Journal of Applied Research in Memory and Cognition

ISSN: 2211-3681

2022, Vol. 11, No. 4, 485–488
https://doi.org/10.1037/mac0000092

COMMENTARY

Correcting Memory Failures: Some Additions

Henry L. Roediger III and Olivia L. Jäggi
Department of Psychological and Brain Sciences, Washington University in St. Louis, United States

Keywords: Absentmindedness, inattentional blindness, memory competitors, memory palace, method of loci

Schacter (2022) has provided an impressive update on what he has called the seven sins of memory. He covers a wide range of research, and of course his recent book (Schacter, 2021) provides an even more comprehensive update. In our brief article, we will provide elaborations on three of the topics Schacter discussed.

Absentmindedness

Schacter's use of absentmindedness refers to several different conditions, though we will focus on one, namely, the failure to pay attention to some feature of the environment, even on its repeated exposure. Others have referred to this lapse as inattentional blindness (Mack & Rock, 1998) or even inattentional amnesia (Wolfe, 1999). This phenomenon occurs when people fail to retrieve information to which they have been repeatedly exposed, as in Nickerson and Adam's (1979) famous demonstration of how difficult it is for most people to recognize a penny on a test with a real penny embedded among plausible alternatives.

Castel et al. (2012) showed that this phenomenon could potentially be dangerous when people fail to retrieve a life-saving device to which they have been exposed to many times. They asked 54 faculty, staff, and students whose offices were in the University of California at Los Angeles psychology building to describe the location of the nearest fire extinguisher and asked for their confidence on a 10-point scale, where 10 was *extremely high confidence* and 1 was *extremely low confidence*. Only 24% of the participants could correctly locate the fire extinguisher, and even they reported relatively low confidence in their selections—an average rating of 4.4—despite having passed the fire extinguisher dozens, if not hundreds of times (see Figure 1, in the article). However, most people could find the fire extinguisher reasonably quickly when exiting their office, showing that with the goal of finding a bright red object on the wall, they could do so. Furthermore, when a subset of participants was given a surprise retest 2 months later, 100% knew the location. Castel et al. attributed the improvement to the original surprising failure, which led to good encoding (Kornell et al., 2009) and then retrieval practice (Karpicke & Roediger, 2008). Castel et al. recommended that a good practice would be to make people explicitly aware of objects in their environment that may save one's own life and that of others (e.g., fire alarms, fire extinguishers, defibrillation devices).

Antitransience

Schacter (2022) refers to forgetting as transience and methods for producing good retention as antitransience; we will largely adhere to the more straightforward terms here. He mentions retrieval practice (e.g., Karpicke & Roediger, 2008; McDermott, 2021) as one promising technique. We agree, of course, but we would especially recommend the technique of successive relearning (Rawson & Dunlosky, 2022). In this technique, students learn a set of material (say, U.S. states and their capital cities) to the criterion of one perfect recall through successive study and test trials (i.e., study-test, study-test). A drop out method can be used, such that when an item has been recalled correctly once or twice, it is dropped from the set. Once all the items have been successfully recalled once, students are tested and given feedback. The procedure is then repeated after a time delay (3 days, a week), and students learn all the pairs again, to one correct recitation. The process is repeated again with a longer time delay, say 2 weeks, and so on. Eventually students will learn all the items and be able to maintain their knowledge over time, although periodic retests would be advisable. In this manner, students can learn information that they must know, such as a would-be neurologist learning all parts of the nervous system and brain. Rawson and Dunlosky (2022) review studies showing that successive relearning is particularly powerful for long-term retention. Of course, cognitive psychologists have evidence for many other facts that enhance retention, too (Brown et al., 2014).

Also under antitransience, Schacter discusses people with HSAM, or Highly Superior Autobiographical Memory (e.g., LePort et al., 2012). These individuals are fascinating for their ability to remember experiences of their own lives quite well, yet they show ordinary performance on standard laboratory tasks (e.g., Patihis et al., 2013). This difference between their autobiographical memory and episodic memory on lab tasks agrees with other

Henry L. Roediger III https://orcid.org/0000-0002-3314-2895

The authors appreciate the comments of Kathleen McDermott and Chris Zerr.

