after training? Which kind of sleep, SWS or REM sleep, is most important for skill learning? Gais *et al.*[11] either trained subjects on the visual discrimination in the evening and retested them after three hours of sleep early in the night (when sleep is mostly SWS), or trained them in the middle of the night and retested them after three hours of sleep late in the night (when REM sleep predominates). In contrast to previous observations[6], the authors show that performance improved only in the early night condition, when subjects mainly got SWS. In this study also, because of their inventive experimental design and control groups, the authors could rule out any nonspecific effect due to sleep deprivation or to circadian variation. They also observed that the enhancement of performance was even larger when subjects were allowed to sleep the whole night. Gais *et al.* thus provide the first strong experimental evidence for a two-step process in memory formation during sleep in humans. Given the substantial differences between SWS and REM sleep, it is likely that each sleep stage contributes in a different way to memory trace processing. As stated by the authors, "procedural memory formation would be prompted by early SWS-related processes", whereas "late REM sleep would promote memory formation at a second stage, only after periods of SWS-rich early sleep have occurred".

The cellular mechanisms underpinning memory reprocessing during sleep are still unknown, but experience-dependent changes have been observed at different levels of description in the sleeping brain. At the systems level, functional neuroimaging shows that some brain areas are significantly reactivated in human subjects previously trained on a serial reaction time task (another implicit learning task)[12]. At the cellular level, neuronal re-activations are observed in hippocampal[13] and cortical[14] neuronal ensembles during sleep after training. Even at the subcellular level, evidence exists for experience-dependent gene transcription. For instance, the immediate-early gene *zif-268* is upregulated during sleep in the cerebral cortex of rats exposed to rich sensorimotor experience in the preceding waking period[15]. Future research will further investigate whether these activity-dependent changes reflect the reprocessing—possibly the consolidation—of memory traces.

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Keep your eye off the ball

The frequently heard coach's advice, "Keep your eye on the ball", may not be the best approach, suggests a new study on page 1236 of this issue. The authors used the cricket batsman's challenge (how to react to a fast-approaching ball) to address how athletes use visual cues to produce rapid and accurate motor responses. Previous theories proposed that a batsman must use direct visual measurements, such as image expansion or the rate of change of binocular disparity, to predict the ball's trajectory. However, given that the batsman has only a fraction of a second to monitor such visual cues, it has been controversial whether these parameters could be measured accurately enough to guide the correct response.

Land and McLeod took a new approach to this problem by monitoring the eye movements of batsmen as the ball was approaching, to determine what type of visual information they were actually collecting. The authors monitored the eye movements of three cricket batsman of widely varying skill, and found that, in general, they made a similar sequence of eye movements. Their eyes followed the ball's trajectory for a short period after release, then made a saccade below the ball to the site where it would be predicted to bounce. They then fixated again on the ball as it bounced, and followed its upward trajectory for approximately 200 ms afterward. The parameters that best distinguished most skilled from least skilled batsmen were the speed and variability of the initial saccade. The best batsman had the shortest delay between the ball's release and saccade initiation, and also used different saccade timing and magnitude for different ball trajectories. Therefore, the cricket batsman prepares his response to an oncoming ball by quickly assessing its predicted trajectory and directing visual attention to appropriate regions of the visual field with a precisely timed sequence of eye movements.

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