Chapter 3
Learning: A Psychological Perspective
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ABSTRACT
This chapter reviews research into human and animal forms of learning. It concentrates on two forms of learning in particular: The first is conditioning. The study of conditioning constitutes the first example of experimental research on learning. At first, it seemed to corroborate the view that learning consists of establishing associations. This form of learning was proposed by the early empiricists. The notion of associative learning influenced the emergence of behaviorism, which used conditioning to account for all forms of human and animal behavior. More recent research, however, has shown that conditioning is a more complex form of learning, related to propositional learning. This makes conditioning important for the study of the mechanisms of other, more complex, forms of propositional learning, as found in language and reasoning. The second form of learning reviewed here is visual learning. The study of this form of learning is important for understanding visual processing. And it is important for investigating the neural mechanisms of learning, given the availability of animal models of visual processing.

INTRODUCTION
The ability to learn is one of the most important features of intelligence. Without it, it is hard to negotiate a complex environment and to deal with ever changing circumstances. Speculations as to how humans learn can be dated back to ancient (Greek) philosophy. From the early days on, the issue of learning is related to the nature-nurture debate. That is, are we born with certain forms of knowledge or abilities, or are all forms of knowledge acquired through experience?

Roughly two opposing positions can be discerned in this debate. The first one is that of rationalism, defended by Plato and, later on, by Descartes. According to this view, the core of human knowledge is inborn. By reasoning, we can expand our knowledge. Experience can be useful...
Learning to focus the mind on certain issues, but it is not the primary source of our knowledge. The opposing view is that of (epistemological) empiricism, as defended by Locke in his *Essay concerning Human Understanding*, first published in 1690. According to empiricism, the mind is a blank slate at birth. No ideas are inborn, instead, the mind gradually acquires ideas through experience.

Learning is of primary importance for empiricism. Locke described how we acquire ideas through our sense (simple ideas) and how these ideas combine into more complex ideas through experience. So, first we would have ideas like round (shape), green (color), smooth (texture), and sweet (taste), derived from our senses. Later on we combine these simple ideas into the complex idea of ‘apple’, based on our recurrent experience with apples. Complex ideas derive from simple ideas by the process of association.

The 17th century empiricists aimed to discover the laws that determine how ideas become associated through experience (learning). They argued that we tend to associate ideas because they are in opposition to each other, like white and black or round and square (law of contrast). Or, we associate ideas because they resemble each other (law of similarity). But the most important law of association suggested by the empiricists is the law of contiguity. We associate ideas when they (frequently) co-occur together in time and place. In this way, we learn for example that the combination of round (shape), green (color), smooth (texture), and sweet (taste) constitutes the idea of an apple, because these simple ideas co-occur in time and place whenever we encounter (certain types of) apples.

Later generations of empiricists also formulated laws of association that would account for the strength of an association. So associations between ideas are stronger when our experience of their combination is more frequent, when our experience is more recent, or when our experience is more intense (e.g., more emotional). However, the study of the process of association (learning) was still based on a theoretical analysis. It became an experimental science when Pavlov discovered the process of conditioning, by which perceptions of different events can become associated (or so it seems). The discovery of conditioning forms the beginning of the scientific research into learning, at first dominated by behaviorism.

**BEHAVIORISM**

In his classical conditioning experiment, Pavlov (1927) showed how an initially neutral stimulus such as the sound of the bell can become the trigger of a response like salivation, that is normally triggered by a food stimulus. The food stimulus is referred to as the unconditioned stimulus (UCS). The salivation response triggered by the food is referred to as the unconditioned response (UCR). Normally, a stimulus like the sound of a bell would not trigger the response of salivation. In the learning stage of the experiment, the bell sound is combined with the food stimulus. That is, the bell sound precedes the presentation of the food. After some time, the bell sound alone triggers the response of salivation. In the terminology of conditioning, the bell sound has become the conditioned stimulus (CS) and the response of salivation has become the conditioned response (CR) when it is triggered by the CS.

At face value, conditioning resembles the process of association proposed by the early empiricists. The CS becomes associated with the UCS (or with the UCR) because the CS and UCS are presented together for some time. This resembles the law of contiguity, one of the association laws proposed by the empiricists. Or course, Pavlov conducted his experiments with animals (dogs) and not humans. But in the mean time, Darwin had proposed his theory of evolution, so animal learning could be seen as a precursor of human learning, because the latter evolved from the first.

Behaviorism combined evolution theory and conditioning into an account of human behavior.