Henry L. Roediger III played the lead role in writing of original draft and writing of review and editing. Olivia L. Jäggi added insightful comments on the article and helped with the original review.

Correspondence concerning this article should be addressed to Henry L. Roediger III, Department of Psychological and Brain Sciences, Washington University in St. Louis, Box 1125, St. Louis, MO 63105, United States. Email: roediger@wustl.edu

research showing differences in normal people on these tasks (see Roediger & McDermott, 2013). A meta-analysis performed by McDermott et al. (2009) examined regions identified in functional magnetic resonance imaging (fMRI) studies of autobiographical memory tasks and those using standard laboratory memory tasks, and they found that the two types of tasks showed minimal overlap in brain regions that were reported. This indicates that autobiographical memory for life experiences and episodic memory for lab tasks may rely on different brain networks (see Chen et al., 2017).

Although HSAM individuals are interesting (and poorly understood), it is a condition that one apparently either has or does not have. More relevant lessons in improving memory for most of humankind comes from another group of individuals, namely, those who compete in memory tournaments (the competitors are sometimes called memory athletes). These individuals have learned the classic mnemonic techniques known since the time of the ancient Greeks: they use the method of loci and "memory palaces," which are essentially the method of loci with an extremely large number of locations (Foer, 2011). A person first learns a set of spatial locations in a familiar place (e.g., in one's house). When encoding a large set of information, one then converts the to-be-remembered items into images and forms interactive images or associations between the locations in one's mental map and the new pieces of information: the locations in the map subsequently serve as retrieval cues to prompt recall of the new information. This description is, in brief, the rationale in most mnemonic techniques. Though simple and seemingly straightforward, masters of these techniques can perform amazing memory feats. Although we discuss memory competitors here, these techniques can be used by anyone as a means to retrieve large amounts of information when it is needed.

Memory competitors have developed many tasks on which they test themselves in memory championships without the help (or hindrance) of psychologists. One such task is what they call "spoken numbers," but which is better known to psychologists as the memory span task. Digits are spoken at the rate of one per second and the task is to recall as many digits, in order, as possible. As is well-known to psychologists, the basic capacity for remembering digits in this task is around 7, ±2 (Miller, 1956), although Ericsson et al. (1980) showed that after 230 hr of deliberate practice in the laboratory, one subject was able to raise his memory span from 7 digits to 79 digits. He learned to use a self-made mnemonic system in which he translated digits into running times (he was an accomplished runner). Ericsson et al. (1980) reported this impressive feat, which was duly celebrated in the pages of *Science*. However, consider the performance of memory competitors on the same task: U.S. memory athlete Lance Tschirhart broke the World Record in spoken numbers (digit span) in 2015 by recalling 456 digits in perfect order! That record is amazing in itself (remember, the digits are spoken at 1/s), yet the record was broken a few years later by Ryu Song I, a young woman from the Democratic Peoples' Republic of Korea (North Korea), who was able to recall 547 digits in order; she is currently (2022) the world memory champion (*Ryu Song I. World Memory Statistics, n.d.*). Another event hosted by the World Memory Championship that may sound familiar to psychologists is the "random words" task: when given 15 min to study and later recall (in serial order) a list of random words, Prateek Yadav of India produced 335. World records for other events can be found at http://www.world-memory-statistics.com/disciplines.php.

Elite memory athletes have high IQs; Konrad (2014) measured the IQ of 28 memory competitors and found it to be 131.5; in addition, they have greater processing speed than control subjects equated on IQ, which is likely more important. However, even college students show impressive gains after only a small amount of training: in one study, Purdue University undergraduates recalled nearly three times as many words in order with minimal training in mnemonic techniques as did a control group given standard instructions to form individual visual images for items (Roediger, 1980). Certainly, with some practice, most everyone could greatly improve their abilities.

Cognitive psychologists studying memory have shown a surprising lack of interest in studying mnemonic devices and their application (but see Worthen & Hunt, 2011), although this situation is beginning to change. For example, Wagner et al. (2021) studied 17 memory athletes (all ranked among the top 50 in the world), and 16 controls matched on fluid intelligence. They also examined 50 controls initially unfamiliar to memory training with matched controls while the experimental group learned to use the method of loci. Results showed much superior recognition and free recall performance for the subjects using mnemonics. In addition, the authors used fMRI during encoding and recognition testing and showed differences in several brain regions in memory competitors relative to controls (see Dresler et al., 2017). They also showed that as naïve subjects learned the method of loci, their pattern of brain activations began to resemble that of the expert competitors.

