

# Why writing by hand beats typing for thinking and learning

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If you're like many digitally savvy Americans, it has likely been a while since you've spent much time writing by hand.

The laborious process of tracing out our thoughts, letter by letter, on the page is becoming a relic of the past in our screen-dominated world, where text messages and thumb-typed grocery lists have replaced handwritten letters and sticky notes. Electronic keyboards



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offer obvious efficiency benefits that have undoubtedly boosted our productivity — imagine having to write all your emails longhand.

To keep up, many schools are introducing computers as early as preschool, meaning some kids may learn the basics of typing before writing by hand.

But giving up this slower, more tactile way of expressing ourselves may come at a significant cost, according to a growing body of research that's uncovering the surprising cognitive benefits of taking pen to paper, or even stylus to iPad — for both children and adults.

In kids, studies show that tracing out ABCs, as opposed to typing them, leads to better and longer-lasting recognition and understanding of letters. Writing by hand also improves memory and recall of words, laying down the foundations of literacy and learning. In adults, taking notes by hand during a lecture, instead of typing, can lead to better conceptual understanding of material.

"There's actually some very important things going on during the embodied experience of writing by hand," says Ramesh Balasubramaniam, a neuroscientist at the University of California, Merced. "It has important cognitive benefits."

While those benefits have long been recognized by some (for instance, many authors, including Jennifer Egan and Neil Gaiman, draft their stories by hand to stoke creativity), scientists have only recently started investigating why writing by hand has these effects.

A slew of recent brain imaging research suggests handwriting's power stems from the relative complexity of the process and how it forces different brain systems to work together to reproduce the shapes of letters in our heads onto the page.

## **Your brain on handwriting**

Both handwriting and typing involve moving our hands and fingers to create words on a page. But handwriting, it turns out, requires a lot more fine-tuned coordination between the motor and visual systems. This seems to more deeply engage the brain in ways that support learning.

"Handwriting is probably among the most complex motor skills that the brain is capable of," says Marieke Longcamp, a cognitive neuroscientist at Aix-Marseille Université.

Gripping a pen nimbly enough to write is a complicated task, as it requires your brain to continuously monitor the pressure that each finger exerts on the pen. Then, your motor system has to delicately modify that pressure to re-create each letter of the words in your head on the page.

"Your fingers have to each do something different to produce a recognizable letter," says Sophia Vinci-Booher, an educational neuroscientist at Vanderbilt University. Adding to the complexity, your visual system must continuously process that letter as it's formed. With each stroke, your brain compares the unfolding script with mental models of the letters and words, making adjustments to fingers in real time to create the letters' shapes, says Vinci-Booher.

That's not true for typing.

To type "tap" your fingers don't have to trace out the form of the letters — they just make three relatively simple and uniform movements. In comparison, it takes a lot more brainpower, as well as cross-talk between brain areas, to write than type.

Recent brain imaging studies bolster this idea. A study published in January found that when students write by hand, brain areas involved in motor and visual information processing "sync up" with areas crucial to memory formation, firing at frequencies associated with learning.

"We don't see that [synchronized activity] in typewriting at all," says Audrey van der Meer, a psychologist and study co-author at the Norwegian University of Science and Technology. She

suggests that writing by hand is a neurobiologically richer process and that this richness may confer some cognitive benefits.

Other experts agree. "There seems to be something fundamental about engaging your body to produce these shapes," says Robert Wiley, a cognitive psychologist at the University of North Carolina, Greensboro. "It lets you make associations between your body and what you're seeing and hearing," he says, which might give the mind more footholds for accessing a given concept or idea.

Those extra footholds are especially important for learning in kids, but they may give adults a leg up too. Wiley and others worry that ditching handwriting for typing could have serious consequences for how we all learn and think.

## **What might be lost as handwriting wanes**

The clearest consequence of screens and keyboards replacing pen and paper might be on kids' ability to learn the building blocks of literacy — letters.

"Letter recognition in early childhood is actually one of the best predictors of later reading and math attainment," says Vinci-Booher. Her work suggests the process of learning to write letters by hand is crucial for learning to read them.

"When kids write letters, they're just messy," she says. As kids practice writing "A," each iteration is different, and that variability helps solidify their conceptual understanding of the letter.

Research suggests kids learn to recognize letters better when seeing variable handwritten examples, compared with uniform typed examples.

This helps develop areas of the brain used during reading in older children and adults, Vinci-Booher found.

"This could be one of the ways that early experiences actually translate to long-term life outcomes," she says. "These visually demanding, fine motor actions bake in neural communication patterns that are really important for learning later on."

Ditching handwriting instruction could mean that those skills don't get developed as well, which could impair kids' ability to learn down the road.

"If young children are not receiving any handwriting training, which is very good brain stimulation, then their brains simply won't reach their full potential," says van der Meer. "It's scary to think of the potential consequences."

Many states are trying to avoid these risks by mandating cursive instruction. This year, California started requiring elementary school students to learn cursive, and similar bills are moving through state legislatures in several states, including Indiana, Kentucky, South Carolina and Wisconsin. (So far, evidence suggests that it's the writing by hand that matters, not whether it's print or cursive.)

## **Slowing down and processing information**

For adults, one of the main benefits of writing by hand is that it simply forces us to slow down. During a meeting or lecture, it's possible to type what you're hearing verbatim. But often, "you're not actually processing that information — you're just typing in the blind," says van der Meer. "If you take notes by hand, you can't write everything down," she says.

The relative slowness of the medium forces you to process the information, writing key words or phrases and using drawing or arrows to work through ideas, she says. "You make the information your own," she says, which helps it stick in the brain.

Such connections and integration are still possible when typing, but they need to be made more intentionally. And sometimes, efficiency wins out. "When you're writing a long essay, it's obviously much more practical to use a keyboard," says van der Meer.

Still, given our long history of using our hands to mark meaning in the world, some scientists worry about the more diffuse consequences of offloading our thinking to computers.

"We're foisting a lot of our knowledge, extending our cognition, to other devices, so it's only natural that we've started using these other agents to do our writing for us," says Balasubramaniam.

It's possible that this might free up our minds to do other kinds of hard thinking, he says. Or we might be sacrificing a fundamental process that's crucial for the kinds of immersive cognitive experiences that enable us to learn and think at our full potential.

Balasubramaniam stresses, however, that we don't have to ditch digital tools to harness the power of handwriting. So far, research suggests that scribbling with a stylus on a screen activates the same brain pathways as etching ink on paper. It's the movement that counts, he says, not its final form.