

## 5 The Psychology of Learning

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### SUMMARY

*In this chapter we will attempt to connect the phenomenon of learning, as it is viewed by medical educators, with former and contemporary learning theories, known principles, and research findings from the domain of general psychology. In many studies in medical education, the issue of learning is addressed; however, in only a minority of them is an attempt made to analyze medical students' learning and to determine the factors that influence this learning. To a large extent, this is a consequence of the traditionally large gap between the study of learning in psychology and the various complex forms of learning that occur in higher education, including medical school. However, during the last decades, the psychology of learning and of expertise development has increasingly focused on the topic of advanced knowledge acquisition, which can be viewed as a middle ground between the fundamentals of learning and the various forms of learning that operate in medical education.*

*We will start this chapter with a concise overview of research on and theories of learning from an historical point of view. Subsequently, we will discuss the current state of the art with respect to learning. A distinction will be made between psychological and educational theories of learning. Broadly speaking, current psychological theories of learning deal with what is going on in the mind of the learner during the learning process, and they tend to focus on processes within the learner, or on the influence of individual aspects of the context in which learning takes place (e.g., details of the learning task). Educational theories of learning, on the other hand, are tailored for application in contexts that are deliberately designed to foster or facilitate learning. Though their grain size is much coarser, educational theories are better able to deal with ecologically important factors such as teaching and instruction. Nevertheless, throughout the text, we will try to connect educational studies with more fundamental research on learning.*

*In a subsequent section we will review and discuss the application of cognitive and educational learning theories in the medical domain. Finally, we will give some directions for future research on learning in medical education.*

## INTRODUCTION

Learning is an extremely important issue in medical education. It is addressed in almost all studies and discussions in the field, either directly, or indirectly, for example, in curriculum development and student assessment. All medical knowledge and skills are learned in one way or another. In the most general sense, medical education aims at providing an optimal context for medical students to facilitate this learning. As such, medical education employs several techniques, ranging from expository instruction in lecture-format to providing opportunities for practice in real-life situations. Implicitly or explicitly, it is assumed that all these techniques result in learning.

Thus, knowledge of what learning is and which environmental conditions are favorable to learning is important for medical education. At this place we will not attempt to give a comprehensive definition of learning, particularly because it is hard to find one upon which everybody will agree. Advocates of behaviorism, for example, will view learning as a relatively enduring change of behavior which results from some sort of practice or experience (cf. Shuell, 1986). In their eyes, learning can be described as “what you see is what is learned”. People who do not endorse this view will emphasize, and probably rightly so, that learning includes more than just behavioral change, that some form of mental product or process is involved. On the other hand, whether learning indeed has occurred can ultimately only be assessed by a change in behavior, however minimal this may be, such as marking a correct alternative instead of a wrong one on a multiple choice test item. It is good to be aware that knowledge cannot be observed directly, and that statements about knowledge always require some form of inference from overt behavior.

Another aspect of learning is also important. In its simplest form, learning refers to the retention of information, which can be demonstrated by recognition or recall. For example, in classical paired-associate learning, learners are tested by presenting them with the first word of a pair, and their task is to recall the second. Though such studies have taught us a lot about the fundamentals of learning, such as the “laws of learning”, their practical significance is generally limited. Therefore, more recent studies on learning almost always involve the learner’s use of prior knowledge in acquiring new knowledge, for example by integrating incoming information in prior knowledge structures. When learning builds upon existing knowledge this is called advanced knowledge acquisition, and learning may need to be assessed, not merely by reproduction, but also by the ability to transfer the newly acquired knowledge to a different context, task, or domain (Feltovich, Spiro, & Coulson, 1989; Gagné,

Yekovich, & Yekovich, 1993). Transfer may range from retrieving a piece of knowledge in a different context than the one in which it was initially acquired (e.g., information from a medical textbook applied in a clinical context), to retrieving and assembling disparate pieces of knowledge in order to solve a complex problem (e.g., the use of an elaborate analogy to understand an unfamiliar domain).

## THE PSYCHOLOGY OF LEARNING: SOME HISTORICAL ASPECTS

The scientific study of learning, as an important aspect of human behavior in general, started in the last quarter of the nineteenth century. Before that, philosophers such as John Locke (1632-1704) and David Hume (1711-1776), had already voiced their view on learning as *associations of ideas*, but only after Darwin's idea that behavior, including human behavior, was subject to laws, became generally accepted by the scientific community, was the stage set for a scientific study of learning. Gradually, the view that associations of ideas simply mirrored the structure of the environment – the Lockean view – was abandoned, and in the last quarter of the nineteenth century, experimental psychologists became convinced that learning consisted of linking mental events, which represented the ideas, rather than the ideas themselves. This linking of mental events was seen as a consequence of associative tendencies established in the nervous system as a result of previous activity.

Obviously, psychologists at the time completely lacked the apparatus to investigate, let alone confirm, assumptions about what actually happened in the brain during learning; hence, in the early 1900s, some psychologists decided to remove the concept of mental (or neural) events altogether from their theories and to study human learning only in terms of the formation of direct, lawful connections between stimuli (external events) and responses (visible and/or measurable behavior). Therefore, this new form of associationism was called stimulus-response (S-R) psychology.

