Discovering Psychology Series

Principles of Learning and Behavior

2nd edition

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Table of Contents

Part VI: Complementary Cognitive Processes

Record of Changes

Edition	As of Date	Changes Made
1.0	May 2019	Initial writing; feedback pending
2.0	June 2021	Copyediting changes; some revisions to add clarity; added a Tokens of Appreciation page.

Tokens of Appreciation

June 8, 2021

I want to offer a special thank you to Ms. Michelle Cosley, undergraduate within the online Bachelor of Science degree in Psychology program, for her edits of the 1st edition during the spring 2020. Her changes, and my own, are integrated into the 2nd edition of the book and are a dramatic improvement over the 1st edition. Thank you, Michelle.

And now to my reader. I hope you enjoy the book and please, if you see any issues whether typographical, factual, or just want to suggest some type of addition to the material or another way to describe a concept, general formatting suggestion, etc. please let me know. The beauty of Open Education Resources (OER) is that I can literally make a minor change immediately and without the need for expensive printings of a new edition. And it's available for everyone right away. If you have suggestions, please email them to me using the email on the title page.

Enjoy the 2nd edition of Principles of Learning and Behavior.

Lee Daffin

Part I. Setting the Stage

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Module 1:

Towards a Theory of Learning

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Module Overview

Welcome to our study of learning and behavior. As you will see, this book and class focus on the experimental analysis of behavior which reflects a pure/basic science approach. This is different from the applied analysis of behavior which reflects an applied science approach. To understand how we arrived at this distinction I will outline the historical development of psychology which led up to a science of behavior, and then its decline as a school of thought. I will also define key terms such as psychology, learning, memory, and behavior. I will conclude by showcasing a few professional societies and journals pertinent to the study of behavior, in its applied and pure science forms.

Module Outline

- 1.1. Historical Background
- 1.2. What is Learning?
- 1.3. Societies and Journals

Module Learning Outcomes

- Describe the development of behaviorism within the field of psychology.
- Define and describe the characteristics of behavior.
- Identify pertinent professional societies and peer-reviewed journals in the experimental analysis of behavior.

1.1. Historical Background

Section Learning Objectives

- Define history and clarify its importance.
- Define and describe philosophy.
- Outline the contributions of the Greeks to the science of behavior.
- Clarify the importance of Descartes' contributions to science.
- Define mechanism.
- Define reductionism, determinism, and materialism.
- Outline the contributions of the empiricists to the science of behavior.
- Clarify how physiology contributed to the development of psychology as a field.
- Clarify how biology contributed to the development of psychology as a field.
- Identify when, where, and how psychology was established as a field.
- Describe Wundt's contributions to psychology.
- Describe Ebbinghaus' contributions to psychology.
- Describe how structuralism contributed to the new science of behavior and learning.
- Describe how functionalism contributed to the new science of behavior and learning.
- Describe how Gestalt psychology contributed to the new science of behavior and learning.
- Describe the rise of behaviorism in the field of psychology.
- Clarify how psychology returned to a study of mental processes, in addition to behavior.

1.1.1. Why History?

This class, and the book for which it is written, is an investigation of learning and behavior. So why is our starting point a history lesson? First, **history** is the study of the past — the people, places, and events that make it up. We study the past so that in the future, we can repeat anything that worked or not make the same mistakes again. In other words, we want to *learn* from the events that occurred at an earlier time. By looking at the past we can see how we arrived at where we are today as a society, or as a person. Whether we want to admit it or not, our past makes us who we are today, and affects our future *behavior*.

So why is the past important to a psychologist? Consider a clinical psychologist. If a client is suffering from depression, anxiety, or post-traumatic stress disorder, there has to be a reason why. Maybe the client has had a series of deaths in the family and lost his job, leading to a major depressive disorder. Maybe an adult client was humiliated by their 5th grade teacher when giving a presentation and now has a bona fide fear of speaking in public and interacting with others, making any type of social interaction anxiety-producing. Or maybe we find out that the client is a veteran of the Gulf War or the War on Terrorism and was deployed numerous times to Iraq or Afghanistan. The frequent combat situations she was placed in, has led to PTSD. As such, an understanding of the past and how it affects the client is very important. It may even change the treatment approach the clinician takes or could help prevent any additional trauma from similar situations.

Now, what about for a behaviorist who studies learning and behavior? The past is essential to understanding why a dog salivates at the mere sound of a bell, and not necessarily the sight/smell/taste of food. Maybe we discover that the dog has come to realize that every time in the past when the bell was rung food came in shortly thereafter. Now at a future time, the bell rings again and the dog salivates because it believes, like in times past, food will be coming and sure enough, it does!!!! The past might also be important to a child who is about to talk back to a parent but quickly remembers that when he did that last Tuesday, his mother scolded him. Not wanting to repeat that aversive event, he engages in a different type of aversive event and bites his tongue…but not literally.

The past is important. Simple as that. And to understand the place behaviorism holds in the field of psychology, we have to understand events that led up to its creation, how it developed, and what happened as it slipped into the mainstream…of psychology that is. So we will discuss history.

1.1.2. Psychology's Origins — Philosophy

Would it surprise you to learn that when Wilhelm Wundt established the first psychological laboratory at Leipzig, Germany in the late 1870s, it arose out of the disciplines of philosophy and physiology? It likely does. Who would have thought our field came from such different disciplines?

1.1.2.1. What is philosophy? Philosophy is the love and pursuit of knowledge. Psychologists are all about gaining knowledge, so the connection between the two disciplines is made. Right? Not quite. Well yes, we gain knowledge, but the two fields are fundamentally distinct, so there have to be glaring differences between them. There should also be similarities since we arose from it. Philosophy had to leave some trace of its influence on the field of psychology.

Let's start by briefly considering the four major areas of study in the field of philosophy. *Metaphysics* is the study of the nature of reality, what exists in the world, how it is ordered, and what it is like. It asks questions such as whether or not there is a God, what truth is, whether we have free will or if everything is pre-determined, what it means to be a person, and how one event causes another. Think about psychology now. We study how the mind works, look for universal patterns so that we can make cause and effect statements, explore what it means to be a person through concepts such as identity and self-esteem, and consider whether all we are going to be in life is determined in childhood or can later events change us… and alter our developmental trajectory.

Second is *epistemology* or the study of knowledge. Philosophers ask what knowledge is and how we know what we do. Psychologists, on the related hand, study thinking and its conscious and sub/unconscious forms. We also study knowledge as a cognitive process and discuss elements of cognition to include concepts, propositions, schemas, and mental images.

Third, philosophy studies *ethics* or questions about what is right and what we ought to do. They wonder about what it means to be good, how we should treat one another, and what makes actions right. Psychologists study this too. Lawrence Kohlberg investigated moral development in children and across the life span and Stanley Milgram studied obedience to authority and its moral implications, such as related to the events of World War II and Nazi Germany. Psychologists also debate issues such as the improper and proper use of punishment (we will tackle this very issue later in the book),

Finally, *logic* covers the nature and structure of arguments, and what constitutes good or bad reasoning. Psychologists cover reasoning too, and its formal and informal manifestations, heuristics or mental shortcuts, and how we make decisions.

As you can see, there is a definite overlap between philosophy and psychology. Religion even factors into the discussion as it tackles the same general questions, but in the end, philosophy, psychology, and religion come up with different answers to these questions.

How do philosophy and psychology differ then? Simply, the methods used. Philosophy focuses on speculation, intuition, and generalization from personal observation. Its methods are subjective. Psychology, on the other hand, utilizes the scientific method — experimentation, observation, and measurement. Its methods are objective.

1.1.2.2. The Greeks. When it comes to the birth of philosophy, we can thank the Greeks and their desire to understand the world around them. Initially though, they adopted two ways of looking at the world – *animism* or the idea that the world is alive and *anthropomorphism* or the practice of giving inanimate objects human attributes. Though these practices seem silly to us they did afford the Greeks, and other ancients, some degree of control over their life. Control also came through their religion and the explanations it provided. These helped to quell the uneasiness that living in a dangerous and uncertain world caused. Greek gods controlled all aspects of the universe, from lightning, the sea, earthquakes, time, the sun, the moon, death, the afterlife, the hunt, agriculture, and childbirth…to name a few. They also controlled love, war, wisdom, travel, pleasure, music, and hearth…to name a few more.

Early Greek philosophers moved beyond these mystical and magical explanations and offered the first, though not always correct, natural explanations of the universe. Many of their ideas were too simplistic but it was a good start. For instance, Heraclitus saw the universe as being in a constant state of flux or change and so assumed that fire was the primary substance. This 'fact' led him to question whether we can ever truly know anything if the world is constantly changing, and so we had to place doubt on the reliability of the senses. Pythagoras echoed his thoughts saying that the senses cannot provide knowledge and believed that experiences of the flesh were inferior to the mind. If you think you know him, you likely do. He believed the universe could be explained through numbers, and offered his Pythagorean

Theorem, which states that the square of the hypotenuse of a right angle is equal to the sum of the squares of the other two sides.

Believing the senses <u>can</u> provide reliable information was the focus of the protopsychologists, such as Alcameon of Croton, who came to the conclusion that sensation and thought occur in the brain after dissecting the eye and tracing the optic nerve to the brain. Empedocles asserted that four fundamental substances made up the universe – earth, air, fire, and water – and that there were two causal powers – strife and love. He is credited with the first theory of perception that relied on our senses and also said that good health occurs when the four fundamental substances are in balance with one another. Otherwise, we become ill.

Though there are numerous other Greek philosophers we can discuss, one final individual needs to be mentioned. Aristotle, a student of Plato who was a student of Socrates, said that information about our world comes from our five senses and they can provide an accurate representation of it. He proposed his laws of association, which we see in modern-day learning theory. First, the **law of contiguity** says that we think of one thing and then think of things that go along with it. The **law of similarity** says that we think of one thing and then things similar to it. Related to this law is the **law of contrast** which asserts that we think of one thing and then things opposite of it. Finally, the **law of frequency** says the more often we experience things together the more likely we will be to make an association between them. Aristotle also investigated emotions, motivation, happiness, dreams, and imagination.

1.1.2.3. Descartes and the mind-body problem. Fast forward to the 17th century and the prevailing thinking of the time that human behavior was governed by free will, conscious intent, and reason. Rene Descartes (1596-1650) shook up this view by suggesting that human behavior was a combination of freely executed actions *and* those that occur automatically and are elicited by stimuli outside us. What he called **dualism**, asserts that the body, as an extension of the physical world, functions much like a machine and produces these involuntary, reflexive responses to external events such as blinking when air hits the eye, while the *mind* has free will and produces voluntary behaviors such as you deciding to read this book. It is our mind that makes us more than mere machines but also what separates us from animals. According to Descartes, the mind and body mutually interact in the brain since all sensations travel there and movement originates from there. This occurs at the only single, unitary structure in the brain – the pineal gland or as he called it, the conarium. Descartes's work helped to usher in the era of modern science and shifted us from a study of the soul to a study of the mind and mental processes.

He also proposed his *reflex action theory* or the idea that an external object can bring about an involuntary response such as a hammer hitting your knee causing it to jerk outward. Descartes said this process was completely mechanical or automatic, and governed by the laws of physics and mechanics.

He also said that the mind held two types of ideas – innate and derived. *Innate ideas* arise from the mind or consciousness and include such concepts as God, the self, perfection, and infinity. It can also include geometrical principles such as the shortest distance between two points being a straight line. *Derived ideas* come from an object directly through our senses, such as hearing the sound of a bell, seeing the sight of a tree, or smelling the scent of a perfume.

1.1.2.4. The rise of mechanism. Descartes had many contributions to the field of science but a lasting contribution to philosophy, and in turn psychology, was to help establish the philosophical worldview of mechanism. Simply, **mechanism** is the idea that the universe is a great machine. As the underlying philosophy of the 17th century, and an influential force for centuries later, it states that all natural processes are mechanically determined and could be explained through the principles of physics and chemistry. As the universe consists of atoms in motion (consistent with Galileo-Newtonian physics dominant at the time) then every physical effect has a direct cause which can be measured, and therefore should be predictable. Observation and experimentation were already cardinal features of science but now measurement was crucial too. People of the time became obsessed with defining and describing all phenomena and could assign a numerical value to it. Devices such as the thermometer, barometer, slide rule, and micrometer were created, but also the pivotal technological achievement of the time, the clock, was only rivaled by the development of the computer in the 20th century.

If the universe was a great machine, this begged the question of whether people were like machines? Many thought yes and mechanical contraptions called *automata* were created to mimic human movement and action. Descartes said that people were machines but more efficient and better. The mechanists agreed but, in the end, said we were still just machines.

1.1.2.5. A few other important philosophical worldviews. Also worth noting is **determinism** which says that every act is determined or caused by past events (shout out to history again). **Reductionism** focuses on breaking things down to their basic components and it is this principle that early schools of thought in psychology battled, including behaviorism. More on this in a bit. Finally, **materialism** states that everything that makes up the universe could be described in physical terms and by explained by the properties of matter and energy. This includes the mind and mental processes which could be studied through anatomy and physiology.

1.1.2.6. And….empiricism. Before we move on from philosophy, we need to discuss maybe the most important philosophical worldview for psychology and a study of learning and behavior — empiricism — which arose in the 18th and 19th centuries. Simply, **empiricism** states that knowledge arises from sensory experience. John Locke (1632-1704) said that we are born with a *tabula rasa* or blank slate, upon which this knowledge is written. Simple ideas are received passively by the mind but can be combined with other simple ideas to form complex ideas. He calls the process by which this occurs association. As you will come to see, learning theorists talk about *associative learning* or learning by linking together (combining) information from the environment. Also, most empiricists had a term for the concept of combining simple ideas to form more complex ones.

For instance, David Hume (1711-1776) said ideas were arranged in numerous ways through the process of *imagination*. Hume also, and similar to Aristotle, proposed three laws for how ideas are associated. His **law of resemblance** states that our thoughts flow from one idea to similar ones. This would approximate Aristotle's law of similarity. Next, he discussed the **law of contiguity** which says that we link together events in time, such as remembering that when we told our parents we did well on a test, they delivered praise to us. Finally, Hume talked about a **law of cause and effect** which stays that when we think of one event, we can follow the sequence of prior events that led to it.

David Hartley (1706-1757), like his fellow empiricists, said that there were no innate associations but all knowledge was gained through childhood experience. He also proposed laws of association to include *contiguity,* or the idea that when sensations or ideas occur together in time, they become linked together, and the idea of *repetition,* or the more times that events occur together, the more likely they will be associated with one another. As you will soon see, these two laws are similar to the specific conditions for respondent conditioning — repeated pairings and moderate spacing in time.

One final empiricist deserves mention. Like his predecessors, John Stuart Mill (1806-1873) said that simple ideas are combined to form complex ones, but that the resultant complex idea is something more than the mere sum of simple ideas. Mill says that something more emerges and they take on new qualities not present in the individual ideas or elements themselves. He calls this a *creative synthesis.* Consider your learning in any class. You learn a bunch of facts (simple ideas) and then to really understand what you are being taught, combine them to form a more holistic or integrated body of knowledge. From these individual facts you see connections, both direct and indirect like in a web of knowledge, that are not present in the individual facts themselves. Something more emerged. For Mill, unlike Locke, this was an active process.

1.1.3. Psychology's Origins – Physiology

As noted above, psychology arose out of philosophy and physiology. We might say philosophy presented us with some of our basic research questions for which we could apply the scientific method to arrive at an answer. Physiology then offered us some initial methods we could use to test our questions, though you will come to see shortly that philosophy gave us an important method too.

Before briefly discussing physiology, it is important to mention another philosophical idea that exists more in the realm of scientific philosophy — positivism. Proposed by Auguste Comte (1798-1857) **positivism** states that only natural phenomena or facts that are objectively observable should be pursued. Anything speculative, inferential, or metaphysical should be rejected as it is illusory. He believed that the physical sciences had reached a positivist stage, though the social sciences were still pursuing metaphysical questions. This emphasis on the observable will be important to behaviorism later, but at psychology's inception, key figures such as Wundt, Titchener, and Ebbinghaus showed that the mind could be empirically studied.

