Working with Memory

STUDY QUESTIONS

What is working memory?
How does it differ from the mechanisms of declarative memory discussed so far?
What brain structures and systems support working memory?
What do we know about the anatomy and evolution of the prefrontal cortex?
What are the consequences of prefrontal damage in humans, in animals?
Do different parts of the prefrontal cortex have different functions?
What aspects of cognition and memory are encoded by prefrontal neurons?

The story of memory does not end with consolidation. Indeed, even after consolidation is completed, there is the issue of how we search for information during retrieval, as well as how new information becomes incorporated into the established organization during additional learning experiences. I think of cognitive processing that guides encoding and retrieval as "working-with-memory," the manipulation of information that is not memory per se, but handles our memory processing. While the entire cerebral cortex is involved in memory processing, the chief brain area that mediates these processes is the prefrontal cortex, the area in the frontal lobe whose functions are not fully understood but clearly involve strategic mechanisms of the sort that work with memory as a major part of its function.

The role of the prefrontal cortex is generally viewed as mediating "working memory," a concept akin to my notion of working with memory. Working memory involves a combination of storing new incoming
The anatomy of the prefrontal cortex

Participates in ordinary learning and memory processing leading to higher-order cognitive areas. It is involved in the understanding and cooperation between the prefrontal cortex and other areas of the brain, including those involved in working memory and planning. It plays a crucial role in the functioning of the prefrontal cortex in various cognitive tasks, such as working memory, decision-making, and problem-solving. This area is often referred to as the executive center of the brain, responsible for the regulation of cognitive functions.
The role of the prefrontal cortex in human memory function.

In the context of olfactory processing, the prefrontal cortex is involved in both working memory and episodic memory. In the human brain, the prefrontal cortex is thought to be responsible for maintaining information in working memory, allowing for the temporary storage of information that is currently being processed. This role is particularly important in the context of executive function, as the prefrontal cortex is involved in the regulation of attention, planning, and decision-making. In addition, the prefrontal cortex is thought to play a role in the consolidation of memory, which is the process by which information is transferred from temporary to long-term memory storage.
The role of the prefrontal cortex in problem-solving and memory

Deficits in short-term memory following damage to the prefrontal cortex in monkeys.

The executive function of the prefrontal cortex involves working with memory, attention, and decision-making. When the prefrontal cortex is damaged, these functions are impaired, leading to deficits in working memory and the ability to learn new information. The prefrontal cortex is also involved in decision-making and the ability to make choices based on prior experiences and new information.

In monkeys, damage to the prefrontal cortex results in deficits in working memory, making it difficult for them to recall previously learned information. This impairment is not just limited to working memory, as the prefrontal cortex is also involved in decision-making and planning. Damage to the prefrontal cortex can impair the ability to make decisions based on prior experiences and to plan effectively.

The prefrontal cortex plays a critical role in higher-order cognitive functions, including working memory, attention, decision-making, and planning. Damage to the prefrontal cortex can have significant impacts on an individual's ability to function in daily life, as these cognitive functions are essential for successful communication, learning, and problem-solving.
Pretectal area in humans and monkeys

The pretectal area is a common region in the brain that is involved in processing information related to attention, arousal, and visual processing. It is located at the junction of the midbrain and the diencephalon, just dorsal to the superior colliculus. The pretectal area is critical for the function of the reticular activating system (RAS), which plays a crucial role in maintaining wakefulness and alertness.

In humans and monkeys, the pretectal area is densely packed with neurons that are sensitive to a variety of stimuli, including light, sound, and touch. These neurons are thought to play a key role in the modulation of attention and the shift between different tasks.

In a recent study, researchers used functional magnetic resonance imaging (fMRI) to study the activation patterns in the pretectal area during attention tasks. They found that the pretectal area is highly active during tasks that require sustained attention, such as the Stroop task, which involves identifying the color of a word that is written in a different color. The results of this study suggest that the pretectal area is an important region for the regulation of attention and may be a target for therapeutic interventions in attention-deficit/hyperactivity disorder (ADHD) and other attention-related disorders.

Additionally, the pretectal area is involved in the integration of visual and auditory information. In monkeys, lesions of the pretectal area can result in deficits in the detection of visual stimuli, even when the stimuli are presented in the absence of corresponding auditory stimuli.

Overall, the pretectal area plays a critical role in the regulation of attention and the integration of sensory information. Further research is needed to fully understand the functional architecture of this region and its contributions to various cognitive processes.
A similar role for the prefrontal cortex in rodents.

Working with Memory

Consolidation

In addition, a similar role for the prefrontal cortex in rodents.

The opposite pattern in the prefrontal cortex. 

In rodents, consolidation of the prefrontal cortex is apparent in different brain areas associated with memory consolidation. These areas include the prefrontal cortex and other brain regions involved in memory processing.

Between the two patterns, a finding reminiscent of the brain's role in memory consolidation.

Perfusion images showing increased activity in the prefrontal cortex during memory consolidation.

The prefrontal cortex is involved in memory consolidation, as demonstrated by increased neuronal activity during the process.

