PROFESSIONAL DEVELOPMENT

# AP® Psychology
## Cognition and Language

Special Focus

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# Contents

# Introduction

**Chris Hakala**

In these special focus materials, we describe the field of cognition and language. As interest in the field of cognition grew throughout the twentieth century, more and more research examining the topics of attention, memory, and language was generated. Each of these topics has unique research approaches, and understanding these approaches will go a long way toward helping students differentiate this material from other areas of psychology.

Unique to the area of cognition (and to some extent to learning) is the utility of the material for students. Thus it is often the case that people teaching cognition provide students with helpful information for studying behavior. These materials are no different.

The first document provides information concerning basic cognitive principles. Michelle Rizzella describes in detail the way that cognition can be studied as a modular approach. To that point, she describes memory as a process that contains several steps along the way. In addition, the importance of attention is included in this section.

The second document describes the topic of language. In this manuscript, I talk about both the structure and function of language. Linguistic universals, language acquisition, and a brief description of the nature and use of language are included in this section.

The final document ties together the study of cognition with ample suggestions designed to help assess whether or not students have developed an understanding of the materials presented in the area of cognition. Emily Soltano presents several active learning activities that she uses in her class, as well as strategies for assessing whether or not students have learned the material well.

It is our hope that these special focus materials will help you better understand the topic of cognition.

# A Brief Introduction to Memory

**Michelle Rizzella**

Typically, students are very interested in learning about memory and memory processes because of their own experiences with memory. Many of them believe that what we know about memory can be gleaned from common sense. Although much of our knowledge of memory is consistent with common sense, there still exist numerous memory myths waiting to be debunked by the instructor (e.g., verbal rehearsal leads to durable memories, confidence predicts accuracy of recall, and hypnosis recovers repressed memories). When I introduce the section on memory, I present students with questions/statements that foster introspection on memory processes and that distinguish among different types of memories. For example, I may ask them to consider what mental processes must occur in order to respond to the following questions/statements:

1. Write down as many concepts/ideas that come to mind when I say the word "YELLOW."
2. What did you do on your fifth birthday?
3. Describe the events that occurred the last time you went to a restaurant.
4. Who is the character in the photo? (I show them a picture of Darth Vader.)

Following the presentation of these questions/statements, students provide their ideas/concepts and describe how they came to those responses. (Responses such as "I do not know or "I do not remember" can also be valuable. How do we make a decision if we don't remember or recall something?)

Students often report that

1. they "just knew the answer" (e.g., "I just recognized Darth Vader, I don't know how I remembered that").
2. they reconstruct their memories (e.g., "I was little and I think I had a birthday party at Chuck E. Cheese, all my friends came, I opened presents, etc.").

3. one idea led to another, which is similar to "stream of consciousness" or spread of activation (e.g., "YELLOW" makes me think of corn, sun, school bus, yield sign, traffic lights, etc.). If pressed, some students will report concepts that are "unique," such as sun → blond → Pamela Anderson.

At this point students recognize a couple things about memory, such as some memory processes are consciously available (e.g., reconstructing a memory of eating at a restaurant), while others are not (e.g., how we know the meaning of "yellow").

Students also observe a considerable overlap in their ability to recall (e.g., students will report similar concepts in response to "yellow," or what happened the last time they went to a restaurant, or that they had a party to celebrate their fifth birthday). This suggests that individuals from similar cultures share some memories; that is, we have similar semantic memories. But, the students' recall also indicates that their memories are also unique ("I went to Chuck E. Cheese for my fifth birthday, I got a Tonka truck, or the waitress spilled wine on my dress; or I thought of Pamela Anderson in response to 'yellow.'"). Our own individual memories involve another type of memory, episodic memory.

## Three Basic Processes

Although in some cases our memories are similar while in others they are unique, memory involves three basic and sequential processes: encoding, storage, and retrieval.

**Encoding** is a process by which a stimulus (e.g., a word, an object, an idea, etc.) is translated into a mental representation that may be stored in memory. For example, we do not have literal letters etched in our minds when presented with the word "rat" —rather, there must be some mental representation of the stimulus, perhaps a verbal code. Or perhaps directions to a friend's house may be represented in a verbal and/or spatial code in memory. It's also useful to tie an example of encoding back to the previous questions/statements. For example, the picture of Darth Vader is not an actual picture of Darth Vader in your head—it's some mental representation that the cognitive system "understands." Once a stimulus has been encoded, it is ready to be stored. A memory may be stored for less than a second to permanently.

**Storage** refers to changes in the neural system that allows retention of information. Storage involves moving encoded information to a memory store and the maintenance of that information. An example of storage involves memorizing a multiplication table by rehearsing it over and over.