To get us to that point, three key German physiologists conducted important research. First, Hermann von Helmholtz (1821-1894) followed a mechanist view of the human body and said that sense organs operated like machines. He studied the speed of the neural impulse and found it to be 90 feet per second and created a theory of color vision. In keeping with the tradition of materialism, he showed that we could study the mind by emphasizing anatomy and physiology.

Ernst Weber (1795-1878) proposed the concept of the *two-point threshold* or the point at which two separate sensations could be perceived. Take two fingers and put them together. If you push them against your arm, you will perceive one sensation. If you slowly separate them, what is the least amount of distance they need to be separated until we detect the two separate sensations? This distance he called the *just noticeable difference*.

Finally, Gustav Theodor Fechner (1801-1887) proposed the area of psychology called *psychophysics* or the scientific study of the relationship between mental and physical processes. He developed the concepts of absolute and difference threshold and offered three methods used in psychophysics today. Fechner is a key figure in psychology's separation from physiology and sometimes is offered as the founder of the field, though this would be inaccurate as he never endeavored or had the motivation to found a discipline.

1.1.4. Psychology's Origins – Biology

Psychology also has origins in the field of biology, though it affects some schools more than others. We can see this if we consider the work of Charles Darwin (1809-1882) who proposed the theory of evolution. Essentially, evolution centers on the notion of "descent with modification" or that species change over time, can bring about new species, and share a common ancestor. Central to the theory is the principle of **natural selection** which has three core propositions. First is the idea that traits can vary within a species and between species such that beetles vary in color (some are green while others are brown; intra-species variation) while some species are carnivores, others are herbivores, and still others are omnivores (inter-species variation). Organisms can vary on traits such as color, size, and shape, to name a few. Second, traits are heritable, meaning that a giraffe will pass down the trait of a long neck to its offspring if it aids in the survival of the species. Finally, there is a competition between organisms for limited resources and so not all individuals are able to reproduce to their fullest potential. This is actually beneficial as the environment cannot support unlimited population growth. Natural selection aids populations with becoming adapted to or better suited to their environment. There is also a *survival of the fittest* which means that the species which are better able to acquire the resources needed for survival will survive.

Darwin's work was important because he introduced animals as a relevant research subject for psychologists, integrated methods from many fields, studied individual differences, and finally focused on function over structure. Keep this in mind as we begin our discussion of the evolution of schools of thought in psychology.

1.1.5. The Birth of Psychology and Its Evolution Over Time

1.1.5.1. Germany — the birthplace of psychology. As noted, Wundt established the first psychology laboratory in the late 1870s, or more specifically, 1879 in Leipzig, Germany. Wundt had a tall order to fill early on. He had to show that the new discipline of psychology could empirically and experimentally study behavior and mental processes. Building off the work of the empiricists, Wundt and his followers had to show that the mind is truly composed of basic elements. The empiricists conducted no formal scientific investigations of their assertion, and so Wundt had to prove that the elements of conscious experience existed and for him were sensations and feelings. One way to prove the latter was to use a metronome and to record the feelings that accompanied the sensations. Wundt's only research subject for these experiments on feelings was himself, and from them he arrived at his tridimensional theory of feelings which consisted of three independent dimensions – pleasure/displeasure, tension/relaxation, and excitement/depression. Wundt said that these elements could be organized or combined to give a sense of unity or wholeness, which he called **apperception**, and said that it was a creative synthesis. Similar to Mill, he said this process was active in nature. Wundt also popularized the use of **introspection**, or the examination of one's mental state. This method arose out of philosophy and so was not new, though its use in an experimental fashion was new.

Fellow German, Hermann Ebbinghaus (1850-1909), introduced the scientific study of memory and published a book in 1885 called *Memory: A Contribution to Experimental Psychology*. Before Ebbinghaus, the focus was to study associations already formed, though he showed that the initial formation of associations could be studied as well. He showed that memory and forgetting could be studied experimentally, and he used what came to be called **nonsense syllables,** though he described them as a meaningless series of syllables, to do just that. These nonsense syllables were generally formed from two consonants surrounding a vowel. He found 2,300 such combinations and drew from this list randomly to create stimulus materials that he was to learn. How did he know he had successfully learned the list? Ebbinghaus determined that two perfect recalls were enough. Relying on just one perfect recall could mean that he recalled it correctly accidentally or by chance. A second perfect recall would likely not be due to anything but true learning. From his research, he discovered that it is easier to learn meaningful material and shorter material. He also arrived at his forgetting curve which showed that within just 19 minutes, most people only accurately recalled about 60% of what they took in. Within an hour this falls to about half and by one day this drops to under 40%. Recall after 2 days falls to about 30%, and this holds stable over the next month approximately.

1.1.5.2. Psychology comes to the United States. Edward Bradford Titchener (1867-1927), originally from England, was a student of Wundt's who, after completing his graduate studies, moved to the United States and became a Professor of Psychology at Cornell University. He offered his own approach to psychology, which he termed **structuralism,** was an effort to break down, or reduce, consciousness to its component parts and determine what its structure is. Like Wundt, he identified specific elements of conscious experience, which he said included sensations and affective states. He then went beyond Wundt to include what Oswald Kulpe (1862-1915) called *imageless thoughts,* and he later termed *images.* Images are experiences not present at the moment but derived from our memory of past events and encounters with these people, objects, ideas, etc. Titchener also used introspection, but a form developed by Kulpe called systematic experimental introspection. Where Wundt's brand of introspection was objective and quantitative, Titchener/Kulpe's was subjective and qualitative and used retrospective reports. Titchener's structuralism, as well as Wundt's system, was important for the field of psychology as it stringently used the scientific method, introduced introspection to the field, and had a clearly defined subject matter in terms of the study of consciousness. Since it was the first formal school in the field of psychology, it was subjected to obvious scrutiny, leading to genuine attempts to offer other views of human behavior and mental processes, but also calculated attempts to destroy it at its foundation.

1.1.5.3. Offering another view of behavior. Late in the 1800s to early 1900s a new school of thought emerged in psychology called functionalism. **Functionalism** was heavily influenced by Darwin's work and so sought to study how the mind works, how it helps the organism survive in its environment, and how what psychology was discovering could be used to the betterment of society. Wundt and Titchener had no interest in what was to become the applied side of psychology and stuck to science in its pure or basic form. Functionalism was important as it showed the applied side of psychology at a time when society was debating the usefulness of the new discipline. Functionalists took jobs in the education setting, military, business, and other organizations, doing such work as helping children with learning disabilities, determining the most effective ways to teach in the classroom, developing mental tests to quantify intelligence, figuring out the personality pattern and skillset of individuals successful in certain jobs so others like them could be fitted to a job that best suited them, helping train individuals in the use of sophisticated equipment used in the making of war, and helping soldiers returning from two world wars deal with physical impairments and mental illness.

Also important was the fact that Darwin said there was no sharp distinction between human and animal minds. Lower animals dreamed, experienced pleasure and pain, were happy, sad, and had imaginations just like human beings. This led men such as George John Romanes (1848-1894) to formalize the study of animal intelligence. He published his book *Animal Intelligence* in 1882 and proposed the concept of the *mental ladder,* that all animal species could be arranged in order from lowest mental functioning to highest, like rungs on a ladder. He also proposed the use of a technique called the *anecdotal method,* which included casual reports about animal behavior from untrained observers such as pet owners, and what he called *introspection by analogy,* meaning that when trying to determine a reason for an animal's behavior, we need to look no further than ourselves. Since animals are capable of the same mental processes that humans are, if we go to the window to see what made a noise and our dog does it at the same time, it's safe to say that Fido went out of curiosity or concern just like we did.

C. Lloyd Morgan (1852-1936) was another key proponent of the use of animals in research and conducted the first large scale experimental studies with animals. He also proposed the **law of parsimony** which states that when explaining an animal's behavior (or human for that matter) a simple explanation sometimes suffices and we do not need to implicate a higher mental process. He said that animal behavior results from learning or making associations between sensory experiences. Morgan will come to exert greater influence on the school of behaviorism because his methods were objective, unlike Romanes whose methods were subjective.

Another key functionalist was John Dewey (1859-1952) who attacked the concept of the reflex arc and replaced it with his concept of a reflex circle. How so? The *reflex arc* says when we experience a stimulus we then respond to it, much like a child seeing a dog (stimulus) and moving to touch it (the motor response). Dewey said it was not that simple. The child, or any person, can change their perception of a stimulus based on their experience with it. If the child touches the dog and is bitten, in the future, the child will hesitate to touch a dog. The child alters his or her perception of the dog and moves from initially being attracted to dogs to being repelled by them. A *reflex circle* is formed and reflects the possibility that our perception of a stimulus can change and affect future interactions with similar stimuli.

Before moving on, understand that learning was a topic of great import to the functionalists. Since they were interested in the function of the mind and how it helps the organism adapt to its environment, learning, as the child does in Dewey's reflex arc, is incredibly important and they further introduced animals as relevant subjects in research studies and to learn about consciousness.

1.1.5.4. Bringing down the house — in Germany. As noted, one of the principal contributions of Wundt's and Titchener's systems was that they gave all who came afterward something to debate or fight against. Functionalism was an example of an attempt to offer a different view of behavior or to help the field of psychology evolve. In Germany, a new school rose in 1912, and about 30 years after Wundt founded psychology, to do more than just evolve the field. It intentionally tried to dismantle what Wundt had built. Called **Gestalt psychology**, it focuses on wholes or looking at consciousness itself and not elements. In this light, the school is very anti-reductionist. This is the fundamental point on which Gestalt psychology disagreed with, and fought Wundt, on. They were fine with the study of consciousness as the subject matter of psychology and the use of introspection as a research method. Gestalt psychology was founded by Max Wertheimer (1880-1943) with his publication of the 1912 article, *Experimental Studies of the Perception of Movement,* but the contributions of Kurt Koffka (1886-1941) and Wolfgang Kohler (1887-1967) were equally important.

In fact, Kohler has relevance to a study of learning as he proposed what he called **insight learning,** or the spontaneous understanding of relationships between objects or ideas. He tasked chimpanzees with solving a simple problem — obtaining bananas hung high up overhead — and gave them props such as sticks, boxes, and the bars of the cage to get them. There was one issue. No one prop by itself could reach the bananas, so the animals had to figure out a way to combine the props to solve the problem. According to Gestalt psychologists, this could only be done by restructuring the perceptual field, or as Wertheimer said, to perceive a problem downward. The parts of the problem could be examined, such as the individual props, but only as they related to the whole problem/total situation. As you will see throughout this book, this differed from behaviorism which asked animals to engage in what is called *trial and error learning or* learning through the making of mistakes until the solution is discovered. The Gestalt psychologists said that for effective problem solving to occur, a person or animal must be able to perceive the whole situation and the relationships between stimuli.

Gestalt psychology was not to last due to the rise of the Nazis and Hitler in the early 1930s. Their anti-intellectualism and anti-Semitism led many scholars, including Wertheimer, Koffka, and Kohler, to flee Germany and flock to the United States. Once here, they resumed their attack of Wundt's system which, if you recall, took the form of Titchener's structuralism. There was just one issue.

1.1.5.5. Bringing down the house — in the United States. In 1913, a man you will become intimately familiar with throughout this book and course, John B. Watson (1878-1958), published his article, *Psychology as the Behaviorist Views It*, in Psychological Review. It was this article that gave birth to the school of behaviorism. Watson was clearly anti-structuralism (and Wundt's system). Why? Recall that there was an ongoing debate in the field of psychology about the use of introspection, whether we should be pure or applied in focus, and whether we should study elements, wholes, or function. At this point, psychology had the schools of structuralism, functionalism, Gestalt psychology, and now behaviorism. Oh yeah. Though we have not discussed it, Freud gave birth to psychoanalysis in 1895 and focused on psychopathology, the study of the unconscious, and the importance of nature-oriented explanations for behavior and personality. So at this time, five different schools of thought were debating these issues.

The essence of Watson's protest was on the study of consciousness and the use of introspection. His behaviorism was to focus on observable acts and events that could be described objectively. He used terms such as stimulus and response. Watson said psychology should discard all mentalistic ideas and to be a science of behavior. Specifically, that psychology be concerned with the prediction and control of behavior. Though the field was slow to receive his ideas, change did come and behaviorism remained a major player and influenced the field for almost 50 years.

To understand behaviorism, and its eventual clash with Gestalt psychology, you have to bear in mind that behaviorism went through three general stages, starting with Watson's version of behaviorism, which was dominant from about 1913 to 1930. After this, behaviorism slid into what could be called Neobehaviorism from 1930 to 1960 and was influenced by such figures as Skinner, Tolman, and Hull. Finally, from 1960 to 1990 behaviorism espoused a sociobehaviorism view of Bandura and Rotter. We will tackle all of these individuals throughout the book and cover very influential figures on the school to include Pavlov and Thorndike.

So back to Gestalt psychology for a bit. In the 1920s its key figures visited the U.S. often and were generally well-received. Or so they thought. After Hitler's rise and their emigration from Germany to the United States, they resumed their attacks on elements. The issue was that behaviorism was in its second stage of development and Titchener's structuralism and its focus on the elements of conscious experience was gone. The Gestalt psychologists were attacking an enemy that no longer existed. Remember their principal disagreement was on breaking down consciousness into parts. They were fine with Wundt's study of consciousness and use of introspection. Once they turned their attention to behaviorism, they found a new natural enemy. The source of their disagreement with behaviorism was on its removal of the study of consciousness, its dismissal of introspection as a viable research method, and they claimed that behaviorism was equally reductionist. Instead of breaking down consciousness into parts, it instead broke down behavior into S-R or stimulus-response units. And so, Gestalt continued its revolutionary ways and went after behaviorism, but it was too firmly established in the United States at that point to do any good. Gestalt psychology began to fade away from psychology as a player, though never completely.

Behaviorism, with its redirection of the field to be just the scientific study of behavior, left the study of consciousness or mental processes off the table for discussion. Gestalt and others did maintain some interest in this area of study, which gave time for things to change as we entered the 1960s.

1.1.5.6. When psychology returned to its roots. Behaviorism established itself and its hold on psychology for about 50 years before the field returned to a study of behavior and mental processes. In the mid-1950s George Miller (born 1920) concluded that behaviorism was "not going to work out" and proceeded to challenge its hold. He is best known for his work on the limits of short-term memory and in 1956 published the paper, "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information." He proposed the concept of cognition and its study along with Jerome Bruner at the Center for Cognitive Studies. Moving forward to 1976, Ulric Neisser (born 1928) published his book *Cognitive Psychology,* and the APA president of the time said psychology needed to become human and not mechanical, representing a breakdown in the hold mechanism had for several centuries. Psychology returned to a study of consciousness and in 1979 the article entitled, *Behaviorism* *and the Mind: A (Limited) Call for a Return to Introspection,* was published in the American Psychologist. Introspection became a widely used method again and it was believed that conscious states revealed by it are good, and accurate, predictors of behavior. Interestingly, even Watson did not completely discard the idea of introspection. In his system, he utilized what was called the *verbal report method* which was a form of introspection. Watson finally conceded and said that the method could be used in limited situations such as when what the person is reporting could be verified. An example is psychophysics research. If a person says that it is becoming dimmer or brighter in the room, such as in a test of the difference threshold, then this could be confirmed by looking at how the experimenter was affecting the lighting.

Again, consider that the almost completely defeated Gestalt psychology kept at least a token interest in consciousness going and did work in learning and memory in the years leading up to the rise of cognitive psychology, and the beginnings of the downfall of behaviorism. Within behaviorism itself, the school underwent a metamorphosis as sociobehaviorism arose in the 1960s with its emphasis on nurture and less on nature, emphasized the importance of social experiences, and noted that responses were self-activated or initiated and not automatic and direct. They also attacked the idea of people as machines, investigated modeling, identified self-efficacy and locus of control as psychological constructs, talked about **vicarious reinforcement**, or learning by observing others and seeing the consequences of their behavior, and studied human subjects in social interactions with the same degree of scientific rigor and experimental control used by the likes of Watson and Skinner.

Today, behaviorism along with other schools such as cognitive psychology, are part of what is called mainstream psychology. We do not use terms such as schools anymore, but their existence early in our history was important and helps us to see how we arrived at where we are today. It also shows us how the study of learning and behavior began and evolved which is what we turn our attention to now.

