Chapter 2
Learning: Developing Knowledge Through Making Meaning

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Introduction

Education of the patient has been a cornerstone of medicine for centuries. Early generations of healthcare professionals could offer patients little beyond prognostication, explanations for reasons for illness, and attempts at helping the patient derive meaning. As the general public has become more educated and medical care has become more complicated, the need for patient education has increased. Indeed, the necessity for patient education is implied by the core biomedical principle of autonomy as an individual's self-determination is not possible without access to information. The need for a better-informed patient population became more explicitly defined in the twentieth century. As early as 1914, the notion of informed consent was articulated by Justice Benjamin Cardoza:

> Every human being of adult years and sound mind has a right to determine what shall be done with his own body; and a surgeon who performs an operation without his patient's consent commits an assault for which he is liable in damages. This is true except in cases of emergency where the patient is unconscious and where it is necessary to operate before consent can be obtained. [1]

Later in the twentieth century, consent alone was not considered sufficient. Rather, *informed* consent in which a patient was educated on consequences of particular therapeutic interventions became more strictly enforced. By the 1970s, the need for general education beyond informed consent processes was codified. In 1973, the American Hospital Associated published *A Patient's Bill of Rights,*

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articulating the right to information regarding diagnosis, treatment, and prognosis. Such bills of rights have been subsequently adopted by different organizations and state legislatures [2].

Beyond the ethical implications regarding the rights of patients to healthcare information, there are important cultural and moral changes that are worth considering. Medicine is becoming less and less paternalistic. We increasingly recognize that healthcare occurs outside the clinic and hospital and that it inevitably requires partnerships with patients and families. We begin patient encounters with asking them to educate us – on what their symptoms are, how these symptoms affect their lives, and what their concerns are. We end patient encounters by summarizing the patient's problems and then educating the patient on the importance and timing of ongoing diagnostic tests and treatments. In this chapter, we will outline the principles and theories of adult learning for the purpose of improving patient education.

Learning Theories

Over the course of the nineteenth through twenty-first centuries, there have been a number of collections of theories to attempt to explain how children and adults learn. While none of these is comprehensive, they all shine a slightly different light on the learner and can each provide insights into strategies that assist with patient education. The strategies we will focus on include:

- *Behaviorism* with a focus on external responses to stimuli rather than internal cognitive processes themselves.
- *Cognitivism* which focuses on internal processes to organize and interpret stimuli.
- *Constructivism* which focuses on the ability of the learner to learn through created experiences.
- *Connectivism,* a recent theory that attempts to explain the different modalities and network methods by which a person acquires information.

Behaviorism

In the late nineteenth and early twentieth centuries, the theory of *behaviorism* was developed. The focus of this theory was on the concrete and observable. Since cognitive processes themselves are not observable, these processes were not considered in regard to development of most theories and largely existed in a black box (Fig. 2.1). The main emphasis was the *response* an organism had to a particular *stimulus.* Learning was seen as the connections that people (or animals) made between stimuli and responses.

In the late nineteenth century, a series of experiments conducted by Ivan Pavlov (1849–1936) developed the basis for *respondent conditioning* (*classical conditioning*) by demonstrating the role of combining stimuli to elicit a response. Pavlov first

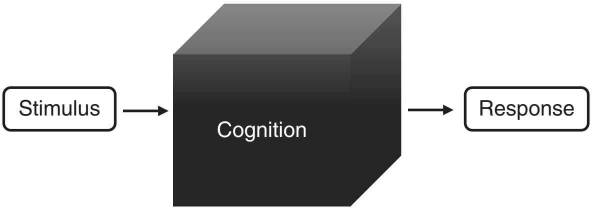

Fig. 2.1 Behaviorists focused on externally observable components of learning. Therefore, much of the interest was placed on a subject's response to a stimulus. Since cognitive processes are not directly observable, the human mind was essentially a black box and not necessary for developing theories of behaviorism

noted that some stimuli were innate (unconditioned). The smell of food (stimulus), for example, innately caused a dog to salivate (response). By definition, this unconditioned response did not need to be learned but occurred naturally. His insight was that by combining this innate stimulus (food) with a neutral stimulus (ringing a bell), these stimuli could become associated so closely that the ringing of a bell could induce salivation. In this way, the dog learned (or was conditioned) to respond to the neutral stimulus. Importantly, these connections could be extinguished if the neutral stimulus occurred enough by itself (e.g., if the bell rang without the appearance of food) [3].

