Rapid detection of dysgraphia

A new tool allows for fast, low-cost and precise diagnosis

by Thibault Asselborn
June 20, 2018

Even with proper training, up to one-third of children never truly master the skill of handwriting. In some cases, their difficulties are associated with severe cognitive deficiencies. In others, they may be due to temporary external factors such as anxiety or stress. In either case, difficulty with the motor process of writing may affect a child’s entire life, as it undermines performance and self-confidence in a wide variety of school activities.

Early detection of dysgraphia has been shown to facilitate effective treatment. Diagnosis is not difficult; children are asked to copy a standard text, which is then evaluated based on a predefined set of features. In French-speaking countries, the “BHK test” (The Concise Assessment Scale for Children’s Handwriting) is widely used for diagnosing dysgraphia. This test is recognized by health insurance companies, which pay the costs of both diagnosis and treatment.

But when it comes to diagnosing dysgraphia with the help of the BHK test, a number of difficulties may arise. These are related to the amount of time required for scoring the tests, variability across evaluators, and most notably the time lag – often a period of 6 months or more – between initial concerns about a child’s handwriting and the opportunity to consult with an expert.

To address these issues, my lab has developed a digital version of the BHK test that can be administered on a tablet computer. Based on data from over 1,000 children, we created a machine-learning algorithm to predict dysgraphia that correctly identifies about 95% of children diagnosed as “dysgraphic” using the conventional version of the BHK test.

The main advantage of this tablet-based system is that it captures the dynamic features of writing, such as velocity, acceleration, pressure and pen tilt – something a human expert is unable to do. The tablet-based data are analyzed using a recurrent neural network, a powerful instrument for dealing with sequential data, which generates very sophisticated measures for identifying dysgraphia.

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Our results also show that writing on a tablet, even a high-quality one, differs in some respects from writing on paper. However, this problem can be addressed by attaching a sheet of paper to the tablet to create a more natural writing environment during testing.

This low-cost (but high-tech) test might pave the way to the systematic diagnosis of dysgraphia in schools. However, we are not seeking to contribute to the rampant medicalization of education or
to the labeling of students, which is becoming increasingly common. Instead, our aim is to minimize the impact of dysgraphia on children’s school experiences by providing a rapid, simple and cheap diagnostic tool that will allow for earlier remediation.

This tool can be employed in conjunction with other screening tests that are already in use in schools, such as auditory and ophthalmologic tests, facilitating the early detection and remediation of handwriting issues.

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But what is more, our tool provides deeper insight into handwriting pathology than existing tests do, allowing for the analysis of the factors that account for imperfections in an individual’s handwriting. This novel aspect of assessing handwriting quality in greater detail may be of great therapeutic value, especially for remediation.

The new features of our test make it possible to reach a more specific diagnosis rather than a simple binary determination of dysgraphia. This will permit clinicians to focus on specific remediation exercises, aimed for example at increasing the stability of the pen tilt or adjusting the amount of pressure exerted on the pen. These factors are crucial for proficient handwriting.

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