

Types of Memory

Slotnick, Scott D.. *Cognitive Neuroscience of Memory (Cambridge Fundamentals of Neuroscience in Psychology)* (pp. 2-21). Cambridge University Press.

Summary

- The six pairs of memory types are **explicit** memory and **implicit** memory, **long-term** memory and **working** memory, **episodic** memory and **semantic** memory, **context** memory and **item** memory, “**remembering**” and “**knowing**,” and **recollection** and **familiarity**.
- The five brain regions that have been associated with memory are the occipital cortex, the temporal cortex, the parietal cortex, the dorsolateral prefrontal cortex, and the medial temporal lobe.
- There are different sensory regions associated with visual processing, language processing, motor processing, and olfactory processing.
- Within the visual modality, there are different sensory regions associated with processing shape (in LOC), color (in V8), spatial location (in V1 and extrastriate cortex), motion (in MT), faces (in the FFA), and context (in the PPA).
- The memory control regions in the brain are the dorsolateral prefrontal cortex, the parietal cortex, and the medial temporal lobe.

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In everyday life, the term memory typically refers to consciously retrieving previously experienced information, such as where someone left their sunglasses before leaving home on a sunny day. However, many different types of memory are investigated in cognitive neuroscience. To put the scientific findings that are detailed in this book in the proper framework, it is necessary to understand each type of memory and how it is related to the other types of memory.

Figure 1.2 shows the different types of memory and how they are related to one another. The number of memory types may appear daunting, but there are major distinctions that divide these into six pairs of memory types (with each pair of memory types listed at the same vertical level in the figure). The fact that nearly all memory types are in pairs indicates that scientists in the field of memory favor dichotomies. A brief description of each memory type, and how it is distinct from its paired type, will be provided in this section. A more thorough description of each memory type will be provided in the relevant sections of the book.

The first pair of memory types is **explicit memory** and **implicit memory**, which refer to conscious memory and nonconscious memory, respectively. That is, all forms of explicit memory are associated with conscious experience/awareness of the previously experienced information, whereas all forms of implicit memory are associated with a lack of conscious experience/awareness of the previously experienced information. There are many types of explicit memory, which are described below. Skills constitute one type of implicit memory. After a skill is learned, performance of that skill reflects nonconscious memory. For example, after a person learns to ride a bike, they don't think about rotating the pedals, steering, braking, or balancing. Instead, their conscious experience is dominated by where they want to ride or whatever else they happen to be thinking about. **Repetition priming** is another category of implicit memory that refers to more efficient or fluent processing of an item when it is repeated. For example, when a television commercial is repeated, that information is processed more efficiently (and when the item from the commercial is seen again while shopping, implicit memory presumably increases the chance that it will be purchased). Skill learning can be assumed to be based on repetition

priming (i.e., more efficient processing after a lot of practice), which illustrates that these types of implicit memory are not independent.

The rest of the memory types are kinds of explicit memory. The second pair of memory types is **long-term memory** and **working memory**. Working memory is also referred to as **short-term memory**. A typical explicit memory experiment will be detailed first to help make the distinction between long-term memory and working memory. During the study phase of both long-term memory and working memory paradigms, items such as words or objects are presented. After the study phase, there is a delay period that can last a variable amount of time. During the test phase, old items from the study phase and new items are presented, and participants make an “old” or “new” judgment for each item, which is referred to as **old–new recognition**. Accurate memory is indicated by a greater proportion of “old” responses to old items than “old” responses to new items. Long-term memory and working memory differ with regard to whether or not information is kept in mind during the delay period. In long-term memory experiments, there are typically many items in the study phase and the delay period is relatively long (e.g., minutes to hours – hence the name of this memory type). Participants do not actively maintain information from the study phase in their mind during the delay period. In working memory experiments, there are typically a few items in the study phase, the delay period is in seconds, and participants are instructed to actively maintain information from the study phase in their mind (which is working during the delay period, and hence the name of this memory type). Although explicit memory refers to both long-term memory and working memory, explicit memory is often used to refer to only long-term memory. In this book, the terms will be used according to the definitions provided in this section.