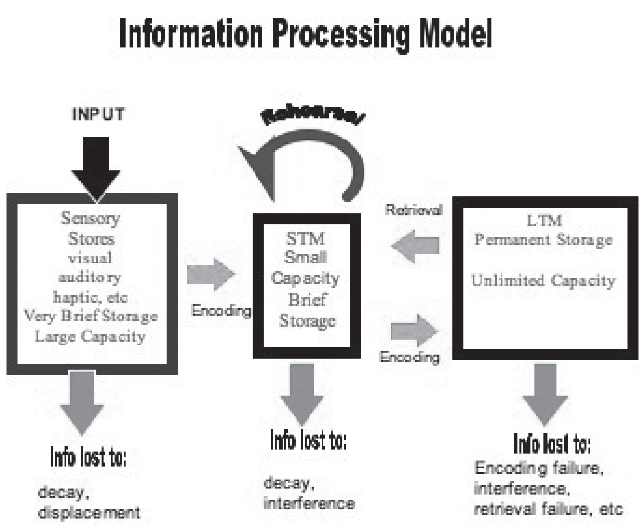
Often, we must access a memory from storage in order to be able to use it. Speaking, reading, solving a problem, walking, and so forth are all tasks that require access to stored memories in order to carry out those tasks. In other words, memories must be retrieved.

**Retrieval** is a process of recovering information from a memory store. For example, I recall the event of getting a Tonka truck for my birthday. Or, in order to use the word "yellow" in a sentence, I must retrieve the memory of the word and its meaning.

To remember and, subsequently, to learn, all three processes must occur. For example, in order to recognize Darth Vader, one must encode the presented picture into some mental representation, store that representation (it can be for a brief period of time or longer), and then retrieve information about the identity of Darth Vader from memory. How well and how quickly information is retrieved from memory depends on how the information was encoded, stored, and retrieved.

## Atkinson and Shiffrin's Information Processing Model

Next, I present Atkinson and Shiffrin's (1971) classic model of memory (an overhead, a PowerPoint image, or drawing it on the board is helpful). Atkinson and Shiffrin characterized memory and its processes within an information processing model. They postulated that there are three distinct memory systems: sensory memory, short-term memory, and long-term memory.



## Sensory Memory

Sensory memory receives input from the environment and holds information in a raw, unprocessed form; it allows some trace of a stimulus to persist after the stimulus itself has disappeared. For example, a sparkler: Why do children twirl sparklers? The twirling action results in the perception of a circle. Of course, the circle does not exist, but a circle is perceived because sensory memory briefly stores information about the light, even through the physical light has gone.

Atkinson and Shiffrin (1971) assumed that we have a sensory store for each sense (iconic, echoic, tactile, taste, and olfaction). However, because the bulk of research has focused on iconic memory and to a lesser extent, echoic memory, I will focus on iconic memory.

## Iconic Memory

Iconic memory is a visual sensory store. It holds visual input in some visual- image-like form for a brief period of time (250 milliseconds or less). Iconic memory holds visual information in a raw, unprocessed form. If the information in iconic memory is attended to, it is then encoded into a more stable storage area, short-term memory. If the information is not attended to, it is lost.

Consider the example of going to the movies: When you view a film, what you are really watching is a series of picture stills. However, we perceive it as movement that is continuous and fluid. Why? Because iconic memory briefly holds picture stills in memory, but long enough to allow an overlap between the picture stills. When presented with a picture still, the still is stored in iconic memory and that image overlaps with the presentation of the next picture still; thus fluid movement is perceived. (This example is similar to making cartoon characters appear to move when one flips through a series of drawings very quickly.)

After students understand what sensory memory is, I present them with the characteristics of the sensory stores:

1. Large capacity (considerable stimuli are impinging on our senses and entering our sensory memory)
2. Holds information briefly (2 seconds for auditory information, 250 milliseconds for visual information)

Although sensory memory has a large capacity, we do not become aware of most of it. For information to have meaning, it must be translated from raw, unprocessed material into some meaningful code in our memory. For information to have meaning and to be retained beyond sensory memory, it must be encoded as something recognizable and more durable. This takes place in short-term memory (STM), also known as working memory (WM). (*Note*: In introductory classes, these two components are often treated as if they are the same, although to do so is a simplification. Alan Baddeley's model of working memory is much more active and elaborate than Atkinson and Shiffrin's original short-term memory model.)

### Short-Term Memory/Working Memory

There is no general agreement on how encoding in short-term memory (STM) takes place or on the form that it takes.

1. Some argue that sensory information is converted into an acoustic, verbal code.
2. Others argue that it is image-like.
3. Still others argue that it is an abstract representation, which is neither verbal nor imaginal.

STM is similar to the concept of consciousness in that it contains information one is currently thinking about or has recently thought about (within 30–60 seconds). I identify two functions of STM as:

1. Maintenance of current information, often by rehearsal; for example, we often maintain information by rehearsing it over and over. If we need to remember a phone number, we maintain it in STM by saying it over and over again.
2. Mental workbench—STM is the storage area where we can perform operations on information (e.g., division).