1.2. What is Learning?

Section Learning Objectives

- Define psychology.
- Define learning.
- Clarify the role of memory.
- Define and exemplify behavior.
- Differentiate overt and covert behavior.
- Describe how behavior impacts the environment.
- Contrast basic and applied science.

1.2.1. Defining Terms

To start things off, let's take a step back in time. The study of learning and behavior is an area in the field of **psychology**. Think back to when you took your introduction to psychology course. How did the text, and your professor, define psychology? If you cannot remember, how would you define psychology now that you have likely taken several psychology courses? After giving this some thought, consider the official definition — the scientific study of behavior and mental processes. Let's examine this definition before we go on.

- First, psychology is scientific. Yes, that is correct. Psychology utilizes the *same* scientific process or method used by disciplines such as biology and chemistry. We will discuss this in more detail in Module 2, so please just keep this in the back of your mind for now.
- Second, it is the study of behavior and mental processes. Psychology desires to not only understand why people engage in the behavior that they do, but also how. What is going on in the brain to control the movement of our arms and legs when running downfield to catch the game-winning touchdown, what affects the words we choose to say when madly in love, how do we interpret an event as benign or a threat when a loud sound is heard, and what makes an individual view another group in less than favorable terms? These are just a few of the questions that we ask.

So, our discussion focuses on the scientific study of behavior and specifically the cognitive process of learning. What is learning then? **Learning** is any relatively permanent change in behavior due to experience and practice. Fortunately, learning is only a *relatively* permanent change in behavior. Nothing is set in stone and what is learned can be unlearned. Consider a fear for instance. Maybe a young child enjoys playing with a rat, but each time the rat is present a loud sound occurs. The sound is frightening for the child, and after several instances of the sound and rat being paired, the child comes to expect a loud sound at the sight of the rat and cries. What has occurred is that an association has been realized, stored in long term memory, and retrieved to working memory when a rat is in view. As you will come to see, this was the premise of Watson and Rayner's study with Little Albert. More on this later. **Memory** plays an important role in the learning process too and is defined as the ability to retain and retrieve information. The memory of the loud sound has been retained and retrieved in the future when the rat is present. But, memories change. With time and new learning, the child can come to see rats in a positive light and replace the existing scary memory with a pleasant one. This will affect future interactions with white rats. We will discuss the complementary cognitive process of memory in Module 10.

Our definition of both psychology and learning included the word behavior, but what is it? Essentially, **behavior** is what people do, say, or think/feel. Consider the case of corporal punishment, or spanking, which is what we do. In terms of what we say, we may berate the child verbally. In terms of what we think or feel, we may tell ourselves that by using corporal punishment we are maintaining order. Behavior can be overt or covert. **Overt** is behavior that is observable while **covert** behavior cannot be observed. We might even call covert behavior private events. When a behavior is observable, it can be described, recorded, and measured. Behavior also impacts the environment or serves a function. If we go to the bathroom and turn on the water, we are then able to brush our teeth. If we scream at our daughter for walking into the street without looking, we could create fear in her or raise her awareness of proper street crossing procedure. In either situation, we have impacted the environment either physically as in the example of the faucet or socially as with the street incident. Here's one more example you might relate to — your professor enters the classroom and says, "Put away your books for a pop quiz."

1.2.2. The Study and Application of Learning Theory

Science has two forms — pure/basic or applied. **Basic science** is concerned with the acquisition of knowledge for the sake of the knowledge and nothing else, while **applied science** desires to find solutions to real-world problems. You might think of it like this — the researcher decides on his own question to investigate in pure science, but an outside source identifies the research question/problem in applied science. Of course, this is not always the case.

In terms of the study of learning, the pure/basic science approach is covered under the *experimental analysis of behavior*, while the applied science approach is represented by *applied behavior analysis* (ABA). This course/book represents the former while a course on behavior modification would represent the latter. We will discuss the experimental analysis of behavior in the rest of this book.

1.3. Societies and Journals

Section Learning Objectives

- Clarify what it means to communicate findings.
- Identify professional societies in the experimental analysis of behavior.
- Identify publications in the experimental analysis of behavior.

One of the functions of science is to *communicate* findings. Testing hypotheses, developing sound methodology, accurately analyzing data, and drawing cogent conclusions are important, but you must tell others what you have done too. This is accomplished by joining professional societies and submitting articles to peer-reviewed journals. Below are some of the societies and journals important to the experimental analysis of behavior.

1.3.1. Professional Societies

- **American Psychological Association → Division 25: Behavior Analysis**
  - Website — https://www.apadivisions.org/division-25/index?_ga=2.1553396.479667280.1554429079-113573048.1548900905
  - Mission Statement — "Div. 25 (Behavior Analysis) promotes basic research, both animal and human, in the experimental analysis of behavior and the application of the results of such research to human affairs. The division was founded in 1964 to promote basic and applied research to stimulate the exchange of information concerning such research, and to work with other disciplines whose interests overlap those of Div. 25."
  - Publication — Division 25 Recorder
  - Other Information — "Along with these original objectives, today's division addresses contemporary issues related to the philosophy, research, and applied practice of Behavior Analysis. Originally intended to serve as a voice for behavior analysis within the APA, Div. 25 also is involved with promoting behavior analysis within the larger society."

- **American Psychological Association → Division 6: Society for Behavioral Neuroscience and Comparative Psychology**
  - Website — https://www.apadivisions.org/division-6/index?_ga=2.265335626.479667280.1554429079-113573048.1548900905
  - Mission Statement — "Division 6: Society for Behavioral Neuroscience and Comparative Psychology members are devoted to studying the biology of behavior. Their focus is on behavior and its relation to perception, learning, memory, cognition, motivation, and emotion. Behavioral neuroscientists study the brain in relation to behavior, its evolution, functions, abnormalities, and repair, as well as its interactions with the immune system, cardiovascular system, and energy regulation systems. Comparative psychologists study the behavior of humans and other animals, with a special eye on similarities and differences that may shed light on evolutionary and developmental processes."
  - Publication — The Behavioral Neuroscientist and Comparative Psychologist

  - Other Information — "Current members remain dedicated to enhancing knowledge of the nervous system and its mediation of behavior across species. The forums for achieving this commitment are meetings, publications, and involvement with APA's Science Directorate and Governing Board."

- **The Society for the Advancement of Behavior Analysis (SABA)**
  - Website — http://saba.abainternational.org/
  - Mission Statement — "SABA was chartered in 1980 as a nonprofit corporation devoted to the welfare and future of behavior analysis. The society secures and administers private funds in support of the field. Your donations are used to provide grants, to support the advancement of basic knowledge about behavior analysis, and to ensure the future of the field through the sponsorship of student presenters at ABAI's annual convention."
  - Other Information — "For more than 30 years SABA has been promoting the field of behavior analysis by supporting talented students, encouraging global dissemination of the science, and recognizing our most inspiring leaders and giving them a platform to reach an even bigger audience."

- **Association for Behavior Analysis International (ABAI)**
  - Website — https://www.abainternational.org/welcome.aspx
  - Mission Statement — "Since 1974, the Association for Behavior Analysis International (ABAI) has been the primary membership organization for those interested in the philosophy, science, application, and teaching of behavior analysis."
  - Publication — ABAI publishes four behavior analysis journals: *The Analysis of Verbal Behavior, Behavior Analysis in Practice, Perspectives on Behavior Science,* and *The Psychological Record*, which are overseen by the Publication Board.

- **Society for the Quantitative Analyses of Behavior**
  - Website — https://www.sqab.org/
  - Mission Statement — "The Society for the Quantitative Analyses of Behavior (SQAB) was founded in 1978 by M. L. Commons and J. A. Nevin to present symposia and publish material which brings a quantitative analysis to bear on the understanding of behavior."
  - Publication — Behavioral Processes
  - Other Information — "The International Society holds its annual meeting in conjunction with the Association for Behavior Analysis International (ABAI). Talks at SQAB focus on the development and use of mathematical formulations to characterize one or more dimensions of an obtained data set, derive predictions to be compared with data, and generate novel data analyses."

1.3.2. Publications

- **Division 25 Recorder**
  - Website — https://www.apadivisions.org/division-25/publications/newsletters/recorder
  - Published by — American Psychological Association
  - Description — "The *Division 25 Recorder* is the official Div. 25 newsletter that informs readers about the division and APA governance and membership activities. It publishes letters to the editor, open letters to the division's executive committee, news and notes about experimental, applied, and conceptual analyses of behavior."

- **The Behavioral Neuroscientist and Comparative Psychologist**
  - Website — https://www.apadivisions.org/division-6/publications/newsletters/neuroscientist
  - Published by — American Psychological Association

  - Description — "The Behavioral Neuroscientist and Comparative Psychologist is the official newsletter of APA Div. 6 and is published three times a year."

- **Journal of Comparative Psychology**
  - Website — https://www.apa.org/pubs/journals/com
  - Published by — American Psychological Association
  - Description — "The *Journal of Comparative Psychology*® publishes original empirical and theoretical research from a comparative perspective on the behavior, cognition, perception, and social relationships of diverse species."

- **Animal Behavior and Cognition**
  - Website — http://animalbehaviorandcognition.org/
  - Description — "**Animal Behavior and Cognition** publishes original empirical research, replication reports, target review articles, opposing viewpoints, brief reports, and theoretical reviews on all aspects of animal behavior and cognition. The journal is multi-disciplinary, and so welcomes submissions from those studying animal behavior, behavioral ecology, ethology, cognitive science, and comparative psychology."

- **Journal of the Experimental Analysis of Behavior**
  - Website — https://onlinelibrary.wiley.com/journal/19383711
  - Published by — Wiley
  - Description — "Journal of the Experimental Analysis of Behavior (JEAB) is primarily for the original publication of experiments relevant to the behavior of individual organisms."

- **Perspectives on Behavioral Science**
  - Website — https://www.abainternational.org/journals/pobs.aspx
  - Published by — Association for Behavior Analysis International
  - Description — "In addition to articles on theoretical, experimental, and applied topics in behavior analysis, it included literature reviews, re-interpretations of published data, and articles on behaviorism as a philosophy."

Module Recap

Well, that's it. In the first module of this book, I shared a generous overview of the formation of psychology as a discipline from the fields of philosophy, physiology, and biology. To arrive at a science of behavior it took the contributions of these fields, but also early schools of thought in the field of psychology to include Wundt's system, structuralism, functionalism, and Gestalt psychology. Psychoanalysis even had some effect. Once established, behaviorism maintained its hold on psychology for about five decades before the next round of schools arose and shifted the field back to a study of behavior and consciousness or mental processes. With an understanding of the development of behaviorism firmly established, we then moved to defining learning, memory, and behavior which will be discussed ad nauseum in the remaining modules. The point of scientific research is to communicate findings which is done through professional societies and journals.

In Module 2, I will outline the scientific method and designs used in the experimental analysis of behavior. Module 3 will conclude Part 3 with a discussion of elicited behaviors and more. I hope you enjoy the material to come.

Part I. Setting the Stage

Module 2:

Research Methods in Learning and Behavior

Module 2: Research Methods in Learning and Behavior

Module Overview

Module 2 will cover the critical issue of how research is conducted in the experimental analysis of behavior. To do this, we will discuss the scientific method, research designs, the apparatus we use, how we collect data, and dependent measures used to show that learning has occurred. We also will break down the structure of a research article and make a case for the use of both humans and animals in learning and behavior research.

Module Outline

2.1. The Scientific Method

2.2. Research Designs Used in the Experimental Analysis of Behavior

2.3. Dependent Measures

2.4. Animal and Human Research

Module Learning Outcomes

- Describe the steps in the scientific method and how this process is utilized in the experimental analysis of behavior.
- Describe specific research designs, data collection methods, and apparatus used in the experimental analysis of behavior.
- Understand the basic structure of a research article.
- List and describe dependent measures used in learning experiments.
- Explain why animals are used in learning research.
- Describe safeguards to protect human beings in scientific research.

2.1. The Scientific Method

Section Learning Objectives

- Define scientific method.
- Outline and describe the steps of the scientific method, defining all key terms.
- Define functional relationship and explain how it produces a contingency.
- Explain the concept of a behavioral definition.
- Distinguish between stimuli and responses and define related concepts.
- Distinguish types of contiguity, and the term from contingency.
- Describe the typical phases in learning research.

2.1.1. The Steps of The Scientific Method

In Module 1, we learned that psychology was the scientific study of behavior and mental processes. We will spend quite a lot of time on the behavior and mental processes part, but before we proceed, it is prudent to elaborate more on what makes psychology scientific. It is safe to say that most people not within our discipline or a sister science would be surprised to learn that psychology utilizes the scientific method at all.

So what is the scientific method? Simply, the **scientific method** is a systematic method for gathering knowledge about the world around us. The key word here is that it is systematic, meaning there is a set way to use it. What is that way? Well, depending on what source you look at it can include a varying number of steps. For our purposes, the following will be used:

Table 2.1: The Steps of the Scientific Method

Step	Name	Description
0	Ask questions and be willing to wonder.	To study the world around us you have to wonder about it. This inquisitive nature is the hallmark of **critical thinking,** or our ability to assess claims made by others and make objective judgments that are independent of emotion and anecdote and based on hard evidence and required to be a scientist.
1	Generate a research question or identify a problem to investigate.	Through our wonderment about the world around us and why events occur as they do, we begin to ask questions that require further investigation to arrive at an answer. This investigation usually starts with a **literature review**, which could include conducting a literature search through our university library or using a search engine such as Google Scholar to see what questions have been investigated already and what answers have been found, so that we can identify **gaps** or holes in this body of work.
2	Attempt to explain the phenomena we wish to study.	We now attempt to formulate an explanation of why the event occurs as it does. This systematic explanation of a phenomenon is a **theory,** and our specific, testable prediction is the **hypothesis.** We will know if our theory is correct because we have formulated a hypothesis that we can now test.
3	Test the hypothesis.	It goes without saying that if we cannot test our hypothesis, then we cannot show whether our prediction is correct or not. Our plan of action of how we will go about testing the hypothesis is called our **research design**. In the planning stage, we will select the appropriate research method to answer our question/test our hypothesis.

4	Interpret the results.	With our research study done, we now examine the data to see if the pattern we predicted exists. We need to see if a cause-and-effect statement can be made, assuming our method allows for this inference. The statistics we use take on two forms. First, there are **descriptive statistics** which provide a means of summarizing or describing data and presenting the data in a usable form. You likely have heard of the mean or average, median, and mode. Along with standard deviation and variance, these are ways to describe our data. Second, there are **inferential statistics** that allow for the analysis of two or more sets of numerical data to determine the **statistical significance** of the results. These techniques include the *z*-test, *t*-test, ANOVA, and regression., to name a few. Significance is an indication of how confident we are that our results are due to our manipulation or design and not chance. Typically, we set this significance at no higher than 5% due to chance.
5	Draw conclusions carefully.	We need to accurately interpret our results and not overstate our findings. To do this, we need to be aware of our biases and avoid emotional reasoning so that they do not cloud our judgment. How so? In our effort to stop a child from engaging in self-injurious behavior that could cause substantial harm or even death, we might overstate the success of our treatment method.
6	Communicate our findings to the larger scientific community.	Once we have decided on whether our hypothesis is correct or not, we need to share this information with others so that they might comment critically on our methodology, statistical analyses, and conclusions. Sharing also allows for **replication** or repeating the study to confirm its results. Communication is accomplished via scientific journals, conferences, or newsletters released by many of the organizations mentioned in Section 1.4.

2.1.2. Making Cause and Effect Statements in the Experimental Analysis of Behavior

As you have seen, scientists seek to make causal statements about what they are studying. In the study of learning and behavior, we call this a **functional relationship.** This occurs when we can say a target behavior has changed due to the use of a procedure/treatment/strategy and this relationship has been replicated at least one other time. A **contingency** is when one thing occurs due to another. Think of it as an if-then statement. If I do X then Y will happen. We can also say that when we experience Y that X preceded it. Concerning a functional relationship, if I introduce a treatment, then the animal responds as such or if that animal pushes the lever, then she receives a food pellet.

To help arrive at a functional relationship, we have to understand what we are studying. In science, we say we operationally define our variables. In the realm of learning, we call this a **behavioral definition,** or a precise, objective, unambiguous description of the behavior. The key is that we must state our behavioral definition with enough precision that anyone can read it and be able to accurately measure the behavior when it occurs.

