Improving reading skills through action video games

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What if video games, instead of being an obstacle to literacy, could actually help children improve their reading abilities? A team from the University of Geneva (UNIGE) has joined forces with scientists from

the University of Trento in Italy to test an action video game for children, which would enhance reading skills. The results, published in the journal *Nature Human Behaviour*, demonstrate improved reading abilities after just twelve hours of training. Notably, these gains persist over time, to the point that language school grades are seen to improve more than a year after the end of training.

Decoding letters into sound is a key point in learning to read, but is not enough to master it. "Reading calls upon several other essential mechanisms that we don't necessarily think about, such as knowing how to move our eyes on the page or how to use our working memory to link words together in a coherent sentence," says Daphné Bavelier, a professor in the Psychology Section of the Faculty of Psychology and Educational Sciences (FPSE) at the UNIGE. "These other skills, such as vision, the deployment of attention, working memory, and cognitive flexibility, are known to be improved by action video games," says Angela Pasqualotto, first author of this study, which is based on her Ph.D. thesis at the Department of Psychology and Cognitive Science of the University of Trento under the direction of Professors Venuti and De Angeli.

A child-friendly action video game to support learning

With this in mind, a video game was designed that combines action video games with mini-games that train executive functions such as working memory, inhibition and cognitive flexibility, functions that are called upon during reading. "The universe of this game is an alternate world in which the child, accompanied by his Raku, a flying creature, must carry out different missions to save planets and progress in the game," Angela Pasqualotto says.

The idea is to reproduce the components of an action game without incorporating violence so that it is suitable for young children. "For example, the Raku flies through a meteor shower, moving around to avoid those or aiming at them to weaken their impact, while collecting useful resources for the rest of the game, a bit like what you find in action video games."

The scientists then worked with 150 Italian schoolchildren aged eight to 12, divided into two groups: The first one played the video game developed by the team, and the second one played Scratch, a game that teaches children how to code. Both games require attentional control and executive functions, but in different manners. The action video game requires children to perform tasks within a time limit such as remembering a sequence of symbols or responding only when the Raku makes a specific sound while increasing the difficulty of these tasks according to the child's performance. Scratch, the control game, requires planning, reasoning and problem-solving. Children must manipulate objects and logical structures to establish the desired programming sequence.

"First, we tested the children's ability to read words, non-words and paragraphs, and also we conducted an attention test that measures the child's attentional control, a capacity we know is trained by action video games," explains Daphne Bavelier. The children then followed the training with either the action video game or the control game for two hours per week for six weeks under supervision at school. Children were tested at school by clinicians of the Laboratory of Observation Diagnosis and Education (UNITN).

Long-term improvement in reading skills

Shortly after the end of the training, the scientists repeated the tests on both groups of children. "We found a seven-fold improvement in

attentional control in the children who played the action video game compared to the control group," says Angela Pasqualotto. Even more remarkably, the research team observed a clear enhancement in reading, not only in terms of reading speed, but also in accuracy, whereas no improvement was noted for the control group. This improvement in literacy occurs even though the action video game does not require any reading activity.

"What is particularly interesting about this study is that we carried out three further assessment tests at six months, 12 months and 18 months after training. On each occasion, the trained children performed better than the control group, which proves that these improvements were sustained," Angela Pasqualotto says. Moreover, the grades in Italian of the trained children became significantly better over time, showing a virtuous improvement in learning ability. "The effects are thus long-term, in line with the action video game strengthening the ability to learn how to learn," says Daphne Bavelier.

The game will be adapted into German, French and English. "When reading, decoding is more or less difficult depending on the language. Italian, for example, is very transparent—each letter is pronounced—whereas French and English are quite opaque, resulting in rather different learning challenges. Reading in opaque languages requires the ability to learn exceptions, to learn how a variety of contexts impacts pronunciation and demands greater reliance on memorization," says Irene Altarelli. Will the benefits of action video games on reading acquisition extend to such complex learning environments as reading in French or English? This is the question that this study will help answer. In addition, the video game will be available entirely at home, remotely, as will the administration of reading and attention tests, in order to complement school lessons, rather than taking time out of school hours.

More information: Angela Pasqualotto, Enhancing reading skills

through a video game mixing action mechanics and cognitive training, *Nature Human Behaviour* (2022). DOI: 10.1038/s41562-021-01254-x. www.nature.com/articles/s41562-021-01254-x

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