#### The two characteristics of STM:

1. ***Capacity is limited***:
I show students the limitation of STM capacity by presenting a series of digits that vary in length and by asking them to recall each list in unison after each presentation.

a. 193 (recall)
b. 8691259 (recall)
c. 6857201623 (recall)
d. 29543768913437 (recall)

Students easily recall list (a), and most recall list (b). However, their recall is often incomplete and/or inaccurate for lists (c) and (d) because the STM capacity has become overwhelmed. When I ask students why they have such difficulty remembering lists (c) and (d), they tell me that they couldn't hold more digits in their head; that is, there is not enough "space" in STM to rehearse so many numbers.

This demonstration suggests that on average, we hold 7 plus or minus 2 chunks of information in STM. One can enhance the capacity of STM by "chunking," which means grouping items together to form a more compressed, more easily recallable memory code.

Dealing with STM capacity constraints can be challenging. We often fail to learn material if our STM capacity is overwhelmed. To enhance capacity, we could "chunk" material into meaningful units. For example:

- 177619412001

Instead of remembering twelve digits, which would overwhelm the capacity of our STM, "chunk" the digits to remember three years (1776, 1941, and 2001). So, "chunking" is just recoding material into meaningful packets of information.

I also point out that STM is the storage area where we perform operations on material and that such processes take up capacity. For example, students can easily do the following division problem in STM:

- 200/2

In contrast, a division problem such as 631/4 is more difficult because it requires division, working with remainders, subtraction, etc.—these processes take up STM capacity.

2. ***Holds information briefly:***
STM holds information for about 30–60 seconds if not attended to. You can demonstrate how quickly information is lost from STM with a demonstration of the Brown-Peterson Task (Brown 1958; Peterson and Peterson 1959). You can also demonstrate how information is lost via interference by giving students a seven-digit phone number to maintain in STM, and then blurting out a series of other numbers. Most students will lose the seven-digit number due to interference.

## Long-Term Memory

I make it clear to students that in order to have durable memories or for learning to occur, information must reach long-term memory (LTM). There are many ways in which information can reach LTM, such as by rehearsal and elaboration.

Before discussing rehearsal and elaboration, I usually do a class demonstration in memory. I send one-half of the class out of the classroom for a few minutes. I present the remaining students with a series of 15–20 word pairs (e.g., frog-boots, tree-bells, horse-clock, etc.). I ask these students to verbally rehearse each word pair silently. After the presentation, the verbal rehearsal group leaves the room and the students who were in the hallway return to their seats. I present the same word list to this group, except I ask them to elaborate on the word pair by forming an image of each pair (e.g., imagine a frog wearing boots). Following their presentations, all students return to their seats for a cued-recall task. I present the first half of each word pair (e.g., frog, tree, horse, etc.), and the students write down the other half of the word pair. Students are told to raise their hands if they remember the word. There is a marked difference in recall—students who received the elaboration instructions always show better recall compared to the verbal rehearsal group. (Usually there is a nice serial position effect for the verbal group. You could point out primacy and recency effects here).

This demonstration nicely discriminates between two LTM strategies, and it clearly shows that elaboration is a superior method in remembering information. Thus, in studying for an exam, students should seek to make the material meaningful instead of memorizing it (mnemonic examples would be appropriate to present to students here).

Following this demonstration, I provide definitions of rehearsal and elaboration.

**Rehearsal** means to repeat things over and over (e.g., looking up a phone number to dial, learning state capitals, learning vocabulary, etc.). Many students rely on rehearsal to learn material; however, I try to dissuade them from using this method because, compared to elaboration, it is less effective. Research has demonstrated that in order to form durable memories, material should be made meaningful.

Material becomes meaningful if it is elaborated. For example, one can connect to-be-learned material with information that is already stored in LTM, or one can form an image of the to-be-learned material.

**Elaboration** refers to the connection of new information to information already stored in memory (for example, a person learning a foreign language may observe that some words are similar to words in English—*cucina* → kitchen; *madre* → mother/mama; or the person may form an image, e.g., remember piano-cigar → envision a piano smoking a cigar. Elaboration leads to durable memories. However, it often requires mental effort, which may be a reason that students often use less efficient studying methods such as verbal rehearsal.

## The Three Characteristics of LTM:

1. Long-term memory is a relatively permanent storage area. Some psychologists argue that we "never" lose information from LTM; rather memory failures occur because we fail to retrieve information. It's still there, but information cannot be retrieved. A good example of retrieval failure is the tip of the tongue phenomenon—the information is stored in LTM, but sometimes it is difficult to retrieve.
2. Storage is assumed to be unlimited: LTM capacity cannot be "full."
3. LTM contains different types of memories such as *semantic*, *episodic*, and *procedural* memories. Semantic and episodic memories are those that require explicit, conscious recollection. In contrast, procedural memories are often implicit—these memories are retrieved without conscious awareness.

