Encourage children to use the cursive writing in their spelling and composing.

e. In fourth grade continue to review cursive handwriting with activities in a classroom handwriting program designed for students at this grade level, but also begin writing lessons with writers' warm up followed by systematic spelling and composing activities. Writers' warm-up can be adapted to include the before and after game. Children are asked to write letters that come before or that come after other letters. This activity helps them find letters in memory during writing and reading.

f. In fifth grade children benefit from periodic brief tune ups for manuscript and cursive handwriting. These might include writing the whole alphabet from memory—on some days in manuscript and on other days in cursive—or the before and after game. Children also benefit from exchanging their compositions with each other and circling the letters they cannot recognize so they can be fixed to be made legible.

5. Not only systematic handwriting instruction but also systematic spelling instruction is being left behind in the computer era. However, considerable research shows the critical importance of systematic spelling instruction, beginning in first grade and continuing through fifth grade, for developing writing skills needed to complete written assignments and tests related to standards. Research has shown that word spelling leads to improved reading as well. Spelling requires the integration of letter writing (handwriting) with the vocabulary, sounds, and prefixes and suffixes and supports expression and refinement of thought and thinking, the ultimate goal of education.

6. Beginning in grade 4 need to teach integration of handwriting with reading and with listening.

7. In an era of limited financial resources, it is important to keep in mind that systematic handwriting AND spelling instruction can reduce the number of children needing special education services. With appropriate, systematic, and sustained handwriting and spelling instruction K to 5 many specific learning disabilities involving some aspect of writing (estimated one in five students) can be prevented, reducing costs for more expensive special education services.

Examples follow of research or dissemination of research resulting from NICH-funded research on writing, beginning in 1989 and continuing to the present, which supports these recommendations regarding policy for writing instruction.

EDUCATIONAL POLICY

Berninger, V. (May/June 2012). Strengthening the mind's eye: The case for continued handwriting instruction in the 21st century. (pp. 28-31). *Principal*. National Association of Elementary School Principals. Invited. www.naesp.org

Berninger, V. (2013, March). *Educating students in the computer age to be multilingual by hand*. Invited Commentary on "The Handwriting Debate" NASBE Policy Debate (2012, September) for National Association of State Boards of Education (NASBE), Arlington, VA.
<http://www.nasbe.org/wp-content/uploads/Commentary-Handwriting-keyboarding-and-brain-development1.pdf>

CURSIVE

Alstad, Z., Sanders, E., Abbott, R., Barnett, A., Hendersen, S., Connelly, V., & Berninger, V. (2015). Modes of alphabet letter production during middle childhood and adolescence: Interrelationships with each other and other writing skills. *Journal of Writing Research*, 6(3), 199-231.
<http://www.jowr.org/next.html> <http://dx.doi.org/10.17239/jowr-2015.06.03.1>

#644747: NIHMS644747 [NCBI tracking system #16689920]

MANUSCRIPT

Berninger, V. (2009). Highlights of programmatic, interdisciplinary research on writing. *Learning Disabilities. Research and Practice*, 24, 68-79. Invited.

Graham, S., Weinstein, N., & Berninger, V. (2001). Which manuscript letters do primary grade children write legibly? *Journal of Educational Psychology*, 93, 488-497.

COMPARISON OF LETTER PRODUCTION MODES (manuscript, cursive, keyboard)

Berninger, V. Abbott, R., Jones, J., Wolf, B., Gould, L., Anderson-Youngstrom, M., Shimada, S., & Apel, K. (2006). Early development of language by hand: Composing-, reading-, listening-, and speaking- connections, three letter writing modes, and fast mapping in spelling. *Developmental Neuropsychology*, 29, 61-92.

Graham, S., Berninger, V., & Weintraub, N. (1998). The relationship of handwriting style and speed and legibility. *Journal of Educational Research*, 91, 290-296.