The third pair of memory types is **episodic memory** and **semantic memory**. Episodic memory refers to the detailed retrieval of a previous episode, such as what occurred, where it occurred, and when it occurred. For example, when a person remembers the last time they saw their parents, this is an example of an episodic memory. Semantic memory refers to retrieval of factual information that is learned over a long period of time, typically years, such as the definition of a word. Semantic memories do not involve any memory for the previous learning episode. For instance, the definition of the word ‘sailboat’ simply comes to mind without having to think back to when its meaning was learned. If any information is retrieved from the previous experience, this would constitute an episodic memory rather than a semantic memory. As mentioned above, cognitive neuroscience long-term memory experiments generally consist of a study phase, a delay phase, and a test phase. Although semantic memory is a type of long-term memory, it is typically acquired over a period of years. This makes semantic memory unique and related to language processing (see Chapter 8). As such, unless otherwise specified, when the term long-term memory is used in this book, it will refer to all the types of long-term memory except semantic memory.

The fourth pair of memory types is **context memory** and **item memory**. These are straightforward terms that refer to different kinds of memory that operate during context memory experiments. During the study phase of such experiments, items are presented in one of two contexts, such as on the left or right side of the screen or in red or green. During the test phase, old items and new items are presented and participants make an “old”–“new” recognition judgment for each item, and for items classified as “old” they also make a “context 1” or “context 2” judgment (e.g., “left” or “right”). It is notable that the second judgment is based on **recall** of previous contextual information rather than recognition, which is almost always the case for context memory judgments. Recall refers to retrieval of information based on an associated memory cue (e.g., recalling the context of an old item). Item memory refers to accurate recognition of old items versus new items, while context memory refers to accurate retrieval of context information. Context memory is also referred to as **source memory**, as a particular context can also be

considered a source of information. In addition, **associative memory**, which refers to memory for an association between two items, is similar to context memory in that one item can be considered the context for the other item.

The fifth pair of memory types is “**remembering**” and “**knowing**.” “Remembering” refers to the subjective experience corresponding to detailed retrieval, while “knowing” refers to the subjective experience corresponding to the lack of detailed retrieval. The quotes around these terms and other behavioral responses that reflect subjective experience (e.g., “old” and “new”) will be used throughout this book. “Remembering” corresponds to the subjective mental experience of retrieving details from the previous experience, such as someone retrieving where they parked their car in a parking lot. If any details are recalled from a previous experience, this constitutes “remembering”. “Knowing” is defined by the lack of memory for details from a previous experience, such as when someone is confident they have seen someone before but not where or when they saw them. “Remembering” is typically assumed to be related to context memory, as it is thought to occur whenever contextual information is retrieved. “Knowing” is typically assumed to be related to item memory and semantic memory, which is why these memory types are connected in the figure.

The sixth and last pair of memory types is recollection and familiarity. The terms **recollection** and **familiarity** can refer to mathematical models of these two kinds of memory (Slotnick & Dodson, 2005; Wixted, 2007) but more commonly refer to all the forms of detailed memory (i.e., episodic memory, context memory, and “remembering”) and non-detailed memory (i.e., semantic memory, item memory, and “knowing”), respectively. It may be useful to think of context memory and item memory as measures of task performance, “remembering” and “knowing” as measures of subjective experience, and recollection and familiarity as general terms that describe strong memory and weak memory, respectively.

In one classic paper by Endel Tulving, a world-renowned cognitive psychologist and cognitive neuroscientist, it was hypothesized that there was a distinction between “remembering” and “knowing” (Tulving, 1985). This hypothesis stemmed from scientific evidence, as it was based, in part, on a patient with a brain lesion who had no detailed memory of the past (i.e., he could not “remember”) but could define words. Tulving’s hypothesis was also based on **introspection**, as this was a novel proposal and it is clear throughout the paper that his arguments were based on personal reflection as well as evidence. As discussed in Box 1.1, introspection is a powerful way for scientists to understand mental processing. Tulving ran behavioral experiments to test the hypothesis that “remember” responses and “know” responses were distinct. During one experiment, words were presented during the study phase, and then during the test phase old words and new words were presented and participants made “old”–“new” recognition judgments. For old items correctly classified as “old,” participants also made a “remember”–“know” judgment and a confidence-rating judgment (ranging from 1 to 3 corresponding to low confidence, intermediate confidence, and high confidence). As shown in Figure 1.3, the probability of “remember” responses increased with increasing confidence, while the probability of “know” responses was maximal at the intermediate confidence rating. These distinct response profiles provide behavioral evidence in support of Tulving’s hypothesis that “remembering” and “knowing” are distinct types of memory. A large body of research has subsequently accumulated showing that “remembering” and “knowing” are also associated with distinct regions of the brain (see Chapter 3).