ACTIVITY: Have the students perform the following activities in order to distinguish among different types of memories:

a. **Semantic Memory:** Present a list of randomized words that belong to three or four categories: horse, desk, shirt, chair, cat, jeans, dog, couch, cow, socks, table, jacket, hat, sheep, etc. Then ask the students to recall the words in any order—the words are likely to be recalled in categories (e.g., horse, cat, dog, cow, jeans, jacket, hat, desk, chair, table, etc.). This suggests that we store information according to meaning, i.e., semantically. Semantic memory involves our general knowledge; individuals from the same society tend to have similar semantic memories (for example, we know what clothes are, we can identify furniture, we know what typical events may occur when we go to a restaurant, etc.).
b. **Episodic Memory:** Ask students to recall one of their happiest days—these memories will be unique in as many ways because they are personal memories. Our own individual memories are episodic memories.

Both *episodic* and *semantic* memories are explicit memories; that is, we are usually consciously aware of retrieving them. In contrast, *procedural* memories are implicit—we are not usually aware of retrieving the material.

c. **Procedural Memories:** Ask the students to tie their shoes. This procedure involves procedural memories—the memory for skills and behavior. Often, it is difficult to verbally describe these types of memories → we just do them. When we want to teach children how to tie their shoes, we show them how to do it—we do not give them detailed, verbal instructions. These types of skills are often implicit, which means that we are not consciously aware of how we do them. *Procedural* memories also tend to be long-lasting. We do not forget how to drive, how to tie our shoes, how to throw a baseball, or how to ride a bike.

The idea that we store different types of memories in different areas of the brain is supported by neurological impairment studies. For example, individuals with brain damage to their hippocampus suffer from anterograde amnesia and cannot form new explicit (episodic and semantic) memories. However, these individuals show improvement on tasks that require skill (e.g., mirror tracing), which indicates that they can form implicit, *procedural* memories. Time permitting, a discussion of amnesic patient HM (see Squire 1992) will fascinate students.

The Atkinson and Shiffrin Information Processing Model accounts for the vast research findings in memory. For example, the model predicts the serial position curve. However, psychologists debate whether there are three separate memory stores due to neurological evidence (see, for example, Warrington and Shallice 1972) and because the model suggests that there is only one route to create a memory: Sensory Store → STM → LTM.

## Durability and Accuracy of Memory

We are able to recall, often with great detail and confidence, events that occurred years and years ago. For example, many of us remember having our first kiss, learning Spanish in high school, learning how to drive, and going to Grandma's house for the holidays.

### Flashbulb Memories

In some cases, we have memories that we seem to relive. For example, many of us remember what we were doing, whom we were with, how we felt, and when we found out about the terrorist attacks on 9/11. In many cases, we can recall this event with remarkable clarity. And, although the event occurred in 2001, for many of us the memory seems fresh.

ACTIVITY: I ask student volunteers to remember 9/11 in as much detail as possible: I ask them to tell me what they were doing, whom they were with, who told them about it, and their reaction and the reactions of others to the news. I also supply my own memory of 9/11 (I had just finished teaching statistics, a professor entered my office to tell me the news, I was in disbelief, I watched the towers fall on TV surrounded by weeping faculty, I remember looking down at the black desks, etc.).

Some psychologists argue that memories like 9/11 are different than ordinary long-term memories and, therefore, deserve special distinction from ordinary long-term memories. Memories like 9/11 are called "flashbulb memories" by Brown and Kulik (1977), who proposed that emotionally charged, surprising, and consequential events often result in flashbulb memories. Flashbulb memories are recalled with vivid detail in that they usually contain the following information:

1. The informant
2. Whom the individual was with
3. The individual's reaction
4. The individual's activity
5. The reactions of others

According to Brown and Kulik (1977), an event like 9/11 triggers a special biological mechanism in memory, capturing and preserving the event *permanently.* It is like taking a "snapshot" of personal details of an event. In contrast to ordinary long-term memories, Brown and Kulik considered flashbulb memories to be permanent, pristine, and accurate.

(Columbine, the Challenger explosion, and the death of Princess Diana are more events that may result in flashbulb memories for students.)

Whether we really have the capacity to form flashbulb memories has been under much debate. Neisser and Harsch (1992) argue that flashbulb memories may be vivid but not necessarily accurate (for example, occasionally you may find some of the details of a student's flashbulb memory to be inaccurate). In other words, flashbulb memories may be subject to forgetting just like other, ordinary long-term memories. Nevertheless, Palmer, Schreiber, and Fox (1991) argue that firsthand experience is key to creating a flashbulb memory. The debate about flashbulb memories is yet to be resolved.

We are capable of remembering vast amounts of highly detailed information. Even though we are confident that our memories are accurate, they may not necessarily be so. In fact, there is considerable research to suggest that our memories are not pristine and perfect, but that they can change over time and material can be forgotten.