2.1.3. Frequently Used Terms in the Experimental Analysis of Behavior

In the experimental analysis of behavior, we frequently talk about an animal or person experiencing a trial. Simply, a **trial** is one instance or attempt at learning. Each time a rat is placed in a maze this is considered one trial. We can then determine if learning is occurring using different dependent measures described in Section 2.3. If a child is asked to complete a math problem and then a second is introduced, and then a third, each practice problem represents a trial.

As you saw in Module 1, behaviorism is the science of stimuli and responses. What do these terms indicate? **Stimuli** are the environmental events that have the potential to trigger behavior, called a **response**. If your significant other does something nice for you and you say, 'Thank you,' the kind act is the stimulus which leads to your response of thanking him/her. Stimuli have to be sensed to bring about a response. This occurs through the five senses — vision, hearing, touch, smell, and taste. Stimuli can take on two forms. **Appetitive stimuli** are those that an organism desires and seeks out while **aversive stimuli** are readily avoided. An example of the former would be food or water and the latter is exemplified by extremes of temperature, shock, or a spanking by a parent.

As you will come to see in Module 6, we can make a stimulus more desirable or undesirable, called an **establishing operation**, or make it less desirable or undesirable, called an **abolishing operation**. Such techniques are called **motivating operations**. Food may be seen as more attractive, desirable, or pleasant if we are hungry but less desirable (or more undesirable) if we are full. A punishment such as taking away video games is more undesirable if the child likes to play games such as Call of Duty or Madden but is less undesirable (or maybe even has no impact) if they do not enjoy video games. Linked to the discussion above, food is an appetitive stimulus and could be an establishing operation if we are hungry. A valued video game also represents an establishing operation if we threaten its removal, and we will want to avoid such punishment, which makes the threat an aversive stimulus.

As noted earlier, the **response** is simply the behavior that is made and can take on many different forms. A dog may learn to salivate (response) to the sound of a bell (stimulus). A person may begin going to the gym if he or she seeks to gain tokens to purchase back up reinforcers (more on this in Module 7). A person may work harder in the future if they received a compliment from their boss today (either through email and visual or spoken or through hearing).

Another important concept is **contiguity** and occurs when two events are associated with one another because they occur together closely, whether in time called **temporal contiguity** or in space called **spatial contiguity**. In the case of time, we may come to associate thanking someone for saying ‘good job’ if we hear others doing this and the two verbal behaviors occur very close in time. Usually, the ‘Thank you’ (or other response) follows the praise within seconds. In the case of space, we may learn to use a spatula to flip our hamburgers on the grill if the spatula is placed next to the stove and not in another room. Do not confuse contiguity with contingency. Though the terms look the same they have very different meanings.

Finally, in learning research, we often distinguish two phases — baseline and treatment. **Baseline Phase** occurs before any strategy or strategies are put into effect. This phase will essentially be used to compare against the treatment phase. We are also trying to find out exactly how much of the target behavior the person or animal is engaging in. **Treatment Phase** occurs when the strategy or strategies are used, or you might say when the manipulation is implemented. Note that in behavior modification we also talk about what is called the maintenance phase. More on this in Module 7.

2.2. Research Designs Used in the Experimental Analysis of Behavior

Section Learning Objectives

- List the five main research methods used in psychology.
- Describe observational research, listing its advantages and disadvantages.
- Describe the case study approach to research, listing its advantages and disadvantages.
- Describe survey research, listing its advantages and disadvantages.
- Describe correlational research, listing its advantages and disadvantages.
- Describe experimental research, listing its advantages and disadvantages.
- Define key terms related to experiments.
- Describe specific types of experimental designs used in learning research.
- Describe the ways we gather data in learning research (or applied behavior analysis).
- Outline the types of apparatus used in learning experiments.
- Outline the parts of a research article and describe their function.

Step 3 called on the scientist to test his or her hypothesis. Psychology as a discipline uses five main research designs to do just that. These include observational research, case studies, surveys, correlational designs, and experiments.

2.2.1. Observational Research

In terms of **naturalistic observation**, the scientist studies human or animal behavior in its natural environment which could include the home, school, or a forest. The researcher counts, measures, and rates behavior in a systematic way and at times uses multiple judges to ensure accuracy in how the behavior is being measured. This is called *inter-rater reliability*. The advantage of this method is that you witness behavior as it occurs and it is not tainted by the experimenter. The disadvantage is that it could take a long time for the behavior to occur and if the researcher is detected then this may influence the behavior of those being observed. In the case of the latter, the behavior of the observed becomes *artificial*.

Laboratory observation involves observing people or animals in a laboratory setting. The researcher might want to know more about parent-child interactions and so brings a mother and her child into the lab to engage in preplanned tasks such as playing with toys, eating a meal, or the mother leaving the room for a short period of time. The advantage of this method over the naturalistic method is that the experimenter can use sophisticated equipment and videotape the session to examine it later. The problem is that since the subjects know the experimenter is watching them, their behavior could become artificial.

2.2.2. Case Studies

Psychology can also utilize a detailed description of one person or a small group based on careful observation. The advantage of this method is that you arrive at a rich description of the behavior being investigated, but the disadvantage is that what you are learning may be unrepresentative of the larger population and so lacks **generalizability**. Again, bear in mind that you are studying one person or a very small group. Can you possibly make conclusions about all people from just one or even five or ten? The other issue is that the case study is subject to the bias of the researcher in terms of what is included in the final write up and what is left out. Despite these limitations, case studies can lead us to novel ideas about the cause of a behavior and help us to study unusual conditions that occur too infrequently to study with large sample sizes and in a systematic way.

2.2.3. Surveys/Self-Report Data

A **survey** is a questionnaire consisting of at least one scale with a number of questions that assess a psychological construct of interest such as parenting style, depression, locus of control, attitudes, or sensation-seeking behavior. It may be administered by paper and pencil or computer. Surveys allow for the collection of large amounts of data quickly, but the actual survey could be tedious for the participant, and **social desirability**, or when a participant answers questions dishonestly so that he/she is seen in a more favorable light, could be an issue. For instance, if you are asking high school students about their sexual activity, they may not give genuine answers for fear that their parents will find out. Or if you wanted to know about prejudiced attitudes of a group of people, you could use the survey method. You could alternatively gather this information via an interview in a structured, semi-structured, or unstructured fashion. Important to survey research is that you have **random sampling,** or when everyone in the population has an equal chance of being included in the sample. This helps the survey to be representative of the population, and in terms of key demographic variables such as gender, age, ethnicity, race, education level, and religious orientation. Surveys are not frequently used in the experimental analysis of behavior.

2.2.4. Correlational Research

This research method examines the relationship between two variables or two groups of variables. A numerical measure of the strength of this relationship is derived, called the *correlation coefficient*, and can range from -1.00, which indicates a perfect inverse relationship meaning that as one variable goes up the other goes down, to 0 or no relationship at all, to +1.00 or a perfect relationship in which as one variable goes up or down so does the other. In terms of a negative correlation we might say that as a parent becomes more rigid, controlling, and cold, the attachment of the child to parent goes down. In contrast, as a parent becomes warmer, more loving, and provides structure, the child becomes more attached. The advantage of correlational research is that you can correlate anything. The disadvantage is also that you can correlate anything. Variables that do not have any relationship to one another could be viewed as related. Yes. This is both an advantage and a disadvantage. For instance, we might correlate instances of making peanut butter and jelly sandwiches with someone we are attracted to sitting near us at lunch. Are the two related? Not likely, unless you make a really good PB&J, but then the person is probably only interested in you for food and not companionship. The main issue here is that correlation *does not* allow you to make a causal statement.

2.2.5. Experiments

An **experiment** is a controlled test of a hypothesis in which a researcher manipulates one variable and measures its effect on another. A **variable** is anything that varies over time or from one situation to the next. Patience could be an example of a variable. Though we may be patient in one situation, we may have less if a second situation occurs close in time. The first could have lowered our ability to cope making an emotional reaction quicker to occur even if the two situations are about the same in terms of impact. Another variable is weight. Anyone who has tried to shed some pounds and weighs in daily knows just how much weight can vary from day to day, or even on the same day. In terms of experiments, the variable that is manipulated is called the **independent variable (IV)** and the one that is measured is called the **dependent variable (DV)**.

A common feature of experiments is to have a **control group** that does not receive the treatment, or is not manipulated, and an **experimental group** that does receive the treatment or manipulation. If the experiment includes **random assignment,** participants have an equal chance of being placed in the control or experimental group. The control group allows the researcher to make a *comparison* to the experimental group, making a causal statement possible, and stronger.

Within the experimental analysis of behavior (and applied behavior analysis), experimental procedures take on several different forms. In discussing each, understand that we will use the following notations:

A will represent the baseline phase and B will represent the treatment phase.

1. **A-B design** — This is by far the most basic of all designs used in behavior modification and includes just one rotation from baseline to treatment phase and from that we see if the behavior changed in the predicted manner. The issue with this design is that no functional relationship can be established since there is no replication. It is possible that the change occurred not due to the treatment that was used, but due to an **extraneous variable**, or an unseen and unaccounted for factor on the results and specifically our DV.
2. **A-B-A-B Reversal Design** — In this design, the baseline and treatment phases are implemented twice. After the first treatment phase occurs, the individual(s) is/are taken back to baseline and then the treatment phase is implemented again. Replication is built into this design, allowing for a causal statement, but it may not be possible or ethical to take the person back to baseline after a treatment has been introduced, and one that likely is working well. What if you developed a successful treatment to reduce self-injurious behavior in children or to increase

feelings of self-worth? You would want to know if the decrease in this behavior or increase in the positive thoughts was due to your treatment and not extraneous behaviors, but can you take the person back to baseline? Is it ethical to remove a treatment for something potentially harmful to the person? Now let's say a teacher developed a new way to teach fractions to a fourth-grade class. Was it the educational paradigm or maybe additional help a child received from his/her parents or a tutor that accounts for improvement in performance? Well, we need to take the child back to baseline and see if the strategy works again, but can we? How can the child forget what has been learned already? ABAB Reversal Designs work well at establishing functional relationships if you can take the person back to baseline but are problematic if you cannot. An example of them working well includes establishing a system, such as a token economy (more on this later), to ensure your son does his chores, having success with it, and then taking it away. If the child stops doing chores and only restarts when the token economy is put back into place, then your system works. Note that with time the behavior of doing chores would occur on its own and the token economy would be fazed out.

3. **Multiple-baseline designs** — This design can take on three different forms. In an *across-subjects design,* there is a baseline and treatment phase for two or more subjects for the same target behavior. For example, an applied behavior analyst is testing a new intervention to reduce disruptions in the classroom. The intervention involves a combination of antecedent manipulations, prompts, social support, differential reinforcement, and time-outs. He uses the intervention on six problematic students in a 6th period math class. Secondly, the *across-settings*

design has a baseline and treatment phase for two or more settings in the same person for which the same behavior is measured. What if this same specialist now tests the intervention with one student but across her other five classes which include social studies, gym, science, English, and shop. Finally, in an *across-behaviors design*, there is a baseline and treatment phase for two or more different behaviors the same participant makes. The intervention continues to show promise and now the ABA specialist wants to see if it can help the same student but with his problem with procrastination and inability to organize.

4. **Changing-Criterion Design** — In this design, the performance criteria changes as the subject achieves specific goals. The individual may go from having to workout at the gym 2 days a week to 3 days, then 4 days, and then finally 5 days. Once the goal of 2 days a week is met, the criterion changes to 3 days a week. In a learning study, a rat may have to press the lever 5 times to receive a food pellet and then once this is occurring regularly, the schedule changes to 10 times to receive the same food pellet. We are asking the rat to make more behaviors for the same consequence. The changing-criterion design has an A-B design but rules out extraneous variables since the person or animal continues meeting the changing criterion/new goals using the same treatment plan or experimental manipulation. Hence successfully moving from one goal to the next must be due to the strategies that were selected.

2.2.6. Ways We Gather Data

When we record, we need to decide what method we will use. Several strategies are possible to include continuous, product or outcome, and interval. First, in **continuous recording,** we watch a person or animal continuously throughout an **observation period**, or time when observations will be made, and all occurrences of the behavior are recorded. This technique allows you to record both frequency and duration. The frequency is reported as a rate, or the number of responses that occur per minute. Duration is the total time the behavior takes from start to finish. You can also record the intensity using a rating scale in which 1 is low intensity and 5 is high intensity. Finally, latency can be recorded by noting how long it took the person to engage in the desirable behavior, or to discontinue a problem behavior, from when the demand was uttered. You can also use *real-time recording* in which you write down the time when the behavior starts and when it ends, and then do this each time the behavior occurs. You can look at the number of start-stops to get the frequency and then average out the time each start-stop lasted to get the duration. For instance:

Table 2.2. Example of the Real-time Recording Method for a Problem Behavior

Target Behavior – Completing homework without interruption Problem Behavior – Checking the phone while studying (recorded below)		
Behavior Start – 1:06 pm	Behavior Stop – 1:07 pm	Lasted – 1 minute
Behavior Start – 1:09 pm	Behavior Stop – 1:12 pm	Lasted – 3 minutes
Behavior Start – 1:15 pm	Behavior Stop – 1:18 pm	Lasted – 3 minutes
Behavior Start – 1:22 pm	Behavior Stop – 1:26 pm	Lasted – 4 minutes
Behavior Start – 1:35 pm	Behavior Stop – 1:38 pm	Lasted – 3 minutes
Behavior Start – 1:45 pm	Behavior Stop – 1:49 pm	Lasted – 4 minutes
Frequency: 6 6 total start-stops	*Duration*: 3 minutes 18 mins/6 behaviors	

Next is **product or outcome recording.** This technique can be used when there is a tangible outcome you are interested in, such as looking at how well a student has improved his long division skills by examining his homework assignment or a test. Or you might see if your friend’s plan to keep a cleaner house is working by inspecting his or her house randomly once a week. This will allow you to know if an experimental teaching technique works. It is an indirect assessment method meaning that the observer does not need to be present. You can also examine many types of behaviors. But because the observer is not present, you are not sure if the person did the work himself or herself. It may be that answers were looked up online, cheating occurred as in the case of a test, or someone else did the homework for the student such as a sibling, parent, or friend. Also, you have to make sure you are examining the result/outcome of the behavior and not the behavior itself.

Finally, **interval recording** occurs when you take the observation period and divide it up into shorter periods of time. The person or animal is observed, and the target behavior recorded based on whether it occurs during the entire interval, called *whole* interval recording, or some part of the interval, called *partial* interval recording. With the latter, you are not interested in the dimensions of duration and frequency. We also say the interval recording is *continuous* if each subsequent interval follows immediately after the current one. Let's say you are studying students in a classroom. Your observation period is the 50 minutes the student is in his home economics class and you divide it up into ten, 5-minute intervals. If using whole, then the behavior must occur during the entire 5-minute interval. If using partial, it only must occur sometime during the 5-minute interval. You can also use what is called *time sample recording* in which you divide the observation period into intervals of time but then observe and record during part of each interval (the sample). There are periods of time in between the observation periods in which no observation and recording occur. As such, the recording is *discontinuous.* This is a useful method since the observer does not have to observe the entire interval and the level of behavior is reported as the percentage of intervals in which the behavior occurred. Also, more than one behavior can be observed.

2.2.7. The Apparatus We Use

What we need to understand next in relation to learning research is what types of apparatus' are used. As you might expect, the maze is the primary tool and has been so for over

100 years. Through the use of mazes, we can determine general principles about learning that apply to not only animals such as rats, but to human beings too. The *standard or classic maze* is built on a large platform with vertical walls and a transparent ceiling. The rat begins at a start point or box and moves through the maze until it reaches the end or goal box. There may be a reward at the end such as food or water to encourage the rat to learn the maze. Through the use of such a maze, we can determine how many trials it takes for the rat to reach the goal box without making a mistake. As you will see, in Section 2.3, we can also determine how long it took the rat to run the maze.