The first author of this comment was involved in organizing the Extreme Memory Tournament (or XMT) in San Diego, along with David Balota, Kathleen McDermott, Mary Pyc and memory athletes Nelson Dellis and Brad Zupp. The XMT was a collaboration between Dart NeuroScience and Washington University in St. Louis. We have studies of memory athletes (not yet published), but the main point for this comment is that a number of memory athletes began using mnemonics for practical purposes, particularly in enhancing learning in their university or graduate education. For example, Alex Mullen learned mnemonics to help him in medical school and, along the way, won the World Memory Championship three times, 2015–2017 (see Alex Mullen [memory athlete], 2022).

Many resources exist to help people learn to use mnemonics, such as books for adults by Dellis (2018) and Lorayne and Lucas (1996), and for children by Zupp (2013) and Dellis and Stilwell (2020). Mullen Memory (n.d.) is another excellent (and free) resource (https://mullenmemory.com/). If we taught mnemonics from a young age, we might greatly improve students' abilities to retrieve information, as well as permit them to devise memory solutions for other issues in life. Worthen and Hunt (2011, Chapters 7 and 8) review evidence about use of mnemonics in education and cognitive rehabilitation.

Hyper-Transience

Hyper-transience refers to fast forgetting. Schacter (2022) reviews fascinating studies of epileptic patients who show normal retention for 30–60 min, but rapid forgetting thereafter (accelerated long-term forgetting, or ALF). He also reviewed Ricci et al.'s (2019) impressive finding that retrieval practice could reduce forgetting in people exhibiting ALF, at least in story recall.

Another example of fast forgetting has been reported by Zerr et al. (2018), albeit in a different paradigm. They had 281 MTurk subjects

learn two lists of 45 Lithuanian-English word pairs to the criterion of having gotten all pairs correct. A drop out procedure was used, such that when subjects correctly recalled an English word when cued with its Lithuanian equivalent, it was dropped from future study and test lists. Subjects continued to study and be tested on an ever-shrinking list until all pairs had been recalled or until 16 trials had occurred, and the study was terminated for that subject. Subjects showed a remarkable range of learning abilities, with some learning the pairs in two trials and others taking 16 trials. The authors were interested in how learning rate would correlate with forgetting on a test given 2 days later. Would slow learners, having studied the pairs many more times than fast learners, be able to hold onto them because of the additional study opportunities? The answer was a resounding *no*: Slow learners—despite their massive study practice advantage—forgot more quickly. Some of the slowest learners showed dramatic forgetting, despite having initially been able to recall all the pairs, with performance between 5% and 15% after 24 hr. On the other hand, the fastest learners could still recall over 90% of the pairs a day later despite studying the items only a few times. This individual difference among subjects was stable across two lists of words, and the entire study was replicated with 100 people of wide abilities recruited from a community sample with much the same results. A later study found that subjects who showed this pattern of results on the Lithuanian-English (verbal–verbal pairs) test showed the same pattern in learning Chinese characters and their English equivalents (visuospatial—verbal) as well as learning objects and their locations (visuospatial—visuospatial learning; Zerr et al., 2021). Thus, the rate of learning and its relation to retention—what Zerr et al. refer to as learning efficiency—seems to be a relatively stable trait. Future work is needed to determine what factors are associated with slow learning and sharp forgetting, as well as whether and how such forgetting can be overcome. Repeated study clearly will not do the trick, but successive relearning might reduce the difference in retention between fast and slow learners (Rawson & Dunlosky, 2022).