## Eyewitness Testimony

In some cases, memories seem to be resistant to forgetting. However, when a memory is stored, it is not necessarily maintained in some pristine state—it can erode and/or change from our own thinking because of other people's suggestions, time, etc. Elizabeth Loftus (see Loftus and Palmer 1974) has shown that our expectations can alter the way we remember an event.

Loftus's work revolved around the accuracy of eyewitness testimony. In particular, she was interested in whether the details of an event were influenced by a post-event suggestion. In a classic experiment, Loftus showed a videotape of a car getting into an accident with another vehicle. After the subjects viewed the tape, they were asked to estimate the speed of the car in one of the following ways:

> How fast was the car going when it smashed into the other car?
> How fast was the car going when it collided with the other car?
> How fast was the car going when it hit the other car?
> How fast was the car going when it bumped the other car?
> How fast was the car going when it contacted the other car?

Loftus found that the wording of the question influenced the estimates provided by the subjects. In particular, the subjects were more likely to estimate faster speeds when the question suggested that the car was going fast (e.g., smashed) than when the question suggested that the car was not going fast (e.g., contacted). Loftus reasoned that the difference in estimates may be due to one of the following explanations:

1. ***Leading questions:*** The subjects did not really know how fast the car was going but provided on estimate based on the suggestion of the verb. For example, the verb "smashed" suggests that the car was going fast, so the subjects in this condition hedged their estimates accordingly.
2. ***Altered memory representation:*** In contrast to the leading question explanation, the question may have actually influenced the subjects' memories of the severity of the accident.

To test these explanations, Loftus replicated her previous experiment and asked subjects if they recalled seeing broken glass at the accident. In reality, there was no broken glass, but Loftus reasoned that if the question influenced the memories of subjects, then those who were given the more severe verbs (e.g., smashed, collided) would be more likely to recall falsely seeing broken glass. This is exactly what Loftus found.

Thus, Loftus demonstrates that post-event information influences the memory of that event. Consider the real-world consequences our memories may have: Eyewitnesses are often used to pick out suspects from lineups—the suggestions posed by police or even how the individuals are lined up may influence the eyewitnesses' memory of the perpetrator, making the eyewitnesses' memory unreliable. I usually like to discuss a case or two of mistaken identity to show students that it is unwise to rely only on the memory of an eyewitness.

## False Memories

It becomes clear to students that, although under many circumstances memory is accurate, memory is not like a videotape that captures all details of an event with perfect accuracy. Loftus's research demonstrates the fallibility of details of memories through post-event suggestions; however, psychologists are also interested in learning if an entire false memory can be created.

Roediger and McDermott's (1995) memory for semantically related words is one of my favorite demonstrations to do because students are typically stunned by the results. To do this demonstration, construct a list of 10 to 12 semantically related words. For example, I try to get students to falsely recall the word sleep" by presenting them a list of words related to it (e.g., bed, tired, doze, blanket, snore, nap, alarm, yawn, dream, drowsy, etc. Observe that "sleep" is not on the list). I read the words, at approximately 3 to 4 seconds apart, one by one to the students. Then I ask them to recall as many words as they can. (This task works well if you can delay their recall by at least 10 to 15 minutes by doing some other activity.) I read each word from the list and ask students to raise their hands if they recalled the word. When I am halfway through the list, I ask them if they recalled sleep—a good percentage of the students have false recall of the word. They are amazed when I tell them sleep is not on the list but rather, they have created a false memory of it. Often, they are able to explain the false memory of the concept in terms of spread of activation of semantically related concepts. Words such as *doze*, *nap*, and *tired* become activated by mentioning them, and that activation automatically spreads to other related concepts such as sleep. (This is the same mechanism responsible for coming up with words like bus and sun in response to "yellow" at the beginning of the module.)

Sometimes, students are not so impressed that we can falsely remember a concept when it is preceded by the presentation of its semantic associates. These students want to know if full-fledged episodes of memories can be created. There is ample evidence to suggest that we are indeed susceptible to creating false memories of complete episodes. I usually cite the research of Hyman, Husband, and Billings (1995), which involves college students' memories of childhood events. The subjects were presented with a series of childhood events, as verified by their parents, and asked to recall these events (e.g., an emergency room visit). In addition to the actual events supplied by their parents, a bogus event (such as spilling punch on the bride's parents at a wedding) was included. In a first interview, the subjects were adept at remembering the actual events (84 percent). In a second interview, their recall of the actual events increased to 88 percent. No one falsely recalled the bogus event during the first interview. But, just by presenting the events again in the second interview, some subjects falsely remembered details of the bogus event (e.g., it was an outdoor wedding, and I think we were running around and knocked something over like the punch bowl or something and made a big mess and, of course, got yelled at for it). This finding suggests that under some circumstances, we may construct false memories.

## Improving Memory

I emphasize the importance of using elaborative rehearsal over verbal rehearsal. I discuss the following elaborative rehearsal strategies to improve memory for students.