HANDWRITING VERUS KEYBOARD

Berninger, V., Abbott, R., Augsburger, A., & Garcia, N. (2009). Comparison of pen and keyboard transcription modes in children with and without learning disabilities affecting transcription. *Learning Disability Quarterly*, 32, 123-141.

Berninger V., Nagy W., Tanimoto S., Thompson R., & Abbott R. (2015, published on line October 30, 2014). Computer handwriting, spelling, and composing instruction for students with specific learning disabilities in grades 4 to 9. *Computers and Education*, 81, 154-168. DOI information: 10.1016/j.compedu.2014.10.00
Posted NIHMS636683 NIHMSID Publ.ID: CAE2713
<http://audioslides.elsevier.com/getvideo.aspx?doi=10.1016/j.compedu.2014.10.005>

INTEGRATED WRITING-READING

Altemeier, L., Jones, J., Abbott, R., & Berninger, V. (2006) Executive factors in becoming writing-readers and reading-writers: Note-taking and report writing in third and fifth graders. *Developmental Neuropsychology*, 29, 161-173.

Berninger, V., Abbott, R., Abbott, S., Graham, S., & Richards, T. (2002). Writing and reading: Connections between language by hand and language by eye. *Journal of Learning Disabilities*, 35, 39-56.

HANDWRITING INSTRUCTION AND ITS LINKS TO SPELLING/COMPOSING

Berninger, V., Rutberg, J., Abbott, R., Garcia, N., Anderson-Youngstrom, M., Brooks, A., & Fulton, C. (2006). Tier 1 and Tier 2 early intervention for handwriting and composing. *Journal of School Psychology*, 44, 3-30. Honorable mention as one of the best research articles of the year.

Berninger, V., Dunn, A., Lin, S., & Shimada, S. (2004). School evolution: Scientist-practitioner educators creating optimal learning environments for ALL students. *Journal of Learning Disabilities*, 37, 500-508. See writing intervention in LA Unified School District.

Berninger, V., Vaughan, K., Abbott, R., Abbott, S., Brooks, A., Rogan, L., Reed, E., & Graham, S. (1997). Treatment of handwriting fluency problems in beginning writing: Transfer from handwriting to composition. *Journal of Educational Psychology*, 89, 652-666.

Berninger, V., Vaughan, K., Abbott, R., Brooks, A., Abbott, S., Reed, E., Rogan, L., & Graham, S. (1998). Early intervention for spelling problems: Teaching spelling units of varying size within a multiple connections framework. *Journal of Educational Psychology*, 90, 587-605.

Berninger, V., Abbott, R., Rogan, L., Reed, E., Abbott, S., Brooks, A., Vaughan, K., & Graham, S. (1998). Teaching spelling to children with specific learning disabilities: The mind's ear and eye beat the computer or pencil. *Learning Disability Quarterly*, 21, 106-122.

Berninger, V., Abbott, R., Whitaker, D., Sylvester, L., & Nolen, S. (1995). Integrating low-level skills and high-level skills in treatment protocols for writing disabilities. *Learning Disability Quarterly*, 18, 293-309. (Invited.)

Traweek, D., & Berninger, V. (1997). Comparison of beginning literacy programs: Alternative paths to the same learning outcome. *Learning Disability Quarterly*, 20, 160-168.

Abbott, S., Reed, L., Abbott, R., & Berninger, V. (1997). Year-long balanced reading/writing tutorial: A design experiment used for dynamic assessment. *Learning Disability Quarterly*, 20, 249-263.

WRITING DEVELOPMENT IN TYPICALLY DEVELOPING WRITERS

Abbott, R., Berninger, V., & Fayol, M. (2010). Longitudinal relationships of levels of language in writing and between writing and reading in grades 1 to 7. *Journal of Educational Psychology*, 102, 281-298.

Abbott, R., & Berninger, V. (1993). Structural equation modeling of relationships among developmental skills and writing skills in primary and intermediate grade writers. *Journal of Educational Psychology*, 85(3), 478-508.