An alternative to this design is what is called the *T-maze* which obtains its name from its characteristic T-structure. The rat begins in a start box and proceeds up the corridor until it reaches a decision point – go left or right. We might discover if rats have a side preference or how fast they can learn if food-deprived the night before. One arm would have a food pellet while the other would not. It is also a great way to distinguish place and response learning (Blodgett & McCutchan, 1947). Some forms of the T-maze have multiple T-junctions in which the rat can make the correct decision and continues in the maze or makes a wrong decision. The rat can use cues in the environment to learn how to correctly navigate the maze and once learned, the rat will make few errors and run through it very quickly (Gentry, Brown, & Lee, 1948; Stone & Nyswander, 1927).

Similar to the T-maze is what is called the *Y-maze*. Starting in one arm, the rat moves forward and then has to choose one of two arms. The turns are not as sharp as in a T-maze making learning a bit easier. There is also a *radial arm maze* (Olton, 1987; Olton, Collison, & Werz, 1977) in which a rat starts in the center and can choose to enter any of 8, 12, or 16 spokes radiating out from this central location. It is a great test of short-term memory as the rat has to recall which arms have been visited and which have not. The rat successfully completes the maze when all arms have been visited.

One final maze is worth mentioning. The *Morris water maze* (Morris, 1984) is an apparatus that includes a large round tub of opaque water. There are two hidden platforms 1-2 cm under the water's surface. The rat begins on a start platform and swims around until the other platform is located and it stands on it. It utilizes external cues placed outside the maze to find the end platform and run time is the typical dependent measure that is used.

To learn more about rat mazes, please visit: http://ratbehavior.org/RatsAndMazes.htm

Check this Out

Do you want to increase how fast rats learn their way through a multiple T-maze? Research has shown that you can do this by playing Mozart. Rats were exposed *in utero* plus 60 days to either a complex piece of music in the form of a sonata from Mozart, minimalist music, white noise, or silence. They were then tested over 5 days with 3 trials per day in a multiple T-maze. Results showed that rats exposed to Mozart completed the maze quicker and made fewer errors than the rats in the other conditions. The authors state that exposure to complex music facilitates spatial-temporal learning in rats and this matches results found in humans (Rauscher, Robinson, & Jens, 1998). Another line of research found that when rats were stressed they performed worse in water maze learning tasks than their non-stressed counterparts (Holscher, 1999).

So when you are studying for your quizzes or exams in this class (or other classes), play Mozart and minimize stress. These actions could result in a higher grade.

Outside of mazes, learning researchers may also utilize a *Skinner Box*. This is a small chamber used to conduct operant conditioning experiments with animals such as rats or pigeons. Inside the chamber, there is a lever for rats to push or a key for pigeons to peck which results in the delivery of food or water. The behavior of pushing or pecking is recorded through electronic equipment which allows for the behavior to be counted or quantified. This device is also called an *operant conditioning chamber*.

Finally, Edward Thorndike (1898) used a *puzzle box* to arrive at his **law of effect** or the idea that an organism will be more likely to repeat a behavior if it produced a satisfying effect in the past than if the effect was negative. This later became the foundation upon which operant conditioning was built. In his experiments, a hungry cat was placed in a box with a plate of fish outside the box. It was close enough that the cat could see and smell it but could not touch it. To get to the food, the cat had to figure out how to escape the box or which mechanism would help it to escape. Once free, the cat would take a bite, be placed back into the box, and then had to work to get out again. Thorndike discovered that the cat was able to get out quicker each time which demonstrated learning.

2.2.8. The Scientific Research Article

In scientific research, it is common practice to communicate the findings of our investigation. By reporting what we found in our study, other researchers can critique our methodology and address our limitations. Publishing allows psychology to grow its knowledge base about human behavior. We can also see where gaps still exist. We move it into the *public domain* so others can read and comment on it. Scientists can also replicate what we did and possibly extend our work if it is published.

As noted earlier, there are several ways to communicate our findings. We can do so at conferences in the form of posters or oral presentations, through newsletters from APA itself or one of its many divisions or other organizations, or through research journals and specifically scientific research articles. Published journal articles represent a form of communication between scientists and in them, the researchers describe how their work relates to previous research, how it replicates and/or extends this work, and what their work might mean theoretically.

Research articles begin with an **abstract** or a 150-250-word summary of the entire article. The purpose is to describe the experiment and allows the reader to decide whether he or she wants to read it further. The abstract provides a statement of purpose, overview of the methods, main results, and a brief statement of what these results mean. Keywords are also given that allow for students and other researchers alike to find the article when doing a search.

The abstract is followed by four major sections – Introduction, Method, Results, and Discussion. First, the **introduction** is designed to provide a summary of the current literature as it relates to the topic. It helps the reader to see how the researcher arrived at their hypothesis and the design of the study. Essentially, it gives the logic behind the decisions that were made.

Next, is the **method** section. Since replication is a required element of science, we must have a way to share information on our design and sample with readers. This is the essence of the method section and covers three major aspects of a study — the participants, materials or apparatus, and procedure. The reader needs to know who was in the study so that limitations related to the generalizability of the findings can be identified and investigated in the future. The researcher will also state the operational/behavioral definition, describe any groups that were used, identify random sampling or assignment procedures, and provide information about how a scale was scored or if a specific piece of apparatus was used, etc. Think of the method section as a cookbook. The participants are the ingredients, the materials or apparatus are whatever tools are needed, and the procedure is the instructions for how to bake the cake.

Third, is the **results** section. In this section, the researcher states the outcome of the experiment and whether it was statistically significant or not. The researchers can also present tables and figures. It is here we will find both descriptive and inferential statistics.

Finally, the **discussion** section starts by restating the main findings and hypothesis of the study. Next, is an interpretation of the findings and what their significance might be. Finally, the strengths and limitations of the study are stated which will allow the researcher to propose future directions or for other researchers to identify potential areas of exploration for their work.

Whether you are writing a research paper for a class, preparing an article for publication, or reading a research article, the structure and function of a research article is the same. Understanding this will help you when reading articles in learning and behavior but also note, this same structure is used across disciplines.

2.3. Dependent Measures

Section Learning Objectives

- List typical dependent measures used in learning experiments.
- Describe the use of errors as a dependent measure.
- Describe the use of frequency as a dependent measure.
- Describe the use of intensity as a dependent measure.
- Describe the use of duration/run time/speed as a dependent measure.
- Describe the use of latency as a dependent measure.
- Describe the use of topography as a dependent measure.
- Describe the use of rate as a dependent measure.
- Describe the use of fluency as a dependent measure.

As we have learned, experiments include dependent and independent variables. The independent variable is the manipulation we are making while the dependent variable is what is being measured to see the effect of the manipulation. So, what types of DVs might we use in the experimental analysis of behavior or applied behavior analysis? We will cover the following: errors, frequency, intensity, duration, latency, topography, rate, and fluency.

2.3.1. Errors

A very simple measure of learning is to assess the number of *errors* made. If an animal running a maze has learned the maze, he/she should make fewer errors or mistakes with each trial, compared to say the first trial when many errors were made. The same goes for a child learning how to do multiplication. There will be numerous errors at start and then fewer to none later.

2.3.2. Frequency

Frequency is a measure of how often a behavior occurs. If we want to run more often, we may increase the number of days we run each week from 3 to 5. In terms of behavior modification, I once had a student who wished to decrease the number of times he used expletives throughout the day.

2.3.3. Intensity

Intensity is a measure of how strong the response is. For instance, a person on a treadmill may increase the intensity from 5 mph to 6 mph meaning the belt moves quicker and so the runner will have to move faster to keep up. We might tell children in a classroom to use their inside voices or to speak softer as opposed to their playground voices when they can yell.

2.3.4. Duration/Run Time/Speed

Duration is a measure of how long the behavior lasts. A runner may run more often (frequency), faster (intensity), or may run longer (duration). In the case of the latter, the runner may wish to build endurance and run for increasingly longer periods of time. A parent may wish to decrease the amount of time a child plays video games or is on his/her phone before bed. For rats in a maze, the first few attempts will likely take longer to reach the goal box than later attempts once the path needed to follow is learned. In other words, duration, or run time, will go down which demonstrates learning.

2.3.5. Latency

Latency represents the time it takes for a behavior to follow from the presentation of a stimulus. For instance, if a parent tells a child to take out the trash and he does so 5 minutes later, then the latency for the behavior of walking the trash outside is 5 minutes.

2.3.6. Topography

Topography represents the physical form a behavior takes. For instance, if a child is being disruptive, in what way is this occurring? Could it be the child is talking out of turn, being aggressive with other students, fidgeting in his/her seat, etc? In the case of rats and pushing levers, the mere act of pushing may not be of interest, but which paw is used or how much pressure is applied to the lever?

2.3.7. Rate

Rate is a measure of the change in response over time, or how often a behavior occurs. We may wish the rat to push the lever more times per minute to earn food reinforcement. Initially, the rat was required to push the lever 20 times per minute and now the experimenter requires 35 times per minute to receive a food pellet. In humans, a measure of rate would be words typed per minute. I may start at 20 words per minute but with practice (representing learning) I could type 60 words per minute or more.

2.3.8. Fluency

Though I may type fast, do I type accurately? This is where fluency comes in. Think about a foreign language. If you are fluent you speak it well. So, **fluency** is a measure of the number of correct responses made per minute. I may make 20 errors per minute of typing but with practice, I not only get quicker (up to 60 words per minute) but more accurate and reduce mistakes measure to 5 errors per minute. A student taking a semester of Spanish may measure learning by how many verbs he can correctly conjugate in a minute. Initially, he could only conjugate 8 verbs per minute but by the end of the semester can conjugate 24.

2.4. Animal and Human Research

Section Learning Objectives

- Defend the use of animals in research.
- Describe safeguards to protect human research subjects.

2.4.1. Animal Models of Behavior

Learning research frequently uses animal models. According to AnimalResearch.info, animals are used "…when there is a need to find out what happens in the whole, living body, which is far more complex than the sum of its parts. It is difficult, and in most cases simply not yet possible, to replace the use of living animals in research with alternative methods." They cite four main reasons to use animals. First, to advance scientific understanding such as how living things work to apply that knowledge for the benefit of both humans and animals. They state, "Many basic cell processes are the same in all animals, and the bodies of animals are like humans in the way that they perform many vital functions such as breathing, digestion, movement, sight, hearing, and reproduction."

Second, animals can serve as models to study disease. For example, "Dogs suffer from cancer, diabetes, cataracts, ulcers and bleeding disorders such as hemophilia, which make them natural candidates for research into these disorders. Cats suffer from some of the same visual impairments as humans." Therefore, animal models help us to understand how diseases affect the body and how our immune system responds.

Third, animals can be used to develop and test potential treatments for these diseases. As the website says, "Data from animal studies is essential before new therapeutic techniques and surgical procedures can be tested on human patients."

Finally, animals help protect the safety of people, other animals, and our environment. Before a new medicine can go to market, it must be tested to ensure that the benefits outweigh the harmful effects. Legally and ethically, we have to move away from *in vitro* testing of tissues and isolated organs to suitable animal models and then testing in humans.

In conducting research with animals, three principles are followed. First, when possible, animals should be *replaced* with alternative techniques such as cell cultures, tissue engineering, and computer modeling. Second, the number of animals used in research should be *reduced* to a minimum. We can do this by "re-examining the findings of studies already conducted (e.g. by systematic reviews), by improving animal models, and by use of good experimental design." Finally, we should *refine* the way experiments are conducted to reduce any suffering the animals may experience as much as possible. This can include better housing and improving animal welfare. Outside of the obvious benefit to the animals, the quality of research findings can also increase due to reduced stress in the animals. This framework is called the 3Rs.
Please visit: http://www.animalresearch.info/en/

One way to guarantee these principles are followed is through what is called the Institutional Animal Care and Use Committee (IACUC). The IACUC is responsible for the oversight and review of the humane care and use of animals; upholds standards set forth in laws, policies, and guidance; inspects animal housing facilities; approves protocols for use of animals in research, teaching, or education; addresses animal welfare concerns of the public; and reports to the appropriate bodies within a university, accrediting organizations, or government agencies. At times, projects may have to be suspended if found to be noncompliant with the regulations and policies of that institution.

For more on the IACUC within the National Institutes of Health, please visit: https://olaw.nih.gov/resources/tutorial/iacuc.htm

For another article on the use of animals in research, please check out the following published in the National Academies Press - https://www.nap.edu/read/10089/chapter/3

The following is an article published on the ethics of animal research and discusses the 3Rs in more detail - https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2002542/

And finally, here is a great article published by the Washington State University IACUC on the use of animals in research and teaching at WSU - https://research.wsu.edu/frequently-asked-questions-about-animal-care-and-use-at-washington-state-university/

2.4.2. Human Models of Behavior

Throughout this module, we have seen that it is important for researchers to understand the methods they are using. Equally important, they must understand and appreciate ethical standards in research. As we have seen already in Section 2.3.1, such standards exist for the use of animals in research. The American Psychological Association (APA) identifies high standards of ethics and conduct as one of its four main guiding principles or missions and as it relates to humans. To read about the other three, please visit https://www.apa.org/about/index.aspx. Studies such as Milgram's obedience study, Zimbardo's Stanford prison study, and others, have necessitated standards for the use of humans in research. The standards can be broken down in terms of when they should occur during the process of a person participating in the study.

2.4.2.1. Before participating. First, researchers must obtain **informed consent** or when the person agrees to participate because they are told what will happen to them. They are given information about any *risks* they face, or potential harm that could come to them, whether physical or psychological. They are also told about *confidentiality* or the person's right not to be identified. Since most research is conducted with students taking introductory psychology courses, they have to be given the right to do something other than a research study to likely earn required credits for the class. This is called an **alternative activity** and could take the form of reading and summarizing a research article. The amount of time taken to do this should not exceed the amount of time the student would be expected to participate in a study.

2.4.2.2. While participating. Participants are afforded the *ability to withdraw* or the person's right to exit the study if any discomfort is experienced.

2.4.2.3. After participating. Once their participation is over, participants should be **debriefed** or when the true purpose of the study is revealed and they are told where to go if they need assistance and how to reach the researcher if they have questions. So, can researchers **deceive** participants, or intentionally withhold the true purpose of the study from them? According to the APA, a minimal amount of deception is allowed.

Human research must be approved by an **Institutional Review Board** or IRB. It is the IRB that will determine whether the researcher is providing enough information for the participant to give consent that is truly informed, if debriefing is adequate, and if any deception is allowed or not. According to the Food and Drug Administration (FDA), "The purpose of IRB review is to assure, both in advance and by periodic review, that appropriate steps are taken to protect the rights and welfare of humans participating as subjects in the research. To accomplish this purpose, IRBs use a group process to review research protocols and related materials (e.g., informed consent documents and investigator brochures) to ensure the protection of the rights and welfare of human subjects of research."

If you would like to learn more about how to use ethics in your research, please read: https://opentext.wsu.edu/carriecuttler/chapter/putting-ethics-into-practice/

To learn more about IRBs, please visit: https://www.fda.gov/RegulatoryInformation/Guidances/ucm126420.htm

Module Recap

That's it. In Module 2 we discussed the process of research used when studying learning and behavior. We learned about the scientific method and its steps which are universally used in all sciences and social sciences. Our breakdown consisted of six steps but be advised that other authors could combine steps or separate some of the ones in this module. Still, the overall spirit is the same. In the experimental analysis of behavior, we do talk about making a causal statement in the form of an If-Then statement, or respectfully we discuss functional relationships and contingencies. We also define our terms clearly, objectively, and precisely through a behavioral definition. In terms of research designs, psychology uses five main ones and our investigation of learning and behavior focuses on three of those designs, with experiment and observation being the main two. Methods by which we collect data, the apparatus we use, and later, who our participants/subjects are, were discussed. The structure of a research article was outlined which is consistent across disciplines and we covered some typical dependent variables or measures used in the study of learning and behavior. These include errors, frequency, intensity, duration, latency, topography, rate, and fluency.

Armed with this information we begin to explore the experimental analysis of behavior by investigating elicited behaviors and more in Module 3. From this, we will move to a discussion of respondent and then operant conditioning and finally observational learning. Before closing out with complementary cognitive processes we will engage in an exercise to see how the three models complement one another and are not competing with each other.