**Mnemonics** are cues that enhance memory by linking organizational sets of information to memory elements that already exist.

a. ***Method of loci:*** Use a list of locations to remember items; mentally travel to locations and associate to-be-remembered information with a specific location. Then have the students recall, mentally travel the path, and "look" at the location and item associated with it. For example, remember the list of items I need to bring to a meeting; associate each item with the locations from my office to the classroom.
b. ***Keyword method:*** This is very effective when teaching a foreign language.

Associate a foreign word with a similar-sounding English word (this is the keyword) and form an image of the meaning of the foreign word with the keyword. For example, *haricot* (French, means bean) sounds like "hairy coat" (key). Imagine a bean wearing a hairy coat. So, when presented with *haricot*, you recall the image of a bean wearing a hairy coat. You know *haricot* means bean.

**Massed versus distributed practice**—tell the students that one of the least effective ways of learning material is to cram. Rather, learning is enhanced when it is spaced apart. Evidence has demonstrated that, when we distribute studying over periods of time, we are more likely to understand and remember it. The distribution of material allows us to step away from the work, think about it, and approach it again. Massed practice does not enable us to treat the material this way. So, if students really want to do well and learn material, they should set aside study time several times a week.

**Overlearning** enables people to strengthen the connections in memory; they are making information easier to retrieve.

**Imagery**—it seems that forming images often helps us learn and retain information for long periods of time. This is explained by Allan Paivio's dual coding hypothesis: we store information in memory in two codes—verbal and pictorial. Paivio argues that we're more likely to remember concrete words because they are stored in two codes (verbal and pictorial), whereas abstract words are stored just in a verbal code. Thus, if we forget information from one code, we always have the other code to help us recall the information. It is harder to form images with abstract material.

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# All You Need to Know to Teach Language to AP® Psychology Students

**Chris Hakala**

Language is one of the most uniquely human activities in which we engage. It allows us to communicate; it allows us to convey thoughts, feelings, and emotions across time and space; and it allows us to write what we think and then have others read those thoughts at times quite separate from when we actually stated them in the first place. Simply put, language is one of the most important characteristics of human behavior.

## What Is Language?

**Language** is a complex communication system that involves the use of abstract symbols to convey unlimited messages. By this definition, we have to leave out most animal communication because there are limits to what animals can communicate to each other. However, human language can convey meaning about things that haven't happened yet, things that happened in the past, and things that may never happen. Because we can transcend time and space with language, we have an unlimited ability to communicate ideas. In addition, gestures that we often use are not language either. For example, waving hello is not really an act of language because the simple act of waving does not transcend time or space. When I wave to someone, I wave to them "right now," not in an hour, not in a week, not yesterday. Animal communication is the same. When a dog barks, it is not an indication of some discomfort the animal had two weeks ago. Rather, the animal is communicating that "right now" there is something in its world that is capturing the animal's attention.

One of the most important issues to consider when discussing language concerns the organization of the complex linguistic units that comprise human language. How is language structured? According to many linguists and psycholinguists, language is a multilayered process. It all starts with the theoretical structures known as *phonemes*. A *phoneme* is the smallest unit of sound in a language. For example, all the letters of the alphabet are phonemes (although there is some overlap; for example, *c* can make the *k* or the *s* sound—a fact that children often struggle with). In addition, blends (such as *ch*, *sh*, *th*, etc.) are also *phonemes*. In English, we produce all the unique sounds that we are able to make by combining only about 40 to 50 unique *phonemes*. (I say between 40 and 50 because there is no universal agreement about this.) Other languages make do with less. For example, Hawaiian is often cited as a language that has less than 30 *phonemes*.

The next level of language is the *morpheme*. According to linguists, morphemes are the smallest unit of meaning in a language. So, small words, such as *dog* or *run* are *morphemes*. If we add the letter *s* to *dog*, we now have two *morphemes* (dog[s]), and if we add *ing* to run, we now have two *morphemes* (runn[ing]). Many words are composed of a large variety of *morphemes*, which are all combined to produce a unique meaning. It's in this recombinant way that we are able to produce such complex words as *underground* or *penultimate*.

Of all the aspects of language, syntax is considered by many psycholinguists as one of the most important. *Syntax* refers to the ordering of words in a particular utterance. For example, in English, we typically place nouns or subjects first and verbs or predicates second (e.g., We are going to the store.). We can reverse the order, but we need to do so only in specific situations, such as when we want to ask a question (e.g., Are we going to the store?). One of the benefits of having a syntactic structure in a sentence is that we often interpret the meaning of a word or the part of speech of a word by its placement in a sentence. For example, if a word follows the article *the*, it almost has to be either a noun or an adjective. At least that is how we might go about interpreting such a word. Given that flexibility in the English language, we are often able to create new words by recombining them into different uses. For example, *book* is almost always a noun, unless we use it in the exclamatory fashion (e.g., Book him!). In this case, we have turned a noun into a verb. We are only able to do this because a verb is what is expected in that first spot, and so we assign the verb role to that word and a new meaning emerges. In fact, we often use this fact to help us understand words that we do not understand.

