

10% Students may have working memory problems: Why does it matter?

By: Dr. Tracy Alloway

Working memory is our ability to store and manipulate information for a brief time. It is typically measured by dual-tasks, where the individual has to remember an item while simultaneously processing a sometimes unrelated piece of information. A widely used working memory task is the reading span task where the individual reads a sentence, verifies it, and then recalls the final word. Individual differences in working memory performance are closely related to a range of academic skills such as reading, spelling, comprehension, and mathematics. Crucially, there is emerging research that working memory predicts learning outcomes independently of IQ. One explanation for the importance of working memory in academic attainment is that because it appears to be relatively unaffected by environmental influences, such as parental educational level and financial background, it measures a student's capacity to acquire knowledge rather than what they have already learned.

However little is known about the consequences of low working memory capacity per se, independent of other associated learning difficulties. In particular, it is not known either what proportion of students with low working memory capacities has significant learning difficulties or what their behavioral characteristics are. The aim of a recent study published in *Child Development* (reference below) was to provide the first systematic large-scale examination of the cognitive and behavioral characteristics of school-aged students who have been identified solely on the basis of very low working memory scores.

In screening of over 3000 school-aged students in mainstream schools, 1 in 10 was identified as having working memory difficulties. There were several key findings regarding their cognitive skills. The first is that the majority of them performed below age-expected levels in reading and mathematics. This suggests that low working memory skills constitute a high risk factor for educational underachievement for students. This corresponds with evidence that working memory impacts all areas of learning from kindergarten to college. It is a basic cognitive skill that we need to perform a variety of activities, and we use it in core subjects like reading and maths, as well as general topics like Art and Music. Crucially, this pattern of poor performance in learning outcomes remains even when students' IQ is statistically accounted.

This fits well with evidence suggesting that working memory is even more important to learning than other cognitive skills such as IQ. For example, in typically developing students, I found that their working memory skills, rather than IQ, at 5 years old were the best predictor of predictor of reading, spelling, and math outcomes six years later.

The next major finding from the studies of students with working memory difficulties is that teachers typically judged the students to be highly inattentive, and have short poor attention spans and high levels of distractibility. They were also commonly described as forgetting what they are currently doing and things they have learned, failing to remember instructions, and failing to complete tasks. In everyday classroom activities, they often made careless mistakes, particularly in writing, and had difficulty in solving problems. In contrast, relatively few of the students were judged to exhibit the high levels of hyperactive and impulsive behaviors.

The final key finding is that students with working memory difficulties take a much longer time to process information. They are unable to cope with timed activities and fast presentation of information. As a result, they often end up abandoning the activities all together out of frustration. One way to overcome this difficulty is to provide them with a shorter activity and to allow for more time during tests.

Studies such as these demonstrate that students with working memory difficulties have an extremely high risk of making poor academic progress and are relatively common in the classroom — they represent approximately 10% of their age group in mainstream schooling. Without early intervention, working memory deficits cannot be made up over time and will continue to compromise a child's likelihood of academic success.

How can we support students' learning? The first crucial step in supporting students with working memory impairments is proper diagnosis, which can be conducted by a school psychologist. However, at present working memory problems often go undetected in students or are misdiagnosed as attentional problems. There are several test batteries that can be used to assess working memory, including the Working Memory Index in the WISC. However, most assessment instruments that are currently available require considerable experience in the administration, scoring and interpretation of cognitive tests. One useful tool to identify and support students with working memory impairments is the Automated Working Memory Assessment (AWMA; Alloway, 2007 published by Pearson). The benefit of the AWMA is that it is designed to provide a practical and convenient way for non-expert assessors such as teachers to screen their pupils for significant working memory problems, with a user-friendly interface. The automated presentation and scoring of tasks provide consistency in presentation of stimuli across participants, thus reducing experimenter error. The AWMA was used in the study described here, as well as in numerous peer-reviewed journal articles on the role of working memory in learning, anxiety, and development in typical and clinical populations.

The main goal of this article was to explore the link between working memory and academic performance. On the basis of a large-scale screening study of over 3000 student, 10% were found to have working memory impairments that jeopardize their chance of academic success. The majority perform below age-expected levels in all areas of learning and struggle to follow simple instructions in the classroom. These difficulties highlight the need for early assessment to identify those at risk. In a future article, I will discuss ways to help students with working memory problems, including clinical trials demonstrating successful transfer of cognitive training to academic attainments.



Reference: Alloway et al. (2009). The cognitive and behavioural characteristics of children with low working memory. *Child Development*, 80, 606–621.

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