Working Memory and Mental Health: 
A Primer for the Mental Health Professional

By Stephen Morgan, Ph.D. & Jerrod Brown, Ph.D.

Abstract

Working memory is an active and integrative stage in the human memory system. This is not simply a passive storage bin for information on its way to long-term storage. Instead, working memory is an essential component in the processes of perception and encoding meaningful episodic events. This includes playing a critical role in attending to and analyzing incoming information. Deficits in working memory are associated with many cognitive and mental health challenges. The degree that treatment and training help with addressing deficits depends on the similarity of the training regimen to the to-be-generalized task. This article is intended to provide mental health professionals with a basic overview of working memory.

Introduction

Arising from the field of cognitive psychology, the traditional model of memory will be familiar to the reader. This so-called modal model, developed by Atkinson and Shiffrin (1968), posits that the human memory system is not a single system, but rather the product of different quasi-independent sub-systems. These subsystems include sensory
memory, short-term memory, and long-term memory. These memory systems represent and store information serially. Information is initially held in sensory memory, transferred to short-term memory, and finally stored in long-term memory. Sensory memory is the initial fleeting mental representation of a visual, auditory, or another stimulus. This representation is not analyzed for meaning but is instead simply a structural representation that lasts about 200 milliseconds (Sperling, 1960). Following sensory memory, the attended information is transferred to the short-term memory, where conscious analysis of the information occurs. The information in this representational state has an acoustic code and is of limited capacity (i.e., 7 plus or minus 2; Miller, 1956) and duration without rehearsal (i.e., about 18 seconds; Peterson & Peterson, 1959). Finally, after conscious evaluation and additional attentional allocation, the information is transferred to long-term memory, which is essentially capacity free and of a very long duration.

The modal memory model discussed above has been altered in recent years. Specifically, this change accommodates evidence that short-term storage is not simply a passive storehouse, but rather the point at which various control processes occur. For instance, this is the stage that mental processes such as conscious awareness, attention, and rehearsal integrate new information with information that has been stored in long-term memory. With this integrated information, decision making, and goal directedness occur. To recognize the active nature of the cognition involved, the field has embraced the term working memory to categorize the events at this stage (Baddely & Hitch, 1974).

Just as the conception of memory in general is comprised of several subsystems, working memory has also been theorized to incorporate several subcomponents (Baddely, 1990). First, the visual spatial sketchpad is responsible for visual information in three-dimensional space. Second, the phonological loop is responsible for the processing and maintenance of auditory information. Third, the episodic buffer represents recent autobiographical information and can integrate information from different sources to bring meaning to presently experienced events. Finally, the central executive directs attention, maintains focus, and drives goal satisfaction.

Executive functioning has been related to a number of tasks demanding mental control and attention. This was tested in a study by exposing participants to different streams of verbal information through headphones (i.e., each ear hearing a different message) and instructing a participant to pay attention to only one stream. Participants with high working memory capacity were less likely to detect their name in the unattended ear. This suggests that high working memory performance is associated with a stronger central executive focus (Conway, Cowan, & Bunting, 2001).

Other researchers have examined the relationship between working memory and attentional allocation. Thomson, Besner, and Smilek (2015) investigated mind wandering. Based on this work, they proposed a resource control theory that posits people have a fixed and limited amount of attention that they can allocate to a task. Mind wandering consumes some of these resources leading to impaired task performance. Typically, our central executive focusses our attention effectively on novel or challenging tasks. However, as we continue to work on a task, central executive resources become depleted and we become susceptible to mind wandering.

As suggested above, deficits in working memory can lead to poor attendance to environmental information that is necessary to maintain a visual-spatial, auditory, or episodic representation in working memory. As we have seen, working memory serves to integrate information into an episodic, wholistic, and meaningful conscious
representation upon. In turn, this is used to guide how we think and act according to current goals. Working memory deficits can present problems associated with focus, attention, integration of the multiple aspects of a stimulus (e.g., auditory and visual components of a speaking person), maintaining goal directedness over time, and avoiding thought wandering.

Indeed, working memory deficits have been associated with a long list of cognitive and mental health challenges. Some of these include schizophrenia (Goldman-Rakic, 1994), attention deficit hyperactivity disorder (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005), and post-traumatic stress disorder (Honzel, Justus, & Swick, 2014) among many others. Such working memory difficulties can impact a variety of learning difficulties in developing children. Examples of tasks that may be negatively affected include mental arithmetic, verbal instructions, remembering directions, difficulty getting started on a task, staying on task, and avoiding mental intrusions and mind wandering.

The question of whether we can improve working memory through treatment and training is often debated and has been examined in many studies. Brain scientists seem equally divided on the issue. This is perhaps owing to the issue of generalization of improvements seen from the training task (e.g., practice on short-term memory tasks, or, in other studies, sustained attention tasks), to a myriad of other cognitive tasks requiring working memory. Presently, it appears that there is clear evidence of improvement on the training task, some improvement on closely related tasks, and little to no improvement on broadly generalized tasks (Simons et al., 2016).

Conclusion

As discussed in this article, working memory is an active and integrative stage in the human memory system. This is not simply a passive storage location for information on its way to long-term memory. Instead, working memory is an essential component in the processes of perception and encoding meaningful episodic events. This includes playing a critical role in attending to and analyzing incoming information. Deficits in working memory are associated with many cognitive and mental health challenges. The degree that treatment and training help with addressing these deficits depends on the similarity of the training regimen to the to-be-generalized task. As such, mental health professionals interested in increasing their understanding of working memory and its implications for the mental health field should consider reviewing the peer-reviewed research literature on related topics on a regular basis. In addition, mental health professionals are encouraged to attend continuing education training programs related to working memory. Finally, collaboration and consultation with other mental health professionals who are subject-matter experts in the area of working memory should be considered.
Author Biographies

Stephen Morgan, Ph.D. is a professor of psychology at Concordia University, St. Paul, and coordinator of the psychology and sociology programs at Concordia. He earned his Ph.D. in cognitive psychology from the University of Wisconsin – Madison, and was subsequently a McDonnell-Pew Fellow in Cognitive Neuroscience at the University of California, San Diego. He has been a faculty member at Concordia for 21 years and teaches cognitive psychology, physiological psychology, sensation and perception, and research methods with statistical applications, among other classes.

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References