Classical conditioning focuses primarily on stimuli that occur *prior* to a response. However, the later behaviorist B.F. Skinner (1904–1990) described the role of stimuli that *followed* a response. In *operant conditioning*, he characterized the role of reinforcements or punishments following a response. Examples of positive reinforcers include grades, praise, and money. The association between the reinforcement or punishment and the desired behavior are modified by a multitude of factors including the type of reinforcement (or punishment), the reinforcement schedule, the specificity of the reinforcement for the particular behavior, and the immediacy with which the reinforcement occurs. Immediacy and specificity likely play a role in solidifying causality of the reward with the stimulus. For example, slot machines are made more addictive when reinforcements occur immediately after a "pull" as opposed to when the reinforcement is delayed [4]. Likewise, a person developing sneezing, rhinorrhea, and hives *immediately* after exposure to a cat and *only* after exposure to a cat will likely begin to draw causal relationships (even if it is not at a conscious level).

Applications

Behaviorist principles themselves do knowingly or unknowingly affect healthcare professional interactions with patients. For example, praise may be given to a patient who has quit smoking (positive reinforcer) while lack of response (nonreinforcement) or disapproving look (punishment) may be given to a patient who continues to smoke. A particular limitation to behaviorism in general is that the subject is considered to be passive and lacking free will. In this model, learned behaviors are nothing more than responses to stimuli with the subject having very little control of those responses. This is clearly at odds with our notion of patients as unique individuals with agency. If learners are viewed as being relatively passive, ethical concerns come to the forefront such as who is actually deciding on the desired behavior – the healthcare professional or the patient? Consequently, strict behaviorism may be contrary to the notion of patient autonomy and building a therapeutic partnership.

Even if strict behaviorist principles are not utilized in the clinic setting, it is important to note the role of these principles in the everyday world. This is especially true as it relates to smoking abuse and other addictions. Operant conditioning is primarily at play as the nicotine in cigarettes (similar to other drugs of abuse) converge on a dopaminergic reward pathway in the limbic system providing a positive reinforcement [5]. As cigarettes themselves are a very rapid delivery device achieving detectable blood levels of nicotine in seconds to minutes [6], there exists a strong relationship between behavior and reinforcer. This behavior is further strengthened by withdrawal effects when smoking stops. Indeed, the mechanism of action for varenicline (Chantix®) is that of a partial agonist of certain nicotinic receptors. From a behaviorist perspective, varenicline minimizes the reinforcement achieved from smoking a cigarette while mitigating withdrawal symptoms (i.e., minimizing the punishment associated with smoking cessation) [7].

Beyond this strict operant reward system that works to maintain smoking, patients also develop strong triggers. Many reports have demonstrated that people can develop urges and physiologic responses to neutral stimuli when paired with smoking demonstrating that environmental cues can be classically conditioned to smoking [8]. Furthermore, classical conditioning strategies have historically been used in advertising campaigns for cigarettes to associate smoking with social acceptance, sexual appeal, etc. In later years, public service announcements have attempted to associate cigarettes (neutral stimulus) with more negative stimuli. As an example, the *Tips From Former Smokers®* campaign from the Centers for Disease Control and Prevention (CDC) makes efforts to connect cigarette smoke viscerally with unwanted consequences that may occur [9].

Cognitive Psychology

While behaviorism is useful for understanding simple responses to a small number of stimuli, the theory is inherently limited. There is no insight into the "black box" of cognition. Furthermore, predictable responses to stimuli are not always observed. Words of praise given to one patient may be a positive reinforcer though may seem patronizing to another and thus have the opposite effect. Finally, behaviorism has a fundamental limitation; it provides no explanation for people's ability to generalize, use analogy, or problem-solve. *Cognitive Psychology* attempts to address some of limitations of behaviorism and place more focus on the learner rather than the environment. Developed in the mid-1950s, it metaphorically drew parallels with computing systems emphasizing how information is received, processed, organized, and retrieved. However, as research findings accrued, the contrast between human brain architecture and computer architecture has become more apparent.