Berninger, V. (2000). Development of language by hand and its connections to language by ear, mouth, and eye. *Topics in Language Disorders*, 20, 65-84. (invited)

Berninger, V., & Graham, S. (1998). Language by hand: A synthesis of a decade of research on handwriting. *Handwriting Review*, 12, 11-25. (Invited)

Graham, S., Berninger, V., Weintraub, N., & Schafer, W. (1998). The development of handwriting speed and legibility in grades 1 through 9. *Journal of Educational Research*, 92, 42-52.

Graham, S., Berninger, V., Abbott, R., Abbott, S., & Whitaker, D. (1997). The role of mechanics in composing of elementary school students: A new methodological approach. *Journal of Educational Psychology*, 89(1), 170-182.

Swanson, H.L., & Berninger, V. (1996b). Individual differences in children's writing: A function of working memory or reading or both processes? *Reading and Writing. An Interdisciplinary Journal*, 8, 357-383.

Berninger, V., Fuller, F., & Whitaker, D. (1996). A process approach to writing development across the life span. *Educational Psychology Review*, 8, 193-218.

Swanson, H.L., & Berninger, V. (1996a). Individual differences in children's working memory and writing skills. *Journal of Experimental Child Psychology*, 63, 358-385.

- Berninger, V., Cartwright, A., Yates, C., Swanson, H.L., & Abbott, R. (1994). Developmental skills related to writing and reading acquisition in the intermediate grades: Shared and unique variance. *Reading and Writing: An Interdisciplinary Journal*, 6, 161-196.
- Whitaker, D., Berninger, V., Johnston, J., & Swanson, L. (1994). Intraindividual differences in levels of language in intermediate grade writers: Implications for the translating process. *Learning and Individual Differences*, 6, 107-130.
- Berninger, V., Mizokawa, D., Bragg, R., Cartwright, A., & Yates, C. (1994). Intraindividual differences in levels of written language. *Reading and Writing Quarterly*, 10, 259-275. (Invited.)
- Berninger, V., & Hart, T. (1992). A developmental neuropsychological perspective for reading and writing acquisition. *Educational Psychologist*, 27, 415-434.
- Berninger, V., Yates, C., Cartwright, A., Rutberg, J., Remy, E., & Abbott, R. (1992). Lower-level developmental skills in beginning writing. *Reading and Writing. An Interdisciplinary Journal*, 4, 257-280.
- Berninger, V., Yates, C., & Lester, K. (1991). Multiple orthographic codes in acquisition of reading and writing skills. *Reading and Writing. An Interdisciplinary Journal*, 3, 115-149.

BRAIN AND HANDWRITING/SPELLING

- Richards TL, T Grabowksi, K Askren, P Boord, K Yagle, Z. Mestre, Robinson, O., Welker, D. Gulliford, V, Nagy, W Berninger (2015, posted on line March 28). Contrasting brain patterns of writing-related DTI parameters, fMRI connectivity, and DTI-fMRI connectivity correlations in children with and without dysgraphia or dyslexia *Neuroimage Clinical*. 10.1016/j.nicl.2015.03.018 NIHMS695386
- Richards, T., Berninger, V., Stock, P., Altemeier, L., Trivedi, P., & Maravilla, K. (2011). Differences between good and poor child writers on fMRI contrasts for writing newly taught and highly practiced letter forms. *Reading and Writing*, 24(5), 493-516.
- Richards, T., Berninger, V., Stock, P., Altemeier, L., Trivedi, P., & Maravilla, K. (2009). fMRI sequential-finger movement activation differentiating good and poor writers. *Journal of Clinical and Experimental Neuropsychology*, 29, 1-17. To link to this Article: DOI: 10.1080/13803390902780201 URL: <http://dx.doi.org/10.1080/13803390902780201>
- Richards, T., Berninger, V. & Fayol, M. (2009). FMRI activation differences between 11- year-old good and poor spellers' access in working memory to temporary and long-term orthographic representations. *Journal of Neurolinguistics*, 22, 327-353. doi:10.1016/j.jneuroling.2008.11.002