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Common Terms

associative memory

Memory for an association between two items.

context memory (also “source memory”)

Memory for the context of a previously presented item.

episodic memory

The detailed retrieval of a previous episode.

explicit memory

Conscious memory.

familiarity

All the types of non-detailed long-term memory.

implicit memory

Nonconscious memory.

introspection

The examination of your own mental processes.

item memory

Memory for whether an item is “old” or “new.”

“knowing”

Subjective experience corresponding to the lack of detailed retrieval during long-term memory.

long-term memory

Type of explicit memory in which information is not actively maintained during the delay period.

old–new recognition

When old items and new items are presented and participants make an “old” or “new” judgment for each item.

recall

Retrieval of information based on an associated memory cue.

recollection

All the types of detailed long-term memory.

“remembering”

Subjective experience corresponding to detailed retrieval during long-term memory.

repetition priming

More efficient or fluent processing of an item when it is repeated.

semantic memory

Retrieval of factual information that is learned over a long period of time.

source memory

(see context memory)

working memory (also “short-term memory”)

Type of memory in which information is actively maintained during the delay period.

Types of memory.

Lane, Sean M.; Houston, Kate A.. Understanding Eyewitness Memory (Psychology and Crime) (pp. 20-22). NYU Press.

Memory is multifaceted (e.g., James, 1890), and there are different ways of describing its various aspects. One key distinction is between a shorter term memory that is highly accessible and available to conscious awareness and memory that is a less accessible but a longer term store of our experiences (e.g., James, 1890). This general distinction has been reflected in the concepts of *primary* and *secondary* memory (James, 1890), *short-* and *long-term memory* (e.g., Atkinson & Shiffrin, 1968), and *working memory* and *long-term memory* (e.g., Baddeley & Hitch, 1974). Most contemporary researchers focus on the latter distinction (e.g., Cowan, 1999), and in this book, this is the focus as well. Although different theorists ascribe different mechanisms to working memory (e.g., Baddeley, 2000; Cowan, 1999; Engle, 2001), they broadly share the assumption that it describes mental processes that are used to manipulate and maintain information in an activated state so that it can be used to perform cognitive tasks such as understanding spoken and written language, mathematical calculation, and problem-solving (e.g., Cowan et al., 2005; Engle, 2001). The number of items that can be maintained in working memory is thought to be limited (e.g., 3–5 items), and information can be lost relatively quickly if not kept active (e.g., through rehearsal). One important finding is that people vary in their ability to effectively use working memory—*working memory capacity* (WMC; Kane et al., 2001), and this ability is highly correlated with intelligence and other important cognitive abilities. Among other things, people with high WMC appear to be more resistant to interference and better able to inhibit irrelevant or distracting information (e.g., Kane et al., 2007).

Researchers also distinguish between various types of long-term memory (e.g., N. Cohen & Squire, 1980; Tulving 1985) that differ with respect to the type of content, the potential for conscious remembering, and the associated brain systems. One broad classification contrasts *declarative* and *nondeclarative memory* (see Squire, 2004, for discussion). Declarative memory refers to memories that are represented in the brain in such a way that they can be consciously remembered, and it corresponds to what most people think of as “memory” (Squire, 2004). There are two types of declarative memory: *episodic* and *semantic memory* (Tulving, 1972). Episodic memory refers to memories of a person’s own experiences that contain specific contextual features (information about “where, what, and when”; e.g., Nyberg et al., 1996) that allow the person to have a sense of reexperiencing the event. If, in thinking back to what you did for lunch yesterday, you remember that you ate a turkey sandwich while sitting on a park bench at the noon hour, you have an episodic memory for that event. In addition, the conscious recollection of episodic memories requires that one intentionally try to remember the past, what Tulving (1983) termed *retrieval mode*. This type of memory is the one most often studied by eyewitness memory researchers. Semantic memory involves facts or other knowledge about the world (e.g., “Martin Luther King was a pioneer of the civil rights movements in the 1960s”). One key feature that discriminates semantic from episodic memory is that although a person is consciously aware of the fact itself, this memory is not accompanied by a sense of remembering the context in which this information was initially learned. Nondeclarative memory describes the fact that memory for past experiences can also be conveyed in our behavior without our awareness (Squire, 2004). For example, people can ride a bicycle without needing to deliberately remember how to do so. This memory for how to do a task has been called *procedural memory* (Tulving, 1983; see also habit memory; Mishkin et al., 1984). Other types of nondeclarative memory include *priming* or *implicit memory*, in which information comes to mind without the sense of remembering (Graf & Schacter, 1985).

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