The Architecture of the Mind

Following the computer metaphor, the mind is generally described with specific modules [10]. People interface with and receive information from the external world through senses (e.g., vision and hearing). Precisely how this information is extracted from the environment is explored through studies of "attention and perception." A central notion of attention and perception is the concept of *working memory* which is somewhat analogous to the random-access memory (RAM) of a computer. However, unlike computer RAM, which has expanded exponentially as computers get more and more powerful, human working memory is severely restricted – approximately seven "chunks" of information [11]. Finally, the processing that occurs in working memory involves accessing prior knowledge in "long-term memory."

The Sensors: Attention and Perception

Due to the constraints of working memory, there are inevitably more stimuli than any person can attend at a single time. As such, learning new information requires selective attention to particular stimuli. These stimuli are not always the same between patient and healthcare professional. The pertinent details of a patient room or hospital room may fade so far into the background for the clinician that it does not register in the conscious mind, whereas these details may be the first and most important impression the patient has about the clinical encounter.

With recent developments in technology such as the omnipresence of computers and smartphones, people (patients and healthcare professionals alike) often believe they have increased their ability to *multitask* (i.e., attend to more stimuli than was previously possible). While this liberation from the constraints mind architecture is popular, careful study shows that the only way a person can "multitask" is when one of the tasks is completely automatized (e.g., driving on a quiet street and carrying on a conversation) [12]. Instead of multitasking, people are more prone to task switching, a practice that comes at the expensive of attentiveness.

In the medical profession, it is particularly important to bear in mind physical and mental limitations that may impede perception such as hearing and visual impairment, cognitive decline, and hemineglect. Even in the absence of deficits, people are capable of only attending to a finite number of stimuli. Therefore, if a patient is worried about a hospital bill, catching a bus home, or a chronic symptom, he or she may be unable to attend to patient education regardless of how well it is presented. Acute illness may further compound patients' ability to attend to information. Pain, medications, sleep deprivation, and delirium may all impede with a patient's ability to pay attention and thus make learning more complicated and daunting. Naturally, patients are not the only people with various stimuli that compete for attention. Indeed, this happens for healthcare professionals on a daily basis. Concerns regarding clinical workload, an upcoming difficult conversation, a grant deadline, or personal problems may all interfere with our ability to perceive and understand concerns from the patient. It is therefore important to be cognoscente that healthcare professionals and patients may be attending to, and interpreting, very different stimuli during an encounter.

Working Memory

One of the most critical elements of memory, in terms of capacity to learn new information, is working memory. Working memory is the component of the mind where active intentional processing takes place and where information is passed from the external world to long-term memory (i.e., learning). As stated above, working memory is limited to about seven bits of information. This is notable in everyday experience; many people begin having difficulty remembering numbers after about seven digits. Methods of overcoming this limitation include combining information (or numbers) into "chunks" (e.g., remembering an area code as a single bit of information) or by using associations with previously learned paradigms to facilitate meaningfully encoding information into long-term memory [13].

Experts in some domains like chess extend their memory prodigiously through this strategy. One study from the 1970s assessed the ability of chess masters to remember the positions of chess pieces in a mid-game position after reviewing the chessboard for only 5 seconds. A chess master could correctly recall the position of about 85% of pieces on the board compared with only 5% for a novice. The master's advantage over the novice completely vanished when a similar number of pieces were placed on the board *randomly* – indeed the chess master did worse than the novice [14]. The explanation for this peculiar finding is that the chess master, who had spent years learning, had a different mental map for understanding a chessboard. While viewing a game in progress, the chess master was able to view the board not as individual pieces but as a smaller number of "chunks" that fit into a mental model built upon years of experience. The chess master's working memory was not improved in the slightest, which is why previous chess experience provided no benefit when the pieces were positioned randomly. Rather than having a meaningful way of encoding information into long-term memory, the chess master (like the novice) was completely reliant on the very limited working memory.