ASSESSING WRITING IN TYPICALLY DEVELOPING AND GIFTED

Niedo, J., Abbott, R., & Berninger, V. (2014) Predicting levels of reading and writing achievement in typically developing, English-speaking 2nd and 5th graders. *Learning and Individual Differences*, 32C, 54-68. Published on line April 18, 2014
doi 10.1016/j.lindif.2014.03.013 NIHMS ID: NIHMS580076
Published PubMed Central (PMC) for public access May 1, 2015:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4058427>

Yates, C., Berninger, V., & Abbott, R. (1994). Writing problems in intellectually gifted children. *Journal for the Education of the Gifted*, 18, 131-155.

ASSESSMENT AND INSTRUCTION FOR SPECIFIC LEARNING DISABILITIES INTERFERING WITH WRITING

Berninger, V., Richards, T., Abbott, R. (2015, published on line April 21, 2015). Differential diagnosis of dysgraphia, dyslexia, and OWL LD: Behavioral and neuroimaging evidence. *Reading and Writing. An Interdisciplinary Journal*. doi:10.1007/s11145-015-9565-0 A2 contains supplementary material available to authorized users: NIHMS683238 Publ ID 2615-04-21_0002 PMCID # forthcoming

Berninger, V., Nielsen, K., Abbott, R., Wijsman, E., & Raskind, W. (2008b). Gender differences in severity of writing and reading disabilities. *Journal of School Psychology*, 46,151-172.

Berninger, V., Nielsen, K., Abbott, R., Wijsman, E., & Raskind, W. (2008a). Writing problems in developmental dyslexia: Under-recognized and under-treated. *Journal of School Psychology*, 46, 1-21. Received honorable mention for best research article of the year.

Brooks, A., Vaughan, K., & Berninger, V. (1999). Tutorial interventions for writing disabilities: Comparison of transcription and text generation processes. *Learning Disability Quarterly*, 22, 183-191. (Invited)

Berninger, V., & Rutberg, J. (1992). Relationship of finger function to beginning writing: Application to diagnosis of writing disabilities. *Developmental Medicine & Child Neurology*, 34, 198-215.

Berninger, V., Mizokawa, D. & Bragg, R. (1991). Theory-based diagnosis and remediation of writing disabilities. *Journal of School Psychology*, 29, 57-79.

Berninger, V., & Stage, S. (1996). Assessment and intervention for writing in students with writing disabilities and behavioral disabilities. *British Columbia Journal of Special Education*, 20(2), 2-23 (invited).

Berninger, V., & Whitaker, D. (1993). Theory-based, branching diagnosis of writing disabilities. *School Psychology Review*, 22, 623-642.

Berninger, V., & Whitaker, D. (1993). Theory-based diagnosis and remediation of writing disabilities: An update. *Canadian Journal of School Psychology*, 9, 150-156. (Invited.)

Berninger, V., & Fuller, F. (1992). Gender differences in orthographic, verbal, and compositional fluency: Implications for diagnosis of writing disabilities in primary grade children. *Journal of School Psychology, 30*, 363-382.

Berninger, V., Hart, T., Abbott, R., & Karovsky, P. (1992). Defining reading and writing disabilities with and without IQ: A flexible, developmental perspective. *Learning Disability Quarterly, 15*, 103-118.

RECENT BOOKS

Berninger, V. W. (2015). *Interdisciplinary frameworks for schools: Best professional practices for serving the needs of all students*. Washington, DC: American Psychological Association. <http://dx.doi.org/10.1037/14437-002> Short Title: *Interdisciplinary Frameworks for Schools*. Companion Websites with Readings and Resources and Advisory Board. All royalties go to Division 16 to support these websites and develop future editions. For developmental stepping stones in handwriting and related skills, see Chapter 4 (early childhood), Chapter 5 (middle childhood), and Chapter 6 (adolescence).