## How Do We Learn Language?

Learning language is an issue that has been rife with controversy in psychology. The behavioral approach posits that we learn language the same way we learn anything else. We are exposed to things in the environment and, if they are reinforced, we repeat the behavior. Nativists, however, would argue that we are "hardwired" to learn language and that humans are unique in this respect. Both sides have their ardent supporters, but the evidence has not clearly settled the debate as of yet.

## Language Acquisition

According to linguist Noam Chomsky, language is learned by exposure to language, but the ability to speak is hardwired; that is, humans are born with the innate ability to speak, and the interaction with the environment allows that skill to emerge. Chomsky argued that the behavioral approaches do not take into account the problem that we learn language differently than we learn other things. According to Chomsky, there is a sensitive period of language acquisition and, if we do not learn language during this time, we are not going to learn language well. There is overwhelming evidence to support this; yet, Chomsky's argument about the speed with which we learn language may be overstated.

It is true that only humans learn language and that only humans learn to speak without being specifically taught language. However, human learning is more complex than simply learning connections between behavior and consequences. Oftentimes, reinforcement can be more subtle. For example, a child might babble and, during the course of babbling, might utter a sound that approximates a word. The parent will then provide reinforcement for the utterance by praising the child. The word then becomes self-reinforcing. In such a way, words will continuously be added to the child's vocabulary. In fact, there *is* evidence that the environment does have a large impact on the amount of verbal behavior that an individual can produce. Specifically, a study done by Hart and Risley (1995) demonstrated that the amount of verbal input has a direct input on the amount of language that a child is able to produce later. Regardless of how a child actually learns language, the pattern of language acquisition is remarkably predictable.

| Age | Milestone |
|---|---|
| Birth to 2 months | Cooing |
| 2 months to 12 months | Babbling |
| Approximately 12 months | First word (typically a simple sound such as "da" |
| Approximately 16 months | Two word utterances |
| 2 to 6 years of age | Add 6–10 new words per day |
| During ages 2 to 6, learn grammar | Overextension (doggie for every four-legged animal |
| Age 5 | Overregularization: I goed to the store |
| From age 5 on | Add words to vocabulary; learn subtleties of language |

This pattern is not only predictable in English. Other languages show the same pattern of language acquisition. In addition, an interesting point to be made about language is that all children appear to babble the same way. That is, children make the same noises in all languages as they acquire language. As a native language begins to emerge, sounds appropriate to that language are strengthened, and the inappropriate sounds drop out. This explains why parents often believe that children are babbling in a foreign language!

In addition, children seem to make the same predictions about language at about the same time. For example, if children are told that they are looking at a "wug," and then are asked what one would say if there were two of these critters, they will say "wugs." In addition, if they are told that a person will "wik," they will generate the forms "wiked" and "wiking." Thus, they seem to learn the rules that they can then apply where appropriate.

## Linguistic Universals

According to the work of Hockett (1963), not only do children learn language in a predictable way, but all languages, across cultures, have characteristics in common. There are, in fact over a dozen linguistic universals. For purposes of this article, I will not present all of them. However, the flavor of these universals is important for understanding the unique properties of human language.

1. ***Arbitrariness:*** Language is arbitrary. This means that words are not inherently imbued with meaning. Rather, words are selected to stand for objects in the world in an arbitrary manner. *Dog* in English is *chien* in French. Neither word is better than the other. However, we have agreed, as speakers of English, to call canines, dogs; and speakers of French have agreed to call these animals *chien*.

2. ***Displacement:*** Language allows us to talk about events that have already happened, events that will happen, and events that may not happen at all. No other form of communication allows for this.
3. ***Vocal-auditory channel:*** All languages in all cultures rely on the vocal auditory channel as the primary form of communication using language. Other forms, such as sign language, are possible, but these are only used in situations when the vocal auditory channel is somehow compromised.

As I described above, there are many more linguistic universals. However, this list represents some of the most important linguistic universals for distinguishing between human language and other forms of communication.

## Conclusion

Language is one of the most interesting concepts in psychology. It is one of the characteristics that makes humans unique in the animal species. Although there is controversy over how we learn language, we know that it is learned in a predictable pattern that is consistent across cultures and languages.

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# How to Evaluate What Students Have Learned About Cognition

**Emily Soltano**

Unlike other areas of psychology, cognitive psychology is abstract and hard for students to grasp. I try to begin each class with a task designed to help prepare the students for the complex material that is about to follow.