Human Associative Long-Term Memory (HAM)

The above scenario highlights one of the ways people are able to meaningfully encode information into long-term memory – namely by association. As an example, memorizing a line of poetry in one's native language would be relatively simple, whereas memorizing an equally long line of poetry in an unfamiliar language would be daunting. Likewise, memorizing a few measures from a piece of music would be dramatically easier for a professional musician compared with a person who has never studied music before. This is one of the main reasons that the human mind differs from a computer. Interestingly, human associative long-term memory has essentially infinite capacity (as it is always able to assimilate and accommodate new information) and has an amazingly rapid processing time of a fraction of a second. Solving a problem or learning something new is all about associating the new information with information already in memory. Arguably, most of human learning amounts to building new information on top of what is already known. As stated by Robert Bjork et al:

> *….. we do not store information in our long-term memories by making any kind of literal recording of that information, but, instead, we do so by relating new information to what we already know. We store new information in terms of its meaning to us, as defined by its relationships and semantic associations to information that already exists in our memories.* [15]

This model of memory has significant implications for learning. Essentially, we must use multiple strategies to help patients relate what we are telling them to what they already know. Strategies include use of analogy, making explicit linkages with what they know, helping them to actively learn through questioning, distributing the learning material over multiple spaced sessions, and many other strategies [16].

Applications

The implications of these insights to patient education loom large. There is some evidence that the size of working memory correlated to Intellectual Quotient (IQ) [17]; however, regardless of intelligence, working memory is *dramatically limited* (again to about seven bits of information). When people have multiple superfluous stimuli that are diverting attention, learning is hampered. Indeed, there is no worse example of this clutter than the nightly television news with different information emerging all over the screen. These additions have repeatedly been shown to have a *negative* impact on learning [18]. The basic idea has been captured in a theory of learning called “cognitive load” theory [19], which hypothesizes that effectiveness of learning is negatively related to the amount of cognitive load the material imposes on working memory. This is why speaking in simple sentences, using plain (non-medical) language, in a setting that is free from distractions is critically important. The goal of effective instruction is to maximize relevant load and minimize extraneous load. In other words, keeping it simple.

Beyond recognizing the limitations of working memory, it is also important to bear in mind the ways that people move working memory into long-term memory – by creating associations with previously learned material. Very often, we as healthcare professionals have a sense that we possess all of the relevant knowledge and simply need to impart this knowledge upon our patients and their families. We fail to recognize that our own unique experiences shape the way we understand the world, and the same is true for our patients. Going back to the previous example, chess masters interpret a chessboard differently than other people because of years of experience, which results in chess masters creating unique mental models they use to create meaningful associations. Likewise, healthcare professionals have years of creating mental models that differ from patients. This means that healthcare professionals and patients may remember, interpret, and understand new information very differently.

During a session with a patient or family, it is critically important to have frequent "check-ins" in order to ensure that (1) the patients' understanding is consistent with what we are trying to convey and (2) our own mental representations are in accord with the patients' concerns. Nowhere is this truer than during complicated decisions regarding treatments with high morbidity. Queries like "What do you mean by never wanting to live on a machine?" or "Tell me more about what you mean by doing 'everything'" are crucial for ensuring that *meaning* gets conveyed accurately.

Constructivism

Developed in the late twentieth century, *constructivism* focuses on the ability of the learner to engage with his or her environment, reflecting on their experience, and then creating meaning from that experience. There are many parallels with the development of different schemas (mental framework), which cognitivists describe. A move toward this type of learning has been seen in traditional undergraduate medical education with the increasing utilization of problem-based learning.

While there is limited evidence regarding efficacy, there are problem-based programs for patients. For example, group learning sessions in management of diabetes may focus on patients "experimenting" with creating meals and determining their insulin coverage. A trial of a problem-based learning curriculum for patients after a coronary event is currently underway where investigators are attempting to assess changes with self-efficacy and empowerment [20].

In a very practical sense, patients often have a wealth of information which they provide. For example, which rehabilitation facilities help them best achieve their functional goals, which inhaled delivery device is the easiest to use, and side effect profiles of a host of medications. Many healthcare professionals would never know these nuances without intentionally interacting with patients' prior experiences. Acknowledging these insights can assist with empowering the development of a therapeutic relationship between healthcare professional and patient.