Berninger, V., & Wolf, B. (in press, 2015). *Teaching students with dyslexia, dysgraphia, OWL LD, and dyscalculia: Lessons from teaching and science, Second Edition*. Baltimore: Paul H. Brookes. Also available as e-book.

Arfé, B., Dockrell, J., & Berninger, V. (Eds.) (2015). *Writing development in children with hearing loss, dyslexia, or oral language problems: Implications for assessment and instruction*. NY: Oxford University Press. Also available as an ebook.

BOOK CHAPTERS

James, K., Jao, J. R., & Berninger, V. (in press). The development of multi-leveled writing systems of the brain: Brain lessons for writing instruction. MacArthur, C., Graham, S., & Fitzgerald, J. (Eds.), *Handbook of Writing Research*. New York: Guilford.

Berninger, V., & Chanquoy, L. (2012). What writing is and how it changes across early and middle childhood development: A multidisciplinary perspective. In E. Grigorenko, E. Mambrino, & D. Preiss (Eds.), *Writing: A mosaic of perspectives and views* (Ch. 5, pp. 65-84). New York: Psychology Press.

Richards, T., Berninger, V., & Fayol, M. (2012). The writing brain of normal child writers and children with writing disabilities: Generating ideas and transcribing them through the orthographic loop. In E. Grigorenko, E. Mambrino, & D. Preiss (Eds.), *Writing: A mosaic of perspectives and views* (Ch. 6, pp. 85-105). New York: Psychology Press.

Berninger, V., & Richards, T. (2012). The writing brain: Coordinating sensory/motor, language, and cognitive systems in working memory architecture. In V. Berninger (Ed.), *Past, present, and future contributions of cognitive writing research to cognitive psychology* (pp. 537-563). New York: Psychology Press.

Berninger, V., Garcia, N., & Abbott, R. (2009). Multiple processes that matter in writing instruction and assessment. In G. Troia (Ed.), *Instruction and assessment for struggling writers. Evidence-based practices* (pp. 15-50). New York: Guilford.

Berninger, V., & Amtmann, D. (2003). Preventing written expression disabilities through early and continuing assessment and intervention for handwriting and/or spelling problems: Research into practice. In H.L. Swanson, K. Harris, and S. Graham (Eds.), *Handbook of research on learning disabilities* (pp. 345-363). New York: Guilford.

ON LINE ENTRIES (control click to activate)

1. ON-LINE ENCYCLOPEDIA OF LANGUAGE AND LITERACY DEVELOPMENT

National Centres for Excellence Canadian Language and Literacy Research Network (CLLRNet) **Published online:** Berninger, V., & Fayol, M. (2008). Why spelling is important and how to teach it effectively. *Encyclopedia of Language and Literacy Development* (pp. 1-13). London, ON: Canadian Language and Literacy Research Network.
<http://www.literacyencyclopedia.ca/pdfs/topic.php?topId=234>

2. ON LINE JUST THE FACTS for INTERNATIONAL DYSLEXIA ASSOCIATION

Understanding Dysgraphia 2008 (Berninger) Revised 2012 (Berninger & Wolf)
Website: <http://www.interdys.org> Click on Fact Sheets What is Dysgraphia?

DISSEMINATION OF RESEARCH TO PARENTS, TEACHERS, AND/OR PSYCHOLOGISTS

Berninger, V., & Richards, T. (2015, May). Research confirms what many teachers know: Learning disabilities is a plural word. *Examiner*, International Dyslexia Association. Invited.

Wolf, B., & Berninger, V. (2015, March 20). Specific learning disabilities: Plural, definable, diagnosable, and treatable. *Dyslexia Connections*, International Dyslexia Association Newsletter for Parents. Invited.