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## How Handwriting Trains the Brain

*Forming Letters Is Key to Learning, Memory, Ideas*

By GWENDOLYN BOUNDS



Ask preschooler Zane Pike to write his name or the alphabet, then watch this 4-year-old's stubborn side kick in. He spurns practice at school and tosses aside workbooks at home. But Angie Pike, Zane's mom, persists, believing that handwriting is a building block to learning.

\* { She's right. Using advanced tools such as magnetic resonance imaging, researchers are finding that writing by hand is more than just a way to communicate. The practice helps with learning letters and shapes, can improve idea composition and expression, and may aid fine motor-skill development.

It's not just children who benefit. Adults studying new symbols, such as Chinese characters, might enhance recognition by writing the characters by hand, researchers say. Some physicians say handwriting could be a good cognitive exercise for baby boomers working to keep their minds sharp as they age.

{ Studies suggest there's real value in learning and maintaining this ancient skill, even as we increasingly communicate electronically via keyboards big and small. Indeed, technology often gets blamed for handwriting's demise. But in an interesting twist, new software for touch-screen devices, such as the iPad, is starting to reinvigorate the practice.

Most schools still include conventional handwriting instruction in their primary-grade curriculum, but today that amounts to just over an hour a week, according to Zaner-Bloser Inc., one of the nation's largest handwriting-curriculum publishers. Even at institutions that make it a strong priority, such as the private Brearley School in New York City, "some parents say, 'I can't believe you are wasting a minute on this,'" says Linda Boldt, the school's head of learning skills.

{ Recent research illustrates how writing by hand engages the brain in learning. During one study at Indiana University published this year, researchers invited children to man a "spaceship," actually an MRI machine using a specialized scan called "functional" MRI that spots neural activity in the brain. The kids were shown letters before and after receiving different letter-learning instruction. In children who had practiced printing by hand, the neural activity was far more enhanced and "adult-like" than in those who had simply looked at letters.

{ "It seems there is something really important about manually manipulating and drawing out two-dimensional things we see all the time," says Karin Harman James, assistant professor of psychology and neuroscience at Indiana University who led the study.

Adults may benefit similarly when learning a new graphically different language, such as Mandarin, or symbol systems for mathematics, music and chemistry, Dr. James says. For instance, in a 2008 study in the *Journal of Cognitive Neuroscience*, adults were asked to distinguish between new characters and a mirror image of them after producing the characters using pen-and-paper writing and a computer keyboard. The result: For those

writing by hand, there was stronger and longer-lasting recognition of the characters' proper orientation, suggesting that the specific movements memorized when learning how to write aided the visual identification of graphic shapes.

Other research highlights the hand's unique relationship with the brain when it comes to composing thoughts and ideas. Virginia Berninger, a professor of educational psychology at the University of Washington, says handwriting differs from typing because it requires executing sequential strokes to form a letter, whereas keyboarding involves selecting a whole letter by touching a key.

She says pictures of the brain have illustrated that sequential finger movements activated massive regions involved in thinking, language and working memory—the system for temporarily storing and managing information.

And one recent study of hers demonstrated that in grades two, four and six, children wrote more words, faster, and expressed more ideas when writing essays by hand versus with a keyboard.

Even in the digital age, people remain enthralled by handwriting for myriad reasons—the intimacy implied by a loved one's script, or what the slant and shape of letters might reveal about personality. During actress Lindsay Lohan's probation violation court appearance this summer, a swarm of handwriting experts proffered analysis of her blocky courtroom scribbling. "Projecting a false image" and "crossing boundaries," concluded two on celebrity news and entertainment site hollywoodlife.com. Beyond identifying personality traits through handwriting, called graphology, some doctors treating neurological disorders say handwriting can be an early diagnostic tool.

"Some patients bring in journals from the years, and you can see dramatic change from when they were 55 and doing fine and now at 70," says P. Murali Doraiswamy, a neuroscientist at Duke University. "As more people lose writing skills and migrate to the computer, retraining people in handwriting skills could be a useful cognitive exercise."

In high schools, where laptops are increasingly used, handwriting still matters. In the essay section of SAT college-entrance exams, scorers unable to read a student's writing can assign that portion an "illegible" score of 0.

Even legible handwriting that's messy can have its own ramifications, says Steve Graham, professor of education at Vanderbilt University. He cites several studies indicating that good handwriting can take a generic classroom test score from the 50th percentile to the 84th percentile, while bad penmanship could tank it to the 16th. "There is a reader effect that is insidious," Dr. Graham says. "People judge the quality of your ideas based on your handwriting."

Handwriting-curriculum creators say they're seeing renewed interest among parents looking to hone older children's skills—or even their own penmanship. Nan Barchowsky, who developed the Barchowsky Fluent Handwriting method to ease transition from print-script to joined cursive letters, says she's sold more than 1,500 copies of "Fix It ... Write" in the past year.

Some high-tech allies also are giving the practice an unexpected boost through hand-held gadgets like smartphones and tablets. Dan Feather, a graphic designer and computer consultant in Nashville, Tenn., says he's "never adapted well to the keypads on little devices." Instead, he uses a \$3.99 application called "WritePad" on his iPhone. It accepts handwriting input with a finger or stylus, then converts it to text for email, documents or Twitter updates.

And apps are helping Zane Pike—the 4-year-old who refused to practice his letters. The Cabot, Ark., boy won't put down his mom's iPhone, where she's downloaded a \$1.99 app called "abc PocketPhonics." The program instructs Zane to draw letters with his finger or a stylus; correct movements earn him cheering pencils.

"He thinks it's a game," says Angie Pike.

Similarly, kindergartners at Harford Day School in Bel Air, Md., are taught to write on paper but recently also began tracing letter shapes on the screen of an iPad using a handwriting app.

"Children will be using technology unlike I did, and it's important for teachers to be familiar with it," says Kay Crocker, the school's lead kindergarten teacher. Regardless of the input method, she says, "You still need to be able to write, and someone needs to be able to read it."

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