Connectivism

Just as many of the cognitivist notions of information processing occurred in the mid-twentieth century with the development of modern computing devices, *connectivism* began to take route as computing devices became more interconnected

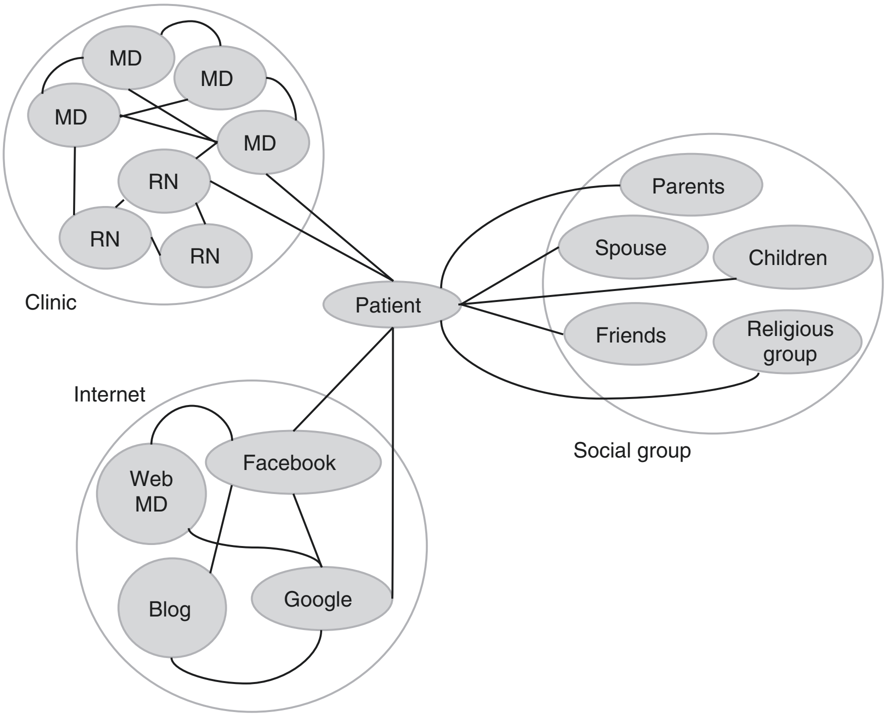

Fig. 2.2 Demonstration of connectivism. Patients may have a multitude of sources for information for which the patient may also contribute. These form a series of nodes and connections that can form a vast network

through web media, communication applications, and social media. Many patients explore opinions outside of the clinic through vast networks of connections (Fig. 2.2). While these outside sources had historically been close social contacts such as family and friends, they have been exponentially expanded by the near-universality of the Internet and social media.

Support groups have expanded to not just include local support groups, but international support groups. In the realm of pulmonary and critical care, there are online support groups for chronic obstructive pulmonary disease (COPD), cystic fibrosis (CF), idiopathic pulmonary fibrosis (IPF), and critical care survivorship—just to name a few [21–24]. Benefits of such support groups include emotional and informational support, as well as companionship being able to relate to people with shared experiences [25]. Many of these benefits are simply not possible in the confines of a strict patient–healthcare professional relationship.

While there is a clear benefit to the abundance of interactions and information, there is also a clear downside. There are potential harms such as emotional turmoil from increased vulnerability in an online setting. Misinformation is another potential harm with anti-vaccination content being the most prominent example.

Applications

In the future, the interaction of patients with online content and support groups is likely only to increase. It will be increasingly important for healthcare professionals to be aware of such social groups and content and to be inquisitive. Helping patients navigate this ever-growing space is likely to become increasingly important. Likewise, staying informed and connected with these platforms ourselves will be crucial.

Conclusions

Patients need to know why they have a diagnosis and what to do about it. Education is a critical element of patient care. Much has been written about best practices in learning and much has yet to be written. There are a number of learning theories that have been put forward to assist with understanding how people learn. While none of them are by any means comprehensive, they help shed light onto how our patients (as well as ourselves) make meaning of the world and their health. In most of our clinical practices, we apply a multitude of theories with or without realizing it. Our sincere congratulations to a patient after quitting smoking stems from behaviorist roots – not that we are trying to manipulate a patient's behavior but rather trying to reinforce a mutually agreed-upon plan. Asking patients "Tell me in your own words what your understanding of your illness is" highlights cognitivist principles. It acknowledges that we view new information through the prism of our past experiences, which colors our understanding. Finally, inquiring about outside resources and even inviting patients to join a support group (in person or online) acknowledges the network of information in which patients participate – a network that extends far beyond the confines of the clinic.

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