Part I. Setting the Stage

Module 3:

Elicited Behaviors and More

Module 3: Elicited Behaviors and More

Module Overview

In the modules that follow this one, we will discuss associative and observational learning. Before we do that, we need to address the fact that some types of behavior are innate. To that end, we will discuss elicited behaviors. These include reflexes and modal action patterns. We will then move to a discussion of two types of non-associative learning — habituation and sensitization — and provide evidence for their adaptive advantage.

Module Outline

3.1. Elicited Behaviors Defined

3.2. Reflexes

3.3. Modal Action Patterns

3.4. Non-associative Learning

Module Learning Outcomes

- Explain what elicited behaviors are.
- Describe reflexes as a type of elicited behavior.
- Describe modal action patterns as a type of elicited behavior.
- Differentiate the two types of non-associative learning.

3.1. Elicited Behaviors Defined

Section Learning Objectives

- Define elicited behaviors.

Before we dive into behaviors that change or are acquired due to learning, we need to first discuss those that are innate and how they change. These behaviors help an organism adapt to its environment and cope with demands. **Elicited behaviors** are behaviors that occur due to a specific environmental stimulus. We will discuss reflexes and modal action patterns and then move to a discussion of how repeated stimulation leads to either an increase or decrease in responding or the strength of a response.

3.2. Reflexes

Section Learning Objectives

- Define reflexes.
- Exemplify reflexes in humans.
- Explain the concept of the reflex arc.

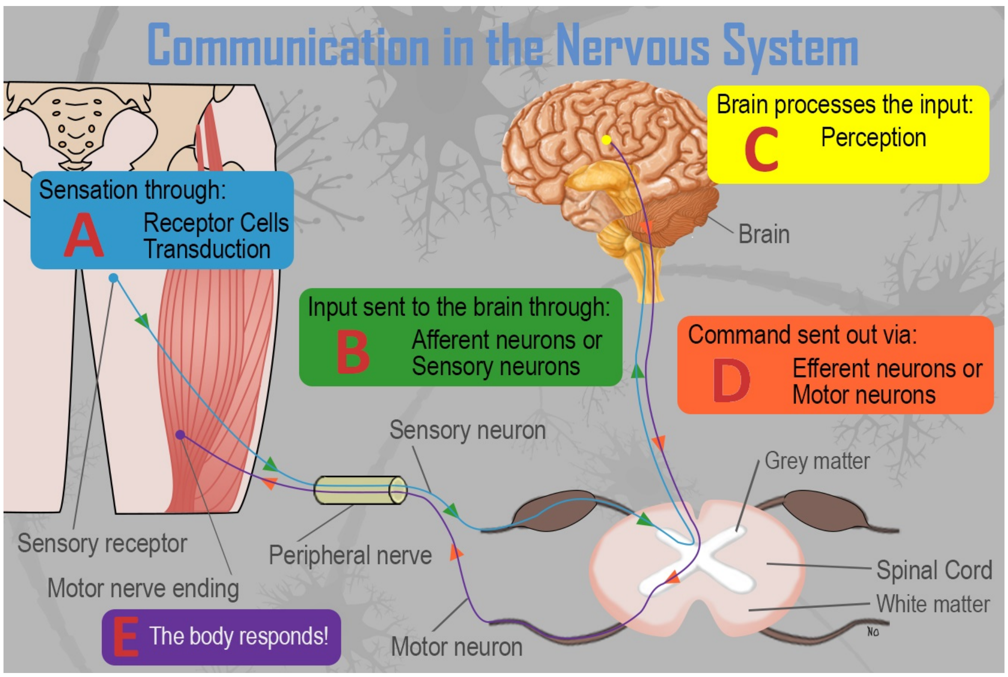
The term **reflex** indicates the relationship between innate behaviors and the environmental events or stimuli that elicit them. An example would be a doctor using a hammer to strike your knee (the stimulus) which causes your leg to kick out (the response). The reflex is not the response (as is commonly thought) of kicking out but the total relationship of the hammer striking the knee causing the leg to kick out. Both the stimulus and subsequent response make up a reflex. Reflexes can include a single gland or muscle such as in the case of an eye-blink in response to a puff of air while others involve several muscles or glands such as in the Moro reflex described below.

Several reflexes are exhibited by an infant as early as birth and occur automatically (they do not have to be learned). Consider the *rooting reflex* which consists of turning the head and sucking (response) elicited by stroking the side of the infant's mouth or cheek (stimulus). The point is to find the nipple at feeding time. Once a nipple is in the infant's mouth, *sucking* begins automatically though the coordination of the rhythmic sucking movements and breathing can be difficult for some infants at first. With time and practice, they come to handle the process fine. Another reflex present at birth is called the *Moro reflex* and occurs when an infant is startled by a loud sound or falls backward. The infant's response is to throw out her arms and legs and extend her neck, which is followed by bringing her arms together. She may cry loudly. Other reflexes include walking/stepping, tonic neck, palmar grasp, and plantar grasp. These reflexes are present at birth, or close to it, showing some variation in when they appear. They help the infant survive and disappear when no longer needed. For instance, the Moro reflex disappears around 2 months after peaking around 1 month of age, the rooting reflex disappears around 4 months, while the sucking reflex stays with us for life. An infant has an instinct to *step* but cannot hold up her weight at first. The reflex disappears around 2 months of age but returns as the learned behavior of walking near the end of the first year. Though newborns are dependent on their caregivers, they are not completely helpless. And our reflexes change across the life span. Consider athletes for instance. How many baseball players do you see in their 40s or 50s compared to their 20s or

30s? Very few, as there is a slowing of our motor reflexes as we move from early to middle and late adulthood.

How do reflexes occur? It's quite simple, and to make sense of it you have to understand how communication occurs in the nervous system. Consider Figure 3.1.

Figure 3.1. Communication in the Nervous System



The process is best described as such:

A. Receptor cells in each of the five sensory systems detect energy.
B. This information is passed to the nervous system due to the process of *transduction* and through sensory or afferent neurons, which are part of the peripheral nervous system.
C. The information is received by brain structures (central nervous system) and *perception* occurs.
D. Once the information has been interpreted, commands are sent out, telling the body how to respond (Step E), also via the peripheral nervous system.

With reflexes, when the doctor strikes your knee with the hammer, receptor cells in your skin detect this energy and pass the information to your nervous system. *Afferent* or *sensory neurons* then carry this information to the brain. Once in the brain, it is processed and commands are sent out via *efferent* or *motor neurons* telling your knee to kick out. It may be quicker than this as the information could produce a more immediate response via the action of *interneurons*. How so?

Consider a *withdrawal reflex* that may be needed if you touch a hot plate or stove (stimulus). You will pull your hand back pretty quickly (response) as the stimulus is painful. This process occurs in three steps. First, receptor cells in the skin detect pressure, warmth, cold, light touch, or in this case, pain. This information is sent to the brain as described above but the central nervous system (CNS) can distinguish between the various pieces of sensory information it is receiving since different pathways are activated due to different stimuli. Excited afferent neurons carry the pain information toward the brain, but they are intercepted in the spinal cord by excitatory interneurons that in turn stimulate efferent neurons, resulting in the muscle in the arm flexing or bending the elbow joint. This moves our hand away from the hot stove. Second and simultaneously, the afferent neurons also activate inhibitory interneurons which prevent the efferent neurons from sending commands for the triceps to contract which would result in the arm straightening out, putting us back in harm's way. This reflex includes the stimulation of nerves in one muscle while inhibiting the nerves in another, opposing muscle to create the desired response, called **reciprocal innervation**. Finally, the afferent neuron stimulates other interneurons which continue moving the original message from the spinal cord to the brain itself so that we are made aware of the pain, where it occurred, and what caused it. This will lead to a decision about what to do and we can store away the information in memory so that in the future we are more cautious when moving near a hot stove.

Taken together, the examples above show a relatively simple process called a **reflex arc,** which demonstrates the earlier point that a reflex is a process, not the terminal behavior. Let's now tackle a more complex process.

3.3. Modal Action Patterns

Section Learning Objectives

- Define and describe modal action patterns.
- Exemplify modal action patterns.

A more complex type of innate response is called a **modal action pattern (MAP)** and can be specific to an individual species (Barlow, 1977). Be advised that in the literature the term fixed action pattern is also used, but is less common, and MAPs have been referred to as instincts in the past. They are similar to reflexes because they are relatively stable across individuals and situations, and as such are described as highly stereotyped. They also have a genetic component and are caused by specific stimuli. The difference is that they are fairly complex, involve the entire organism and not specific muscles like the neck or fingers, and can vary. MAPs are elicited by releasing stimuli, or **sign stimuli,** in the environment, and aid a species' survival by dealing with threats, finding food sources, and passing genetic information from one generation to the next. Once began, the MAP must be carried out to completion.

Ethologists have uncovered many such MAPs and their sign stimulus. For instance, a nesting Graylag Goose will roll a displaced egg back to its nest using its beak. The goose will continue with this behavior even if the egg is removed during the behavior. It is as if the egg is still there. The sight of the displaced egg is the sign stimulus that brings about or elicits the behavior of egg-retrieval (rolling it back in the nest).

Niko Tinbergen (1952) described the courtship behavior of male three-spined stickleback fish during mating season, which begins by establishing a territory, building a nest in it, and changing the color of its underbelly to red. Males entering their territory are attacked while females are courted and encouraged to enter the nest and lay eggs. The presence of the other male is not the sign stimulus for aggressive behavior, but the sight of its red underbelly. Similarly, aggressive behavior is displayed by a male bighorn sheep who wins its mate by bashing its head against that of a competing male. In the case of some birds, females decide which male to mate with based on how elaborate its plumage is and its dance. The male knows to display its plumage and dance (the response) at the sight of the female (the sign stimulus).

Kelp gull chicks cause their mother to regurgitate by pecking (the response) a red spot they see on their mother's beak (the sign stimulus). Moths are also known to instantly fold their wings and drop to the ground (the response) if they detect ultrasonic signals produced by bats (the stimulus).

Interestingly, some species have evolved to exploit the MAPs of another species by mimicking its sign stimulus. Called *code-breaking*, one species duplicates another species releasing mechanism. For instance, the North American cowbird, classified as a brood parasite, lays its eggs in another species nest and once hatched, its young push the eggs and hatchlings of the other species out of the nest leaving them to die. Being that it is larger and louder than the original species, it causes its "adoptive" parent to forage more frequently than it would normally need to and to feed the impostor baby.

3.4. Non-associative Learning

Section Learning Objectives

- Contrast habituation and sensitization.
- Describe habituation.
- Clarify how tolerance is a form of habituation.
- Describe sensitization.
- Clarify how the dual process theory explains habituation and sensitization.
- Clarify how the opponent process of emotion shows the malleability of our emotions.
- Explain where there is an adaptive advantage to habituation and sensitization.

As noted above, repetitive stimulation can lead to either an increase or decrease in our likelihood of responding or the intensity of our response. When the size or probability of a response decreases, **habituation** is occurring, such as when we no longer hear the ticking of a clock or the fan in our computer. We may also experience an increase in our responding or its intensity, called **sensitization**. A police officer involved in a shoot-out will not habituate to the sound of gunshots, but actually become more aware of them.

These two forms of learning are non-associative in nature, or not learned by linking together environmental events, as respondent and operant conditioning are.

3.4.1. Habituation

Habituation is not to be confused with *sensory adaptation,* which occurs when a sense organ becomes disabled, such as being temporarily blinded by a camera flash or having your hearing limited due to a loud sound like a gun being fired on a range. It should also not be confused with *response fatigue* or when a muscle is incapacitated due to repeated use such as weight training one's legs and then not being able to run in an emergency. Habituation occurs within the nervous system while sensory adaptation and response fatigue occur outside it and in sense organs and muscles, respectively. It is a nearly universal occurrence in the animal kingdom and helps organisms save time and energy by not engaging in behaviors that are not functional.

Habituation generally ends if the stimulus is not present for a period of time and can either be short-term or long-term, indicating the length of time or durability of the habituation effect. When we think about learning, long-term habituation is what we are describing as it is a relatively permanent and stable change in behavior, as the definition of learning from Module 1 stated. The response slowly decreases with repeated stimulation and our ability to respond slowly recovers when the stimulus ends. In contrast, in short-term habituation, the response quickly decreases with repeated exposure to the stimulus and quickly recovers once gone.

Drug tolerance represents a form of habituation. According to the National Institute of Drug Abuse (NIDA), **tolerance** occurs when a drug is used repeatedly over time. The person no longer responds to the drug the way he or she initially did, meaning that higher doses of the drug are needed to obtain the same effect achieved early on. According to drugabuse.com, tolerance can take three forms. *Acute*, or short-term, *tolerance* results from repeated exposure to a drug over a short period of time while *chronic*, or long-term, *tolerance* develops when a person adapts to constant exposure to the drug over weeks or months. Finally, *learned tolerance* may result from frequent exposure to the drug. People who abuse alcohol for months or years may not appear intoxicated to others because they learn to compensate for the effects of alcohol on their coordination by practicing a task repeatedly while intoxicated. This tolerance disappears if the task is altered (Vogel-Sprott, 1997). Kesner and Cook (1983) found that 96 male Long-Evans rats developed tolerance to morphine in a nondistinctive environment due to repeated presentation of the drug, and that tolerance was quicker in massed rather than spaced presentations of the morphine.

Dishabituation occurs when an organism's state of arousal is enhanced, leading to an increase in the response that previously was habituated. If you habituated to the sound of the clock ticking in your office, you might notice it again if an unrelated, but novel, stimulus presents itself such as a coworker talking to you. Dishabituation represents a separate process from sensitization.

3.4.2. Sensitization

As with habituation, sensitization ends when the stimulus is not present for a period of time. Unlike habituation, sensitization can generalize to similar stimuli. Consider that soldiers returning from war will jump at the sound of a car backfiring as it sounds like an explosion caused by an artillery shell or IED (Improvised Explosive Device).

Sensitization is also important in sexual behavior and responding to tactile stimuli such as kissing or hugging your significant other. When doing so, you become aroused, unlike when you engage in similar behaviors with your mother or a sibling. For instance, one study showed that vibrotactile sensitivity increased in a sample of 30 heterosexual, healthy males after viewing an erotic video, but did not occur in response to a non-erotic video (Jiao et al., 2007).

3.4.3. An Explanation for Habituation and Sensitization

The two processes of habituation and sensitization are controlled by different mechanisms that are described by the **dual-process theory** (Groves & Thompson, 1970). Habituation occurs due to the **S-R system** or through changes in neurons controlling our response. The S-R system is best represented by the reflex arc, and subsequent activation of this system causes the build-up of habituation. It is active with each occurrence of an eliciting stimulus.

On the other hand, sensitization occurs due to changes in an organism's arousal, called the **state system**, which leads to excitability. The state system consists of those parts of the nervous system involved in our readiness to respond to an environmental event, and only activates due to arousing events.

3.4.4. The Malleability of Emotional States

Given what you have read so far, would it surprise you to learn that emotional states can also change due to the repeated exposure to environmental stimuli? The **opponent process theory of emotion** (Solomon & Corbit, 1974) states that our primary emotional reaction to an emotion-arousing stimulus, or ***a* process**, is followed by an opposite after-reaction, or ***b* process**, which counteracts this shift, and the primary reaction becomes weaker or habituates with repeated stimulation, while the after-reaction becomes stronger. This serves to maintain homeostasis or to keep our emotions fairly even or neutral. We seek to minimize highs and lows. For instance, in the first few stimulations opiate users will experience euphoria, a rush, and pleasure (a process) which will be followed by craving and aversive withdrawal signs for a short duration (b process). But after many such stimulations, they will experience a loss of euphoria, normal feelings, and no rush (a process), followed by an intense craving and agony lasting a long time, which is called abstinence agony (b process). Solomon and Corbit (1974) refer to this behavioral phenomenon of addiction as a “ghastly experience” (pg. 123).

3.4.5. Are Habituation and Sensitization Adaptive?

To understand the adaptive value of habituation and sensitization, we need to understand the role of stimulus intensity. Basically, low-intensity stimuli lead to habituation while high-intensity stimuli lead to sensitization. Why is that? Stimuli that are low intensity tend to be non-threatening, such as the fan in your computer running, while stimuli that are high intensity tend to be threatening, such as the sound of a gun firing. What is important is the threshold level of the organism when the first stimulus in a series occurs such that the greater the response the lower the organism’s sensory threshold prior to the stimulus. This initial response level will determine whether habituation or sensitization occurs (Eisenstein, Eisenstein, & Smith, 2001).