The Seven Cardinal Sins

Schacter's analysis of the seven sins of memory is by analogy to the seven cardinal sins, sometimes called the seven deadly sins. These can be remembered through the convenient mnemonic of WASPLEG, which is also the title of a book on first letter mnemonics (Benne, 1988). The sins are *w*rath, *a*varice, *s*loth, *p*ride, *l*ust, *e*nvy and *g*luttony. Taken to the extremes, these seven features of living are deleterious, but they all have their adaptive features, too. We sometimes need anger to protect ourselves, a bit of greed to meet our needs, some pride or self-esteem, some lust to pass on our genes to the next generation, some envy to motivate us, and a healthy appetite to keep us going. In moderation, all the "sins" seem like critical components for life. Much like the seven deadly sins, Schacter (2021, 2022) points out that the seven sins of memory have their own set of adaptive features.

References

Alex Mullen (memory athlete). (2022, August 4). In *Wikipedia*. Retrieved November 10, 2022, from https://en.wikipedia.org/wiki/Alex_Mullen_(memory_athlete)

Benne, B. L. (1988). *Waspleg and other mnemonics*. Taylor Publishing Company.

Brown, P. C., Roediger, H. L., & McDaniel, M. A. (2014). *Make it stick: The science of successful learning*. Harvard University Press.

Castel, A. D., Vendetti, M., & Holyoak, K. J. (2012). Fire drill: Inattentional blindness and amnesia for the location of fire extinguishers. *Attention, Perception & Psychophysics*, *74*(7), 1391–1396. https://doi.org/10.3758/s13414-012-0355-3

Chen, H.-Y., Gilmore, A. W., Nelson, S. M., & McDermott, K. B. (2017). Are there multiple kinds of episodic memory? An fMRI investigation comparing autobiographical and recognition memory tasks. *The Journal of Neuroscience*, *37*(10), 2764–2775. https://doi.org/10.1523/JNEUROSCI.1534-16.2017

Dellis, N. (2018). *Remember it!: The names of people you meet, all of your passwords, where you left your keys, and everything else you tend to forget*. Abrams Image.

Dellis, N., & Stilwell, S. (2020). *Memory superpowers! An adventurous guide to remembering what you don't want to forget*. Abrams Books for Young Readers.

Dresler, M., Shirer, W. R., Konrad, B. N., Müller, N. C. J., Wagner, I. C., Fernández, G., Czisch, M., & Greicius, M. D. (2017). Mnemonic training reshapes brain networks to support superior memory. *Neuron*, *93*(5), 1227–1235.e6. https://doi.org/10.1016/j.neuron.2017.02.003

Ericsson, K. A., Chase, W. G., & Faloon, S. (1980). Acquisition of a memory skill. *Science*, *208*(4448), 1181–1182. https://doi.org/10.1126/science.7375930

Foer, J. (2011). *Moonwalking with Einstein: The art and science of remembering everything*. Penguin Books.

Karpicke, J. D., & Roediger, H. L., III. (2008). The critical importance of retrieval for learning. *Science*, *319*(5865), 966–968. https://doi.org/10.1126/science.1152408

Konrad, B. N. (2014). *Characteristics and neuronal correlates of superior memory performance* [Doctoral dissertation]. Ludwig Maximilian University of Munich.

Kornell, N., Hays, M. J., & Bjork, R. A. (2009). Unsuccessful retrieval attempts enhance subsequent learning. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *35*(4), 989–998. https://doi.org/10.1037/a0015729

LePort, A. K. R., Mattfeld, A. T., Dickinson-Anson, H., Fallon, J. H., Stark, C. E. L., Kruggel, F., Cahill, L., & McGaugh, J. L. (2012). Behavioral and neuroanatomical investigation of highly superior autobiographical memory (HSAM). *Neurobiology of Learning and Memory*, *98*(1), 78–92. https://doi.org/10.1016/j.nlm.2012.05.002

Lorayne, H., & Lucas, J. (1996). *Memory book: The classic guide to improving your memory at work, at school, and at play*. Random House Publishing Group.

