groups that were trained either in the morning or evening and then tested 24 hours later also showed an 18% increase in accuracy, indicating that the improvement was not due to general circadian effects on learning.

These results extend another finding — that power naps can reverse the detrimental effects of overtraining[8] — in two ways. First, Fenn *et al.* show that sleep can rescue memories that have spontaneously deteriorated, and second, they demonstrate that memories involving generalization can be recovered. It will be interesting to see what other kinds of memories can be rescued by sleep and what phases of sleep cause this effect.

But how does sleep enhance memory? Cellular consolidation takes only a few hours. So according to theory, most memories should be fixed in the brain and insensitive to further manipulation before a period of sleep occurs. Walker *et al.*[3] examined the consolidation profile of a motor memory by looking at interference between two related memories. Interference — when the acquisition of a second memory impairs the memory of the original task — is time dependent and is a classical approach to determining whether memories are labile or consolidated[4].

The authors show that if a second finger-tapping exercise is learned immediately after a first exercise, the memory of the second sequence interferes with that of the first, and the performance of only the second sequence is enhanced by sleep. The memory of the second sequence is not somehow erasing the memory of the first, as the subjects performed the first exercise normally if they were tested immediately after the training for the second exercise. In contrast, if the second sequence is learned six hours after the first sequence, interference does not occur and the performance of both sequences is enhanced by sleep.

This finding demonstrates that the memory of the first sequence becomes consolidated within six hours. So how can a subsequent period of sleep enhance this already 'fixed' memory? The authors have previously suggested that there is a second time window for consolidation during sleep, but how can fixed memories become sensitive to further processing?

The answer probably includes the fact that reactivating a consolidated memory can return it to a labile state from which it needs to undergo cellular re-storage or reconsolidation in order to persist. For example, if auditory fear memories are reactivated in rats, protein synthesis is required for these memories to persist. If the fear memories are not reactivated, inhibiting protein synthesis has no effect on their persistence, demonstrating that reconsolidation is predicated on memory reactivation[1]. So memory storage seems to occur more than once.

There is excellent evidence that some memories are reactivated during sleep and that this might return them to a labile state[9,10]. The crucial question, however, is whether reconsolidation occurs in humans. Memory reconsolidation in people exposed to electroconvulsive-shock therapy was reported some 30 years ago[11], but it was not clear whether the phenomenon could be detected under more natural conditions. Walker *et al.*[3] have now demonstrated exactly this. They looked at whether consolidated motor memories, when reactivated, would return to a labile state that would again be sensitive to interference. Subjects trained on the first finger-tapping exercise on day 1 performed with greater speed and accuracy when they were retested on days 2 and 3. But if, on day 2, they were given the second exercise immediately after the retest of the first, all improvements in the accuracy of the first exercise were reversed by day 3. Strikingly, this interference was prevented if the first exercise was not retested on day 2 — in other words, if this memory was not reactivated.

These results show that reactivating a consolidated motor memory returns it to a labile state that is once again sensitive to interference. Walker and colleagues show that new memories and reactivated memories respond in qualitatively similar ways when challenged using interference, so the most parsimonious interpretation of the data is that the reactivation of the consolidated motor memory caused it to undergo reconsolidation. The interference-induced block to reconsolidation might represent the first convincing demonstration of the erasure of a consolidated memory in humans.

The finding that reconsolidation occurs in humans is a landmark discovery. But Walker *et al.* also demonstrate that not all memories are equal. Although the accuracy of the finger-tapping tests was affected by interference, the speed with which they were performed was not. So perhaps not all memories undergo reconsolidation. Alternatively, the reconsolidation of different memories might be affected by interference in different ways. Understanding the intricacies of this phenomenon is crucial if we are to exploit its clinical potential to address psychological disorders such as post-traumatic stress or addiction. ■

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100 YEARS AGO

Certain letters have appeared in NATURE upon the bearing of the properties of radium upon the cosmical time scale. These letters are based on the assumption that radium, or some equally active body, exists in the sun and contributes materially to the output of solar energy. If this assumption were true, we ought, I think, to be able to detect the rays peculiar to radio-active bodies on the surface of the earth — they should bear some proportion to the great stream of light and heat waves which reaches us. Now a solution of iodoform in chloroform is very sensitive to the β and γ rays. A purple coloration is produced by the rays from 5mg. of radium bromide even after filtering through 1cm. of lead. On the other hand, I find that direct sunlight (if heating be obviated) has no action when the thinnest screen is interposed even after many days. Some of my solutions are now nearly two months old, and they have been exposed in light-tight cardboard boxes to such sunshine as has reached us during that period. They are quite unchanged. It is, of course, possible that the stream of rays needs to be above a certain critical density in order to decompose the iodoform, but in any case, my experiments prove that the β and γ rays reach us at most in only faint quantities from the sun.
From *Nature* 8 October 1903.

50 YEARS AGO

During a short survey of Milford Haven (July 27–30, 1953) for the purpose of assessing the possibility of reviving the oyster fishery, six American slipper limpets (*Crepidula fornicata*) were found in or near Pennar Gut, the estuary of the Pembroke River. *Crepidula*, a serious pest of oysters, had previously been recorded only from the east and south coasts of Britain… Pennar Gut was used in the years following the Second World War for laying up both merchant and naval ships, and is adjacent to Pembroke Dock. There is a ship-breaking yard on the opposite shore near Milford Haven. Evidence has been adduced to show that a major factor in the spread of *Crepidula* has been the movement of laid-up naval and merchant ships, which may remain for several years in infested areas on the east and south coasts of Britain and later be transferred for refitting or breaking-up to other areas.
From *Nature* 10 October 1953.