

New software helps analyze writing disabilities

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Credit: AI-generated image (disclaimer)

Nearly 10% of elementary school students have trouble learning to write, with potentially lasting consequences on their education. EPFL researchers have developed a software program that can analyze these children's writing disabilities and their causes with unparalleled precision.



Trouble learning how to write, called dysgraphia, affects some 10% of schoolchildren. This learning disability is often associated with dyslexia and can appear in children to varying degrees, with causes that can differ from one child to the next. A team of researchers at EPFL's Computer-Human Interaction in Learning and Instruction Laboratory (CHILI) has developed software that enables doctors to make highly detailed, personalized assessments of this disability and to accurately identify the letters and numbers that are most difficult and are thus the most discriminative. Their research has just been published in *Nature Digital Medicine*.

Writing is an essential skill for schoolchildren, but it requires an adroit combination of careful concentration, well-developed motor skills and good language comprehension – something that not all children possess. And although writing problems may appear trivial at first, if they are not treated early on, they could quickly snowball into more serious conditions like a lack of confidence, low self-esteem, trouble learning other skills, a high level of fatigue and even behavioral problems. Early detection is therefore key.

In French-speaking countries, dysgraphia is currently diagnosed using a standardized writing test called BHK. Ergotherapists or psychomotor therapists use the test to assess a child's handwriting according to 13 criteria. But according to Thibault Asselborn, a Ph.D. student at CHILI and lead author of the study, the BHK test is limited. "It relies entirely on a therapist's own observation and is therefore subjective. And it can be six months or more between when a teacher first becomes concerned about a child's writing skills and when the child is finally taken to a specialist."





Example of a disgraphic child's handwriting. Credit: Ecole Polytechnique Federale de Lausanne

Analyzing over 50 different characteristics

The test developed at EPFL, called Tegami, which is run using a tablet computer, represents a major step forward in terms of analytical precision and accuracy of input. It was developed from a database of writing samples from 300 children, around 25% of whom suffered from dysgraphia. The program was able to detect the learning disability 98% of the time.

The big advantage of Tegami is that it can help pinpoint the cause of a child's dysgraphia because it analyzes no fewer than 53 different



characteristics of a child's writing, which are measured up to 200 times per second. These characteristics include the angle of the pen, the amount of pressure the child applies to the tablet, how fast the child writes and any changes in that speed, whether the child's hand trembles and if so, with what frequency, and which letters or characters are most discriminative.

A dynamic assessment

"Our software brings a dynamic aspect to the evaluation of a child's writing. The BHK test lets therapists evaluate a writing sample only after it's been written. But with Tegami, therapists can analyze the entire writing process and get a clear, comprehensive picture of all of a child's movements," says Thomas Gargot, a child psychiatrist, expert in cognitive science, Ph.D. student in computer science at Pitié Salpêtrière teaching hospital in Paris and one of the study's authors.

According to Gargot, the software also paves the way to classifying different kinds of <u>dysgraphia</u>. The new types of data it collects will enable pediatricians to determine whether there are writing disabilities associated with autism, hyperactivity or <u>attention deficit disorder</u>, and to better understand how teaching methods can be adapted accordingly.

Tegami should also help children with writing disabilities get more targeted treatment. The EPFL researchers are now working with psycho motor therapists and speech therapists to outline remedial measures; for example, if a child shows too much variation in the pressure he puts on his pen, his doctor can prescribe motor-skill exercises. The researchers are also looking into how they can combine Tegami with another program developed at CHILI called CoWriter, where children improve their skills and self-confidence by teaching a robot how to write.

More information: Thibault Asselborn et al. Automated human-level



diagnosis of dysgraphia using a consumer tablet, *npj Digital Medicine* (2018). DOI: 10.1038/s41746-018-0049-x

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