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Improve Reading & Hand-eye Coordination by Learning Cursive?

Accurate high-speed visual tracking is useful for reading and fine motor skills

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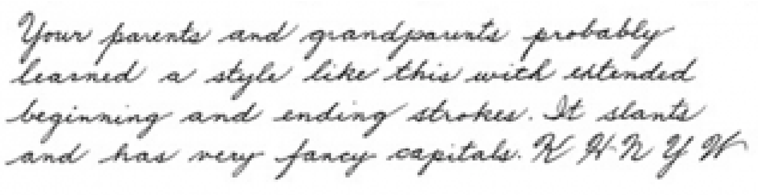
When directing the writing by hand, the brain has to visually track rapidly changing positions of the pencil and control hand and finger movements. To learn such skills, the brain must improve its control over eye-movement saccades and the processing of visual feedback to provide corrective feedback. Both tracking and movement control require much more engagement of neural resources in producing cursive or related handwriting methods than in hand printing, because the movements are more complex and nuanced. Thus, learning cursive is a much greater neural activator, which in turn must engage much more neural circuitry than the less demanding printing.

The key to learning successful handwriting, whether cursive, italics, or calligraphy, is well-controlled visual tracking and high-speed neural responses to the corrective feedback. Scientists are now starting to study the mechanisms, but not yet in the context of education. Two recent reports, seemingly unrelated to each other or to cursive, examined visual tracking and found results that could have

Visual targets are fixed by saccades. One theory is that the eyes scan the target with a linked series of saccades, in this case the changes in cursive letter structure as the letters are being rapidly formed. We already know that the brain predicts eye movements based on what they see at each saccade fixation. This is how our visual world is made stable, even though the eyes are flicking around; otherwise, the image would jitter back and forth constantly. This suggests that visual image representation is integrated rapidly over many successive saccades. The degree of tracking speed, accuracy, and prediction error must surely influence how well the letters are transcribed during handwriting. The corollary is that the better one learns to write by hand, the better the brain is learning how to track visually.



Scientists used to think that these predictions were the source of error in estimating the position of seen objects. In handwriting, for example, the brain would assess the shape of part of a letter as you draw it and predict how and where the next portion of the letter should be added. Learning how to optimize the drawing then would be a matter of learning how to reduce prediction errors.

However, a new study tested the hypothesis that if localization errors really are caused by faulty predictions, you would also expect those errors to occur if an eye movement, which has already been predicted in your brain, fails to take place at the very last moment in response to a signal to abort the eye movement. The investigators (Atsma et al. 2014) asked test subjects to look at a computer screen and tracked eye movement fixation on a very small ball that appeared at various random positions. During this task, the brain must correctly predict where the eyes have to move to keep the eye on the ball.

The experiment ended with one last ball on the screen, followed by a short flash of light near that ball. The person had to look at the last stationary ball while using the computer mouse to indicate the position of the flash of light. However, in some cases, a signal was sent around the time the last ball appeared, indicating that the subject was NOT allowed to look at the ball. In other words, the eye movement was cancelled at the last moment. The person being tested still had to indicate where the flash was visible.

Subjects did not make any mistakes in fixation on the light location during the abortion test, even though the brain had already predicted that it needed to fixate on the ball. Most mislocations occurred when the flash appeared at the moment the eye movement began. Thus, the errors seemed to be associated with neural commands for eye fixation, not with saccade predictions. The application for handwriting learning is that the neural circuits that control target fixation may be a major factor in learning how to write cursive well. Surely, these circuits would be responsive to training, though that was not done in this experiment. It would seem possible that these circuits might be trained via learning cursive to provide faster and more accurate visual tracking, which should have other benefits—as in reading.

A related study of visual tracking in monkeys reveals parallel processing during visual search (Shen and Paré. 2014). Recordings from neurons in the visual pathway during visual tracking of targets in a distracting field showed that in the untrained state, these neurons had indiscriminate responses to stimuli. However, with training the neuronal function evolved to predict where the moving target should be in advance of the actual saccade. Results also showed that more than half the neurons learned to predict where the next two eye movements (saccades) needed to be, which obviously suggests that accurate tracking can be accelerated without loss of information.

In short, learning cursive should train the brain to function more effectively in visual scanning. Theoretically, reading efficiency could benefit. I predict that new research would show that learning cursive will improve reading speed and will train the brain to have better hand-eye coordination. In other words, schools that drop cursive from the curriculum may lose an important learning-skills development tool. The more that students acquire learning skills, the less will be the need for "teaching to the test."

"Memory Medic's" latest books are Mental Biology (Prometheus) and Memory Power 101 (Skyhorse).

Sources:

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Shen, Kelly and Paré, Martin. 2014. Predictive saccade target selection in superior colliculus during visual search. The Journal of Neuroscience, 16 April 2014, 34(16): 5640-5648; doi: 10.1523/JNEUROSCI.3880-13.2014