And habituation leads to a preservation of valuable energy that can be better spent by the organism. This represents the ability of an organism to change its behavior due to experience, which reflects learning.

Module Recap

Module 3 discussed forms of innate behavior to include reflexes and modal action patterns, and our inherent predisposition to respond more or less to recurring stimuli in our environment based on our threshold level when the stimulus is first encountered. We now move to associative and observational learning in Modules 4-8.

Part II. Associative Learning – Respondent Conditioning

Module 4: Respondent Conditioning

Module 4: Respondent Conditioning

Module Overview

We begin our coverage of models of learning by discussing respondent conditioning, based on the work of Ivan Pavlov. In this form of learning an association is formed between two events — the presentation of a neutral stimulus (NS) and the presentation of an unconditioned stimulus (US). As you will see, though the response to the US appears similar to the response to the NS, they are not identical and in some cases the response is much different or even opposite. We will talk about more complicated forms of conditioning such as higher order conditioning and how conditioning can be appetitive or aversive, or excitatory or inhibitory. Four variations of the normal respondent conditioning paradigm will be described, centered on when in time the US and NS occur. These include delay, trace, simultaneous, and backward conditioning. We will then discuss properties governing respondent conditioning to include extinction, spontaneous recovery, generalization, and discrimination. Sensory preconditioning, latent inhibition, overshadowing, blocking, and occasion setting will be discussed and the effect they have on how easily conditioning occurs. Finally, we will discuss five theories of conditioning.

Module Outline

Module Learning Outcomes

- Describe how respondent conditioning occurs in humans and animals.
- Outline and explain properties related to respondent conditioning.
- Describe theories related to respondent conditioning.

4.1. The Nuts and Bolts of Respondent Conditioning

Section Learning Objectives

- Describe Pavlov's accidental discovery.
- Define respondent conditioning.
- Recognize other terms used for respondent conditioning.
- Outline the three phases of respondent conditioning. Define all terms.
- Describe and exemplify higher order conditioning.
- Contrast appetitive and aversive conditioning.
- Contrast excitatory and inhibitory conditioning.
- Outline and describe the four temporal presentations of US and NS in respondent conditioning.
- Describe the phenomena of pseudoconditioning.

4.1.1. Pavlov and His Dogs

You have likely heard about Pavlov and his dogs but what you may not know is that this was a discovery made accidentally. Ivan Petrovich Pavlov (1849-1936; 1927), a Russian physiologist, was interested in studying digestive processes in dogs in response to being fed meat powder. What he discovered was the dogs would salivate even *before* the meat powder was presented. They would salivate at the sound of a bell, footsteps in the hall, a tuning fork, or the presence of a lab assistant. Pavlov realized there were some stimuli that automatically elicited responses (such as salivating to meat powder) and those that had to be paired with these automatic associations for the animal or person to respond to it (such as salivating to a bell). Armed with this stunning revelation, Pavlov spent the rest of his career investigating the learning phenomenon and won a Nobel Prize in 1904 for his work.

The important thing to understand is that not all behaviors occur due to reinforcement and punishment as operant conditioning says. In the case of respondent conditioning, antecedent stimuli exert complete and automatic control over some behaviors. We saw this in the case of reflexes. When a doctor strikes your knee with that little hammer it extends out automatically. You do not have to do anything but watch. Babies will root for a food source if the mother's breast is placed near their mouth. If a nipple is placed in their mouth, they will also automatically suck, as per the sucking reflex. Humans have several of these reflexes, though not as many as other animals, due to our more complicated nervous system.

4.1.2. Respondent Conditioning Described

Respondent conditioning occurs when we link or pair a previously neutral stimulus with a stimulus that is unlearned or inborn, called an unconditioned stimulus. Note that this form of learning also goes by the name classical conditioning or Pavlovian conditioning in honor of Ivan Pavlov.

Respondent conditioning is best described as occurring in three phases: pre-conditioning, conditioning, and post-conditioning. See Figure 4.1 for an overview of Pavlov's classic experiment.

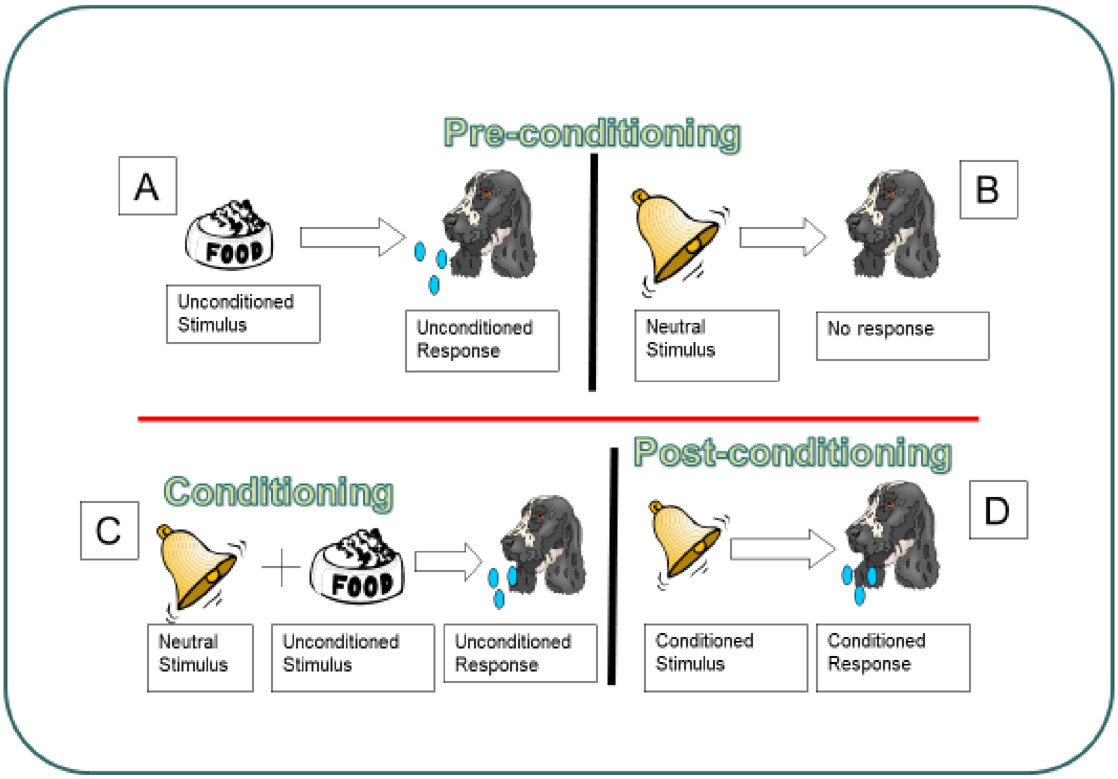
Let's define terms first. The term *conditioning* means learning. So *pre*-conditioning is before learning occurs, conditioning is during learning or the acquisition of the relationship between the two stimuli, and *post*-conditioning is after learning has occurred. If we say something is *un*-conditioned it is not learned. Going back to our earlier philosophical discussion, this is learning that is innate or present at birth. Also keep in mind that the *stimulus* is what is sensed in the world through vision, hearing, smell, taste, or touch. The *response* is the behavior that is made. Making sure you have the terms straight will help you to understand respondent conditioning easier.

4.1.2.1. Pre-conditioning. Notice that pre-conditioning has both an A and a B panel. All this stage of learning signifies is that some knowledge is already present. In Panel A, the taste of food makes a dog salivate. This does not need to be trained and is the relationship of an unconditioned stimulus (US) yielding an unconditioned response (UR). The association occurs naturally. In Panel B, we see that a neutral stimulus (NS) yields nothing. Dogs do not enter the world knowing to respond to the ringing of a bell (which it hears).

4.1.2.2. Conditioning. Conditioning is when learning occurs. Through a pairing of a neutral stimulus and an unconditioned stimulus (bell and food, respectively) the dog will learn that the bell ringing (NS) signals food coming (US) and salivate (UR). The key is that the NS is presented just before the US which yields a UR (in most cases; more on that in a bit).

4.1.2.3. Post-conditioning. Post-conditioning, or *after* learning has occurred, establishes a *new* and not naturally occurring relationship of a conditioned stimulus (CS; previously the NS) and conditioned response (CR; the same response). So, the dog now reliably salivates at the sound of the bell because he expects that food will follow, and it does. If it doesn't, the response ends or extinguishes as you will see later.

Figure 4.1. Pavlov's Classic Experiment



Let's now clearly define our terms:

- **Unconditioned stimulus** — The stimulus that naturally elicits a response.
- **Unconditioned response** —The response that occurs naturally when the US is present.
- **Neutral stimulus** — A stimulus that causes no response.
- **Conditioned stimulus** — The initially neutral stimulus that has been associated with a naturally occurring stimulus to bring about a response.
- **Conditioned response** — The response which is elicited by a CS, though it is not the same as the UR. This response is usually weaker than the UR (the dog salivates to the bell, though it does not do it as much as it does to the sight/smell/taste of the food).

Note to Student: Be sure you not only understand these terms but the acronyms used to represent them. I will use the shorthand the rest of the way through this module and in other places in the book.

To fully understand respondent conditioning, know that the pairings of an NS and US each represent a single trial, called the **conditioning trial**. The period between conditioning trials is called the **intertrial interval.** The period between the presentation of the NS and then the US (Panel C) within a conditioning trial is called the **interstimulus interval**.

The entire process of conditioning, to include when we first make the association between an NS and US to its strengthening over time through repeated pairings, is called **acquisition**. It is likely not surprising to learn that conditioning occurs quicker if the US is more intense. We will be more motivated to learn to associate making an incorrect response with shock if we receive 150 volts compared to 25 volts.

Conditioning is also more effective when the trials are spaced rather than massed (Menzel et al., 2001). For instance, spacing the trials 5 minutes apart is more effective than spacing them 25 seconds apart. One explanation for this is that we have time to rehearse the CS and US in memory during the intertrial interval and if a new trial occurs too soon, it could interfere with rehearsal (Wagner, Rudy, & Whitlow, 1973).

And we can determine how good the learning is if we toss in a *test trial* occasionally in which the NS is presented alone to see if it elicits the response (UR/CR; ring the bell alone and see if salivation occurs). We can also wait to see if after the presentation of the NS (bell) and before the US appears (sight of food) if the UR/CR appears on its own (salivation). In other words, does the response occur during the interstimulus interval?

4.1.3. Conditioning and its Different Forms

It is worth noting that the conditioning procedure described in the preceding section on Pavlov is not the only form it can take. In this section, we will discuss a type of layered conditioning, conditioning based on the event being something we desire or want to avoid, conditioning based on the presentation or removal of the US, and finally temporal factors that can produce unique conditioning procedures.

4.1.3.1. Higher order conditioning. Sometimes, a stimulus that is associated with a CS (formerly the NS) becomes a CS itself and elicits the CR. We call this **higher order conditioning,** and each level of conditioning is referred to as first, second, third, etc. order conditioning. So how might this work?

Being assaulted (US) will elicit fear (UR). A person wearing a ski mask would alone not cause any response (it is an NS_1). If though, you pair the person wearing the ski mask (NS_1) with the assault (US) which causes fear (UR), then the sight of a person wearing a ski mask (CS_1) will elicit fear (CR). Keep in mind that with the stimuli, you see a person wearing a ski mask and feel the effects of the assault (touch or pain receptors in the skin will be activated). This is *first-order conditioning* (not to be confused with the training of First Order stormtroopers in Star Wars) and in this example involves a person being associated with fear.

But what if the assault occurred in an alley in your neighborhood? Now the alley (NS_2) is paired with the person wearing the ski mask (CS_1) which causes fear (CR), and post-conditioning shows that the alley (CS_2) causes fear (CR). This is second-order conditioning and involves a location being associated with fear.

Could the time of day be a factor too? What if the mugging occurred at night? If night (NS_3) is paired with the alley (CS_2) which causes fear (CR), then being outside at night (CS_3)

could lead to fear (or at least some anxiety; CR). This would be third-order conditioning and now involves a time of day being associated with fear.

Fear was originally elicited by being assaulted. Through higher order conditioning, it was also elicited by the sight of a ski mask, being in an alley, and being outside at night. The fear reaction becomes weaker across the conditioning of these additional NS, such that our response to being outside at night could be better classified as anxiety and not so much the bona fide fear felt while being assaulted (and likely for a time afterward) which suggests that the response is strongest to the US and becomes weaker across CS_1, CS_2, and CS_3.

4.1.3.2. Appetitive and aversive conditioning. Recall from Section 2.1.3 that appetitive stimuli are those that an organism desires and seeks out while aversive stimuli are readily avoided. In respondent conditioning, the US could be an appetitive or aversive stimulus. For instance, in *appetitive conditioning,* the US would be something desirable such as candy which makes us happy. Other examples could include water, food, sex, or drugs. In *aversive conditioning*, the stimulus is not pleasant and could include extreme temperatures, a painful sting such as from a wasp or a bite from a dog, electric shock, or something that does not smell nice. It would not be surprising to learn that conditioning occurs relatively fast when aversive US are involved. Since these stimuli could harm or kill us, learning to avoid them is adaptive and aids our survival.

4.1.3.3. Excitatory and inhibitory conditioning. Our discussion so far has included examples in which the NS is associated with the presentation of the US, called **excitatory conditioning**. For Palov's dogs, they associated the ringing of a bell (NS) with the presentation of the food (US) which caused their salivation (UR). Eventually, salivation (CR) occurred to just the ringing of the bell (CS).

Interestingly enough, the absence of the US could be associated with an NS too, in a process called **inhibitory conditioning**. Go back to our example for higher conditioning. A person wearing a ski mask is an excitatory CS for fear but seeing someone wearing such a mask during the daytime leads to an inhibition of fear. It being day indicates a safe interval and we will not be overly concerned about ski masks. We have only ever been assaulted at night. The excitatory CS is expressed as CS+ and the inhibitory CS as CS-.

4.1.3.4. Temporal factors affecting conditioning. In the previous section we saw that generally, the US is presented after the NS though the NS could be followed by the absence of an US. These examples have also always presented the NS before the US, but this is not necessary in all cases.

First, **delay conditioning** involves the presentation of the NS before the US, but the NS overlaps with the US for a short period of time. In the case of Pavlov's experiment, the bell would ring for say 10 seconds, then the food would enter the room, and then the bell would end 5 seconds after this. The ISI (interstimulus interval) should be relatively brief to use this procedure.

What if we present the NS well ahead of the US in time? Let's say we ring the bell for 10 seconds and then there is a 5-second gap before the food enters the room. The NS and US do not overlap. This is the basis of **trace conditioning** and the trace is a memory that we have to access. The organism will need to remember that the NS occurred before the US to make the association, or that the bell rang before the food came in. The period of time between the NS terminating and the US beginning is called the *trace interval* and ideally should be short, or a few seconds.

The NS and US could occur at the same time such as in **simultaneous conditioning.** As you might expect, conditioning in this procedure is poor since the NS does not predict the occurrence of the US. They occur simultaneously. The bell would ring as the food enters the room. The bell-ringing does not lead to an expectation that food will come shortly, which aids with learning the association.

Finally, the US could come before the NS in a procedure called **backward conditioning**. The US would occur first and last for a few seconds with the NS starting near the end of this time. Hence, the NS and US co-occur for a short period of time. Of the four methods, backward conditioning is the least effective for excitatory conditioning though it could lead to inhibitory conditioning. Consider a shock paradigm in which a rat is given a shock (US) and then near the end of the shock a light is turned on (NS). The light (NS) would signal the end of the shock (US) and serve as a safety signal. Hence, the NS would become a CS-.

4.1.4. How Do You Know if Learning Occurred?

A cardinal feature of science is to verify that any change in your variable of interest (the DV) is caused by the treatment or manipulation (the IV). It could be that the elicited response was not actually caused by the NS/CS and so a product of learning or conditioning, but was caused by sensitization instead, called **pseudoconditioning**.