### *Behaviorism*

Behaviorism is the philosophical and methodological framework upon which several S-R learning theories were founded. The common denominator of all behaviorists is a reluctance to invoke “mentalistic” concepts (needs, feelings, thoughts, and knowledge) to explain behavior. In addition, as behavior that was supposed to be innate or the result of biological development also fell out of the behaviorists' scope, learning, in the restricted sense of the construction and establishment of S-R connections, soon became the single most important subject of investigation. Actually, researchers have never been more interested in learning than in the years during which behaviorism dominated psychology, roughly from

around 1910 until the late 1950s. Two behaviorists have had the greatest impact on the development of a theory of learning.

*Edward Thorndike* (1874-1949) formulated some laws of learning that he thought would, like laws in physics, be able to account for all apparently diverse forms of learning. One of these was the *law of effect* (1911), which states that learning occurs if and only if the behavior has some (for the animal or human) satisfactory effect upon the environment. Such an effect would result in an increased probability of behavior being repeated in the immediate future. This law of effect was assumed to operate in conjunction with the *law of exercise*, which states that the use of a (S-R) connection increases its strength. Though Thorndike formulated his laws on the basis of research on animal learning, this did not prevent him from applying them to school learning. In his view, the basic mechanism of school learning was repetition followed by reward. Complex learning – and this is typical for behaviorist learning theories – such as occurs in school should be understood in terms of simpler learning principles, such as the law of effect and law of exercise.

The approach of *B. F. Skinner* (1904-1990), known as the *functional analysis of behavior*, is the only variant of behaviorism to survive today (Howard, 1995). Unlike other behaviorists, Skinner focused on the control, rather than the explanation, of behavior. However, like Thorndike, he also extended his theories into the educational field. Basically, Thorndike's law of effect was transformed by Skinner into the notion of *reinforcement*: by controlling the environmental consequences the learner – in Skinner's case often an animal like a rat or pigeon – received after performing some behavior, this behavior could be manipulated, or, in other words, new S-R connections could be formed. Skinner also demonstrated that animals could learn to perform simple chains of responses. As the prevailing view was that human behavior, though much more complex, did not differ fundamentally from animal behavior, Skinner concluded that all learned human behavior could be explained by simple learning principles, which ultimately boiled down to appropriate administration of reinforcement. In fact, the better part of Skinner's work consisted of finding out how reinforcement should be administered to be effective. Based on numerous studies, he concluded that three variables were important: *frequency*, *contiguity*, and *contingency*. For optimal learning to occur, reinforcement should be given frequently (but not on all attempts), it should be delivered immediately (contiguity), and should depend on the appropriate response being made (contingency).

Though laypeople often have an unfavorable view of behaviorism, and hence tend to associate it with unfavorable forms of learning – such as rote memorization or drill – the facts do not justify this view. From Thorndike onwards, behaviorists realized that, to be successful, any form of learning must be rewarding for the learner. Skinner, for example, criticized the prevailing teaching techniques, featured by the use of punishment and the lack of consistent and frequent reinforcement of correct behavior, which in his view impeded effective learning (Skinner, 1954).

Skinner's view of the role of reinforcement in society, as exposed in his novel *Walden Two* (1948), pervasively influenced American education in the 1950s and 1960s. To foster classroom learning, controlling the contingencies of reinforcement is crucial; in practice this boiled down to – at least in primary education – controlling behavior by consistently and immediately rewarding desired behavior and ignoring undesired behavior. In higher education, on the other hand, it was soon realized that reinforcement was most effective not in the form of an external reward, but if it also contained information about the quality of the response. Such reinforcement, which informs the learner about his performance, is called *feedback*. Feedback has several benefits: it creates motivation, supplies reward, and provides cues and guidance that assist in the shaping of learning (Mosél, 1964). In addition, feedback can be controlled by the instructor, and thus effectively optimized. As it would be too demanding for a single teacher in a classroom to consistently apply feedback principles to each individual student, the next step was to program feedback, in order to provide it with minimal delay and appropriate specificity. Thus, the technique of programmed instruction was developed.

Programmed instruction is particularly useful for learning factual information that can easily be sequentially organized. The method can be implemented in a booklet, teaching machine, or even a computer. In 1984, Skinner asserted that computer assisted instruction (claimed by cognitive psychologists as being new) is nothing more than an extension of earlier implementations of programmed instruction (Skinner, 1984). In programmed instruction, a course is divided into self-contained units, consisting of a series of easy questions about the topic. A topic starts with a question the learner can already answer and moves in very small steps to the topic's end. The learner reads each question, answers it, and then sees if he is right. As the gaps between questions are slight, he almost always will be. The behavioral principles at work are clear: The aim is a behavior change (to answer all questions correctly), the learner is responding (by answering questions), and responses are immediately reinforced (usually) by the learner being told he is correct (specific feedback), and there is a progressive build-up to the terminal performance.

In the early 1960s, programmed learning was hailed as a major educational advance. Many programs and even whole textbooks were written in programmed learning code. By the early 1970s enthusiasm waned, however, and the method is not often seen today (Howard, 1995). Possible reasons for this are that the programs take a lot of effort to write, and students – in particular students at the university level – may find them boring (Roth, 1963) because of their repetitive character. In addition, though programmed instruction sometimes worked well, only a minority of programs were superior to conventional teaching (Holding, 1987) and the method seems not particularly well suited for considering more controversial aspects of subject matter or for expressing originality and independence of thought. Finally, though it is basically an individualized form of self-instruction,

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