

## NEUROSCIENCE

# Handwriting boosts brain connectivity

For learning and memory, pens may be mightier than keyboards

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Writing out the same word again and again in cursive may bring back bad memories for some people, but handwriting can boost connectivity across brain regions that are implicated in learning and memory, a new study shows.

When college students wrote words by hand, connectivity across the brain — particularly in brain waves associated with memory formation — increased compared with when students typed the words, researchers report January 26 in *Frontiers in Psychology*.

The finding shows that “there is a fundamental difference in brain organization for handwriting as opposed to typing,” says neuroscientist Ramesh Balasubramaniam of the University of California, Merced, who was not involved in the research.

It also adds to growing evidence of handwriting’s benefits. Previous research has shown that handwriting improves spelling accuracy, memory recall and conceptual understanding. Scientists think that the slow process of tracing out letters and words gives individuals more time to

process the material and that the intricate movement itself aids learning.

In the new study, psychologists Audrey van der Meer and Ruud van der Weel, both of the Norwegian University of Science and Technology in Trondheim, recruited 36 students from the university and stuck a cap of electrodes on their heads. The researchers asked the students to type or handwrite in cursive with a digital pen a word that appeared on a computer screen. The cap recorded electrical brain activity while participants carried out each task.

In the data, the researchers looked for coherence: two brain areas active with the same frequency of electrical waves at the same time. Scientists use brain activity to calculate coherence between brain areas, which can indicate how strongly those areas are connected.

Handwriting but not typing showed coherence. Relative to typing, handwriting increased activity in low-frequency alpha and theta waves in brain areas associated with learning, the team found. Handwriting also increased connectivity across central brain regions, many of which are

implicated in memory, and across parietal regions, which are involved in sensory and motor processing.

The findings suggest that distinct processes of brain activation happen while a person types or writes. Even with very similar movements, “the activation seems much, much higher in handwriting,” Balasubramaniam says. “There’s more involvement of these brain regions when you’re handwriting.”

Van der Meer and van der Weel think this boost may facilitate learning because these particular waves between these specific brain regions are implicated in memory formation. But since the study did not test whether participants remembered the words, it’s unclear how the increased activity impacts learning, says psychologist Kathleen Arnold of Radford University in Virginia. The study “warrants some follow up to see what exactly is causing those connectivity differences and whether or not they reflect learning outcomes.”

The unique movement required to type or write could explain the differences, Balasubramaniam says. But “we’ve got to start somewhere, and these are the first results to actually show that these two things have different brain activation patterns.”

Handwriting may help with learning processes, but typing is often faster and more practical. Students and teachers should therefore consider the task at hand when deciding to handwrite or type, van der Meer says. For example, taking notes by hand may help retain information better while typing an essay may be easier.

Despite the need for more studies to determine optimal learning strategies, experts say that handwriting shouldn’t be left behind in the digital age. Schools “need to bring in more writing into curriculum design,” Balasubramaniam says.

In California, a recently enacted law requires students in first through sixth grade to learn cursive writing. The new study and others like it could give fodder for similar legislation elsewhere.

Writing is also part of our cultural heritage, van der Meer notes. The ability to write a grocery list or a love letter, she says, “is important for us humans.” ■



In an experiment, college students in Norway typed and handwrote words they saw on a screen while electrodes monitored their brain activity. Compared with typing, handwriting boosted connectivity across brain regions implicated in learning and memory, researchers found.