## The First Day

I begin each new semester by bringing a *furby* to class. A *furby* is an electronic toy that speaks Furbish and, with time, speaks less Furbish and more English. When a *furby* is moved it begins to “talk” and, after a period of time of no movement, it “goes to sleep.” I present the *furby* to demonstrate that something makes *furby* talk, something that neither I nor the class can see. We begin a discussion about what makes the *furby* talk: Is it a simple stimulus—I move it—followed by a response? Is the *furby* more complicated than that? Is there something inside *furby*, such as batteries, wires, a computer chip, etc.? This demonstration is a starting point for a discussion about the nature of cognitive processing. I make it clear that as human information processors we are more complex than a computer chip even though we cannot directly see how we process information. We can see the overt behavior (e.g., verbal response or button-press response) that is a result of an underlying process. In other words, cognitive processing is inferred based on observable responses to tasks that cognitive psychologists create. This typically leads to a discussion about how mental processes can be inferred, and I introduce the concept of reaction time in milliseconds as a measurement. Understanding the concept of measurement in milliseconds is difficult. At this point in the course, students have not yet considered how quickly we process information, (i.e., in milliseconds). Students get a sense of this precise measurement when they participate in computer-generated experiments such as those found on the CogLab2 Web site.

## Assignments—General Cognitive

Students are required to purchase access to CogLab2 (http://coglab2.wadsworth.com), an online cognitive psychology laboratory that hosts experiments for just about every cognitive process. Many of the experiments are replications or modifications of classic research (e.g., Stroop 1935, false memory). For each CogLab experiment a brief description of the classic study is provided along with the results. An online access code costs approximately $30 per student. This includes unlimited access to all the cognitive experiments. Students can participate in experiments and also access the data for the experiments. An access code can be purchased directly from the CogLab Web site, or the faculty can request that it is bundled with a particular textbook published by Thomson/Wadsworth. Alternatively, there is a CogLab CD version. The cost is approximately $38 per CD.

Using CogLab, students experience cognitive tasks firsthand rather than hearing a lecture or reading about them; they are exposed to real experiments and various experimental designs. Their participation is invaluable in demonstrating how cognitive processes are measured in milliseconds, a concept that is not easily understood. Students gain an understanding of the timing of events; that is, 50 milliseconds are faster than they thought, if they ever thought about it. CogLab allows an instructor to set up a class Web site so that the class can view the data they provided and discuss whether their data replicated the classic studies. You may see the aggregated data (e.g., mean reaction times for the different conditions of an independent variable), or use the raw data and compute a data analysis (e.g., a *t*-test).

CogLab is an invaluable tool because, not only do students learn about concepts in this area of psychology, they also learn more about research methodology, such as hypotheses, independent and dependent variables, between and within subjects designs, replications, partial replications, importance of controlled experimental settings, confounds, and ecological validity, to name a few examples. Often the class data replicates the classic findings, but I take advantage of the instances when it does not. We spend time discussing possible reasons for the class results, such as the importance of a controlled environment, potential confounds, variability of equipment, and sample size.

CogLab participation promotes active learning and students like participating in them. Many students have said that simply reading about experiments is boring and that being a participant helps them learn about and remember the experiment. It even helps students remember the names of researchers associated with classic cognitive psychological research (e.g., Miller 1956, short-term memory span). One student even indicated that "it is something new and would probably stand out from the rest of the information that is taught in classes." A student in a current section of cognitive psychology said that she is amazed that researchers have designed these experiments to get at an understanding of cognitive functions. That could not be achieved without the student's participation in the experiments.

There are other Web sites similar to CogLab such as PsychMate (http://www.pstnet.com/products/PsychMate), which offers students opportunities to participate in experiments. There is a fee for students to participate in these studies. There are other simulations available online such as those found at a Web site (http://iea.fau.edu/pusateri/home/cognition.htm) created by Thomas Pusateri.

In my class, students keep a journal of the CogLabs in which they participated. For each CogLab entry, they do the following: (a) describe the task, (b) identify the cognitive process for which the task provides evidence, (c) identify the independent and dependent variables, and (d) provide a real-world application. Writing about the experiments encourages students to make connections between the abstract concept and the experiment, the cognitive process it is supports, and how this abstract concept is a part of their own life.

CogLab is an effective tool for teaching students about the information processing view of memory systems (Atkinson and Shiffrin 1968). There is a simulation for demonstrating the capacity and duration of information stored in iconic sensory memory (partial report task, Sperling, 1960); for demonstrating characteristics of short-term memory such as capacity (Memory Span task, Miller 1956), and duration (Brown-Peterson task (Brown 1958; Peterson and Peterson 1959).

As an introduction to the topic of language, I discuss Hockett's (1960) linguistic universals that propose features that characterize human languages as different from animal communication systems. Which linguistic universals are critical for language? Which aren't? Which ones are unique to auditory language (versus American Sign Language [ASL])? We watch the Koko video (*A Conversation with Koko*) about a gorilla that was raised in captivity and taught American Sign Language. We discuss which universals are present in Koko's language (i.e., Koko's version of ASL), and which critical universals are present. Does Koko have language as defined by Hockett's (1960) universals?

These activities are designed to help students learn about the material and to help the faculty member evaluate the material effectively so that the amount of learning that has occurred can be determined.

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## About the Editor

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