Mack, A., & Rock, I. (1998). *Inattentional blindness*. MIT Press. https://doi.org/10.7551/mitpress/3707.001.0001

McDermott, K. B. (2021). Practicing retrieval facilitates learning. *Annual Review of Psychology*, *72*(1), 609–633. https://doi.org/10.1146/annurev-psych-010419-051019

McDermott, K. B., Szpunar, K. K., & Christ, S. E. (2009). Laboratory-based and autobiographical retrieval tasks differ substantially in their neural substrates. *Neuropsychologia*, *47*(11), 2290–2298. https://doi.org/10.1016/j.neuropsychologia.2008.12.025

Miller, G. A. (1956). The magical number seven plus or minus two: Some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81–97. https://doi.org/10.1037/h0043158

Mullen Memory. (n.d.). Retrieved November 10, 2022, from https://mullenmemory.com/

Nickerson, R. S., & Adams, M. J. (1979). Long-term memory for a common object. *Cognitive Psychology*, *11*(3), 287–307. https://doi.org/10.1016/0010-0285(79)90013-6

Patihis, L., Frenda, S. J., LePort, A. K. R., Petersen, N., Nichols, R. M., Stark, C. E. L., McGaugh, J. L., & Loftus, E. F. (2013). False memories in highly superior autobiographical memory individuals. *Proceedings of the*

National Academy of Sciences of the United States of America, *110*(52), 20947–20952. https://doi.org/10.1073/pnas.1314373110

Rawson, K. A., & Dunlosky, J. (2022). Successive relearning: An underexplored but potent technique for obtaining and maintaining knowledge. *Current Directions in Psychological Science*, *31*(4), 362–368. https://doi.org/10.1177/09637214221100484

Ricci, M., Wong, T., Nikpour, A., & Miller, L. A. (2019). Testing the effectiveness of cognitive interventions in alleviating accelerated long term forgetting (ALF). *Cortex*, *110*, 37–46. https://doi.org/10.1016/j.cortex.2017.10.007

Roediger, H. L. (1980). The effectiveness of four mnemonics in ordering recall. *Journal of Experimental Psychology: Human Learning and Memory*, *6*(5), 558–567. https://doi.org/10.1037/0278-7393.6.5.558

Roediger, H. L. & McDermott, K. B. (2013). Two types of event memory. *Proceedings of the National Academy of Sciences*, *110*(52), 20856–20857. https://doi.org/10.1073/pnas.1321373110

Schacter, D. L. (2021). *Seven sins of memory: How the mind forgets and remembers*. Marine Books.

Schacter, D. L. (2022). Memory sins in applied settings: What kind of progress? *Journal of Applied Research in Memory and Cognition*, *11*(4), 445–460. https://doi.org/10.1037/mac0000078

Wagner, I. C., Konrad, B. N., Schuster, P., Weisig, S., Repantis, D., Ohla, K., Kühn, S., Fernández, G., Steiger, A., Lamm, C., Czisch, M., & Dresler, M. (2021). Durable memories and efficient neural coding through mnemonic training using the method of loci. *Science Advances*, *7*(10), Article abc7606. https://doi.org/10.1126/sciadv.abc7606

Wolfe, J. M. (1999). Inattentional amnesia. In V. Coltheart (Ed.), *Fleeting memories: Cognition of brief visual stimuli* (pp. 71–94). The MIT Press.

World Memory Statistics. (n.d.). *Official statistics and world rankings*. World Memory Sports Council. http://www.world-memory-statistics.com/

World Records. (2022, October 26). *The world memory championships*. Retrieved November 10, 2022, from https://www.worldmemorychampionships.com/

Worthen, J. B., & Hunt, R. R. (2011). *Mnemonology: Mnemonics for the 21st century* (p. 161). Psychology Press.

Zerr, C. L., Berg, J. J., Nelson, S. M., Fishell, A. K., Savalia, N. K., & McDermott, K. B. (2018). Learning efficiency: Identifying individual differences in learning rate and retention in healthy adults. *Psychological Science*, *29*(9), 1436–1450. https://doi.org/10.1177/0956797618772540

Zerr, C. L., Spaventa, T., & McDermott, K. B. (2021). Are efficient learners of verbal stimuli also efficient and precise learners of visuospatial stimuli? *Memory*, *29*(5), 675–692. https://doi.org/10.1080/09658211.2021.1933039

Zupp, B. (2013). *Unlock your amazing memory: The fun guide that shows grades 5 to 8 how to remember better and make school easier*. Simply Sensible Entertainment.

Received November 11, 2022
Revision received November 14, 2022
Accepted November 14, 2022 ■