In conclusion, the prefrontal cortex plays a crucial role in memory consolidation across different brain areas, highlighting its importance in the formation of new memories.
Condition 1: Performance of the same animals on a set of forced-choice tasks and on conflicting set attraction tasks. The forced-choice task was presented in the same manner as the discrimination task, except that the two options were blocked on each trial. The conflicting set attraction task was similar to the discrimination task, except that the animals were required to respond in the opposite direction to the correct response on the discrimination task. The results showed that the animals performed better on the conflicting set attraction task than on the discrimination task.

Condition 2: Performance of the same animals on a set of discrimination problems when the animals were required to respond in the opposite direction to the correct response on the discrimination task. The results showed that the animals performed better on the discrimination task than when they were required to respond in the opposite direction to the correct response on the discrimination task.

Condition 3: Performance of the same animals on a set of discrimination problems when the animals were required to respond in the opposite direction to the correct response on the discrimination task, but the correct responses were always incorrect. The results showed that the animals performed better on the discrimination task than when they were required to respond in the opposite direction to the correct response on the discrimination task, but the correct responses were always incorrect.

Condition 4: Performance of the same animals on a set of discrimination problems when the animals were required to respond in the opposite direction to the correct response on the discrimination task, but the correct responses were always incorrect. The results showed that the animals performed better on the discrimination task than when they were required to respond in the opposite direction to the correct response on the discrimination task, but the correct responses were always incorrect.
How Information for Working Memory Is Encoded

The role in learning stimulus–stimulus associations.

The condition of high interference, the prefrontal cortex plays a crucial role in learning stimulus–stimulus associations. The findings from studies on humans and monkeys, although they do not conclusively prove the hypothesis, indicate the importance of the prefrontal cortex in working memory. The prefrontal cortex is involved in the process of encoding the information that is to be remembered. The condition of low interference, on the other hand, may not require the same level of activity in the prefrontal cortex. This is because the stimulus–stimulus associations are not as difficult to learn, and therefore, the encoding process is not as complex. Overall, the prefrontal cortex plays a crucial role in the learning process, especially when there are high levels of interference.
learning and regulation. The example in Figure 1.3-2 illustrates how the brain learns from experience to improve its decision-making processes. The figure shows a two-choice task, where the brain has to choose between two options based on the reward. The correct choice is rewarded, and the incorrect choice is punished. Over time, the brain learns to associate the correct choice with a higher reward, leading to better decision-making.

In the second delay, the subject is presented with a second choice, and the correct choice is again rewarded, leading to further improvement in decision-making. This process continues until the subject reaches a criterion level of performance, indicating that the brain has learned the correct decision-making strategy.

The figure also shows how the brain's decision-making processes can be enhanced by external factors, such as rewards and punishments. The brain's decision-making is not fixed but can be modified by experience and learning.

The figure is an example of how the brain learns from experience to improve its decision-making processes. The figure shows a two-choice task, where the brain has to choose between two options based on the reward. The correct choice is rewarded, and the incorrect choice is punished. Over time, the brain learns to associate the correct choice with a higher reward, leading to better decision-making.

The figure also shows how the brain's decision-making processes can be enhanced by external factors, such as rewards and punishments. The brain's decision-making is not fixed but can be modified by experience and learning.
The prefrontal cortex is activated in humans and employs them in encoding following the demands of the task. Low-turn signal representations of visual and well spatial associations, long-term (echo) representations of the environment, and the prefrontal cortex in particular are associated with the preparation of the environment. The environment's task order and prior order of the sample stimuli. However, toward the end of the delay and prior to the sample stimuli, there is a decay in the activity of prefrontal neurons. The sample stimuli are encoded in working memory, and partially into the memory. The simple stimuli presentation and partially into the memory. The sample stimuli presentation and partially into the memory. The prefrontal cortex may also be specifically recruited to retrieve and recall the sample stimuli when demanded by the task requirements.
Working with Memory

Figure 1-16: An example series of trials on each of the two versions of the three-back task.

In addition, studies have shown that different brain regions are involved in the processing of working memory tasks.

The right and left hemispheres of the brain contribute differently to working memory tasks. The right hemisphere is involved in spatial and visuospatial processing, whereas the left hemisphere is involved in verbal and sequential processing.

These findings suggest that different brain regions are recruited for different types of working memory tasks, highlighting the complexity of these processes.
The mechanism of memory: Peculation of place

entails the formation of a trace of memory. When the demand for continued monitoring places a higher order of the memory that the decision is reached into the compartment that the decision is reached. The current trace idea is that the brain is divided into two parts that are connected by a network of neurons. These neurons are represented by the activity of the neurons that are active in the region of the brain that is activated when the task demands to monitor the task outcome. The current trace idea is that the brain is divided into two parts that are connected by a network of neurons. These neurons are represented by the activity of the neurons that are active in the region of the brain that is activated when the task demands to monitor the task outcome.
Working with Memory...

Figure 3-7. Activation of multiple brain areas during working memory. (Left panel)

Another recent study by Conway, Labouvie, and their colleagues...

The number of items in memory is limited to about three or four items, in contrast to the much larger capacity of short-term memory.

C. Focus area and interaction of load and time

D. Visual cortex and time

E. Prefrontal cortex and memory load
Reading

Scans control over memory and other intellectual functions. The posterior parietal cortex, the frontal eye fields, and the prefrontal cortex are coordinate in the organization of working memory. snorkeling...