Let's say you were working with turtles and presented them with a tone (the NS) followed by tapping on the shell (US) which resulted in the turtles withdrawing into their shells (UR). With a few such pairings, the tone (CS) would lead to withdrawing into shells (CR). So the tone has been associated with tapping, right? Possibly, but let's say in addition to the tone we also flash a light. The turtles also withdraw into their shells at the presentation of this stimulus. In the case of sensitization, repeated presentation of a stimulus leads to an increase in how strong the response is. It can also lead to other stimuli eliciting the same response as in the case of the bright light and tone both eliciting the withdraw into shell response.

To know if the effect on the behavior you are seeing is due to conditioning and not sensitization, a simple adjustment can be made — the inclusion of a control group. The experimental group would have the tone and tap paired together resulting in a withdrawal response. The control group would have the tone played and then the tap made far apart in time. Now when the tone is presented to each group alone, the experimental group would have a strong withdrawal into shell response while the control group may have the same response, but it would be weak. The intensity of the response, or in this case it being stronger in the experimental rather than control condition, indicates conditioning has truly occurred. There is no pseudoconditioning in other words.

4.2. Properties Governing Respondent Conditioning

Section Learning Objectives

- Define extinction.
- Describe spontaneous recovery in relation to extinction.
- Differentiate stimulus generalization and discrimination.
- Describe sensory preconditioning.
- Describe latent inhibition.
- Define overshadowing.
- Define blocking.
- Explain the use of occasion setters.

4.2.1. Extinction and Spontaneous Recovery

Once an association between the NS and US has been established resulting in the NS becoming a CS, is there a way to break this association? The answer is yes, and respondent **extinction** involves the CS no longer being paired with the US leading to no response when the CS is presented again. For instance, the sound of a bell ringing (CS) is not followed by food (US) as the animal has come to expect and predict, and so eventually the dog stops salivating (the CR) when the bell sounds.

This property leads us to wonder if the broken association of the CS and US is permanent. The answer is no and eventually, the bell will ring making the dog salivate. If no food comes, the behavior will not continue. The organism may make the response a few more times with the strength of the response weakening each time until eventually it ends. If food comes, the salivation response will be re-established. This property is called **spontaneous**

recovery and is when the CS elicits the CR after extinction has occurred. The association between CS and US is re-established relatively quickly once the pairing is made again.

4.2.2. Stimulus Generalization and Discrimination

When a number of similar CS or a broad range of CS elicit the same CR, **stimulus generalization** is said to have occurred. An example is the sound of a whistle eliciting salivation the same as the sound of a bell, both detected via audition. As you would expect, the more similar the new stimulus is to the original CS, the stronger the response will be. If a child was conditioned to be afraid of white rats, we would expect the response to be stronger if made in the presence of a white mouse rather than a German shepherd.

When the CR is elicited by a single CS or a narrow range of CSs, **stimulus discrimination** is said to have occurred. Teaching the dog to not respond to the whistle but only to the bell, and just that type of bell, is an example. Other bells would not be followed by food, eventually leading to the extinction of the erroneous association. Teaching an organism to make such discriminations is called *discrimination training*.

4.2.3. Sensory Preconditioning

There are situations in which a stimulus becomes a CS, making other stimuli it was paired with likely candidates to become a CS in the future too. This is called **sensory preconditioning**. Years ago, I worked for the National Institutes of Health where I did learning and memory experiments on rats and mice. Though when I started the rats in particular did not scare me, one fateful March day I injected a rat in the wrong spot, hurt it (unintentionally, of course), and it promptly turned around and took a piece of my hand with it. The bite of course elicits fear in keeping with a US-UR relationship, and for me the rat was an NS. Through that experience, and some close calls after that, I came to associate rats (CS) with fear (CR) when injecting them. Before all this, I associated rats (NS_1) with their home cage where they lived (NS_2) from which I took them out to handle. After the bite, I became afraid (CR) of handling rats when injecting them again (CS_1), and when handling them in the home cages (CS_2). Animals can detect fear, so this was not a good development, but also my confidence declined.

What was the end result? After a few months, I no longer worked with rats. This was not because of the bite incident. In keeping with what we learned about extinction above, eventually having numerous attempts injecting rats and not being bitten, the fear would have extinguished. That is what happened. Unfortunately, when the rat bit me he intensified my allergies that I did not realize were to the rats and mice I worked with. I believed they were just normal seasonal allergies and worse that year than past years, which did happen from time-to-time. I went about my business, ignorant of just how close to going into anaphylactic shock I truly was. So exit mice and rats. Enter fruit flies as my research subject of choice for learning and memory experiments from that point forward. I did that for about a year and finally had enough.

4.2.4. Latent Inhibition

The property of **latent inhibition** states that it is easier to condition a novel stimulus than a familiar one (Lublow, 1973). If you are using music as an NS, use a song you are unfamiliar with (or your subjects are) such as a Barry Manilow song, rather than one they know and listen to often such as Lady Gaga or Taylor Swift. So in your experiment, the song (NS) is followed by food (US) which elicits salivation (UR) in the person (much like one of Pavlov's dogs). If you use that Taylor Swift song as the NS, salivation is not likely to occur, assuming the participants have heard it numerous times already. If you use the Barry Manilow song (CS), they will likely make the salivary response as expected (CR). The benefit of latent inhibition is that we do not form associations between CRs and repetitive stimuli in our environment that are linked by mistake or coincidentally.

Complementary to latent inhibition is the concept of **US preexposure effect** or exposure to a US before conditioning occurs which can make subsequent conditioning more difficult (Randich & LoLordo, 1979). Hence, the more preexposure an organism has to a US, the worse learning is later and habituation may be the culprit here. Being exposed repeatedly to the US before conditioning, the organism may habituate to it at least to some degree, making conditioning more difficult.

4.2.5. Overshadowing and Blocking

There are times when we are presented with two or more stimuli simultaneously, called a **compound stimulus**. We might, for instance, be presented with a light and a sound at the same time. In what is called **overshadowing** (Pavlov, 1927), two neutral stimuli are presented at the same time and the more salient of the two becomes a CS. Let's say a green light and high-pitched tone were both presented at the same time and paired with the US of food which elicits salivation (UR). Which part of the compound would become the CS and elicit salivation? It appears the tone which was high-pitched would stand out more than a mere green light. But what if this green light was neon green or flashing and the tone was relatively faint and monotone? Now the light would be the more relevant or salient stimulus and become conditioned as the CS. The more salient part of the compound stimulus causes the less salient part to elicit little to no response, or remain as an NS.

In **blocking** (Kamin, 1969; 1968), the compound stimulus is composed of an NS and a CS and the established CS interferes with learning a new CS relationship. This differs from overshadowing which has two NS as part of the compound stimulus differing only in terms of salience. Let's use the example above. Say you presented a dog with a tone (NS) and food (US) leading to salivation (UR). The dog will learn that when it hears the tone (CS) food is coming and will salivate (CR). What if now you present the tone (CS) with a green light several times (NS; note that the tone and light are a compound stimulus and presented simultaneously) and pair them with food (US), which causes salivation (UR). By doing this, you are trying to teach the dog to salivate to the green light, but when the stimuli are presented separately, the tone (CS) elicits salivation (CR) while the green light (NS) causes no response. The former learning has blocked the new learning.

4.2.6. Occasion Setting

The context in which learning occurs is also important. **Occasion setters** are stimuli that help an organism determine if the CS will be followed by a US leading to the CR. In other words, the CS elicits a CR only when the feature is present, called a *feature-positive occasion setter*. This feature may also indicate when a CS will *not* be followed by the US, called a *feature-negative occasion setter* (Palmatier, 2014). Consider the example of a bell (NS) being followed by food (US), which elicits salivation (UR). What if the food only comes out if the bell rings when a white light over it turns on (OS or occasion setter). If the light is on (OS) when the bell rings (NS), food comes out (US), leading to salivation (UR). If the light is off when the bell rings (NS), no food comes out, which will not elicit the behavior of salivation. We can test whether the discrimination was made by turning the light on (OS) when the bell rings (CS), which leads to salivation (CR; and the correct response) and then not having the light on when the bell rings, which should cause no response in the organism. If this is true, conditioning and the discrimination was learned. The animal now knows that food will only come out when the light is turned on during the ringing of the bell and salivate.

4.3. Theories of Conditioning

Section Learning Objectives

- Describe Pavlov's stimulus substitution theory.
- Describe the preparatory-response theory.
- Describe the compensatory response theory.
- Describe the Rescorla-Wagner model.
- Describe Mackintosh's attentional model.

In this final section of Module 4, we will cover five theories of conditioning that identify the processes that underly respondent conditioning. They include the stimulus substitution theory, preparatory-response theory, compensatory response theory, Rescorla-Wagner model, and the attentional model.

4.3.1. Stimulus Substitution Theory

According to Pavlov (1927), respondent conditioning is a matter of substituting one stimulus with another, or the CS acts as a substitute for the US. A connection or association is established in the brain between CS and US, and when the CS is activated alone, following acquisition, it automatically activates the US portion of the cortex. The CR, therefore, is identical or nearly identical to the UR since the connection between US and UR is hardwired or innate.

As such, the presentation of food (US) to a dog activates the food center in the cerebral cortex. This, in turn, activates the salivation center in the brain which leads to the behavior of salivation (UR). Then if we introduce an NS such as a bell ringing, it activates an area of the brain responsible for processing the sound and then is followed by an US and UR as described above. This happens over a few trials (the conditioning phase). Learning has occurred if after the presentation of the bell (CS) the area of the brain which processes the sound of the bell activates the area responsible for processing the food, which activates the area responsible for salivation, and then salivation (CR) occurs. It is the simultaneous activation of the brain areas responsible for the CS and then the US that causes a new functional neural pathway to form between the active areas.

It should be noted that Pavlov was incorrect and the process is more complex than he made it seem. Timberlake and Grant (1975) tested Pavlov's theory by conditioning rats to expect a food pellet after a brief interval across two situations differing in terms of what type of CS was utilized. In one situation, a woodblock was secured to a platform and was the CS for food, while in the other situation a live rat was secured to the platform and was the CS for food. Utilizing the stimulus substitution theory, they predicted that the rats would approach and bite the CSs that were paired with the food. The results showed that rats in the woodblock condition bit the block CS as predicted but this did not occur when a live rat was the CS. Instead, rats groomed the live rat CS. They concluded that the nature of the CS influenced the topography of the CR, contradicting the stimulus substitution theory. The specific response that was displayed was related to the form the CS took.

Recall that in the stimulus substitution theory, the CR is identical or almost identical to the UR. We know that is not always the case though. Consider a man who has panic attacks (US) which can be quite fear-evoking (UR). Flying is an NS which yields no response. If the man is flying on a plane (NS) and has a panic attack (US) which causes him a fear (UR), then in the future the mere thought of flying in a plane (CS) will cause not fear necessarily, but definitely anxiety (CR). Hence, in this example, the CR is not the same as the UR, and not even close. Fear and anxiety are different physiological and emotional reactions. Hence, the UR and CR being identical, or even close, is not always the case as Pavlov's theory suggests.

4.3.2. Preparatory-Response Theory

It might be that the CR exists to prepare the organism for the presentation of the US such that a dog salivates (CR) when it hears the bell ring (CS) to prepare for the arrival of the food (US). This is called the **preparatory-response theory** (Kimble, 1967; 1961) and it makes up for the shortcoming of the stimulus substitution theory in terms of the UR and CR not having to be identical (or close). In the example just given, the CR and UR are virtually the same. But consider a rat that is shocked (US) and displays fear (UR). If a light (NS) signals the presentation of the shock (US) causing fear (UR), then the rat will display a freeze behavior (CR) when the light turns on (CS) as it expects the shock to follow.

4.3.3. Compensatory Response Model

Not only can the UR and CR be different, the CR can be the direct opposite of the UR. In the **compensatory-response model**, and building off the opponent-process theory of emotion (Solomon & Corbit, 1974), a CS that has come to be repeatedly associated with the a-process or primary response to a US will with time, elicit a compensatory response or b-process. Evidence for this process comes from Siegel (1972) who gave rats repeated injections of insulin which reduces the level of glucose in the blood. He tested the CR by giving the rats an injection of saline in place of insulin. The results showed that a strong CR did occur, but it was the opposite of the reaction to insulin. The rats showed an increase in blood glucose levels (hyperglycemia CR). The CR and UR were not the same and the CR was compensatory.

Consider drug tolerance. Morphine, as a US, causes the UR of **analgesia**, or a reduced sensitivity to pain. Siegel et al. (1978) found that the CR to stimuli paired with morphine such as lights or tones, is **hyperalgesia**, or an increased sensitivity to pain. In the study, Siegel placed a rat's paw on a hot plate and measured latency in terms of how long it took the rat to pull its paw off the plate. He found that rats injected with morphine took longer to remove their paws compared to rats which did not receive the injection. The rats which had a stimulus such as a tone paired with morphine removed their paws quicker than rats that had a stimulus not paired with morphine (the US).

4.3.4. Rescorla-Wagner Model

Robert Rescorla and Allan Wagner (1972) developed an associative model of respondent conditioning built on the idea that a given US can only support so much conditioning and must be spread out among the CSs that are present. Four main ideas are captured in this model.

1. There is a maximum associative strength that can develop between a US and CS. This is determined by the US and different US support varying maximum levels of conditioning. Stronger stimuli, therefore, support more conditioning such that if a US is a favorite food such as chicken, it will produce more salivation in an organism than a less preferred food such as Brussel sprouts.
2. Associative strength goes up with each trial, though the amount of associative strength gained on a trial is a function of the level of prior training. In general, more associative strength is gained in early trials.

3. Associative strength will accumulate quickly to some stimuli and slowly to others and some USs will produce rapid learning compared to others.
4. A specific US can only support a certain degree of conditioning even when paired with more than one stimulus. The addition of each stimulus beyond the first means that the US must share associative strength across all stimuli. Let's say a US has 15 maximum associative strength units. If 11 of these units are distributed to Stimulus A, then only 4 can be shared with a Stimulus B. This would be particularly true in the case of a compound stimulus. A would obviously be more salient than B, or recall from earlier, A *overshadows* B.

The Rescorla-Wagner model also does a good job explaining *blocking*. Recall our earlier example of a dog presented with a tone (NS) and food (US) leading to salivation (UR). Acquisition is complete when the tone (CS) causes salivation (CR). The US of food has a maximum associative strength of 8 units which is transferred in full to the tone (CS) upon acquisition. If we now introduce an NS of a green light presented simultaneously with the tone (CS) to form a compound stimulus followed by food (US) which causes salivation (UR), then when the tone and green light are tested separately, the tone will cause salivation as it has the associative strength of 8 units assigned to it and the light will cause no response since no associative strength is left to be assigned to it.

4.3.5. Mackintosh's Attentional Model

Nicholas Mackintosh (1975) presented a very simple theory of conditioning centered on the concept of attention. The **attentional model** states that how much attention an organism will give a CS is dependent on how well the CS predicts the US. If it is a good predictor, we will pay attention to the CS. If it is not a good predictor, our attention will decline. When attention is high, learning will be high as well. Organisms will pay more attention to the best predictor of the US and less attention to weaker predictors during conditioning. The theory explains blocking by saying that though the US was able to bring about learning to both the light and the tone, the animal paid less attention to the green light than it did to the tone.

Module Recap

With the conclusion of this module, you should have a firm understanding of respondent conditioning in place. You will use this knowledge to discuss applications of respondent conditioning in Module 5 and then see how the learning paradigm relates to operant conditioning, a second associative model. We will then discuss observational learning, and through an exercise you will see how the three models of learning are complementary to one another, and not competing. I hope you enjoyed this module and its coverage of respondent conditioning. If something was not clear, please ask your instructor about it.

Part II. Associative Learning – Respondent Conditioning

Module 5:

Applications of Respondent Conditioning

Module 5: Applications of Respondent Conditioning

Module Overview

Having covered basic and advanced topics in relation to respondent conditioning, also called classical or Pavlovian conditioning, I will now present some applications of the learning model in the real world. To that end we will discuss the acquisition of fears (phobias) from a clinical psychology perspective, the paradigm of eyeblink conditioning, how food preferences and taste aversions are learned, PTSD and treatment approaches, and advertising and its use of the learning model.

Module Outline

Module Learning Outcomes

- Describe how fears are learned and unlearned using respondent conditioning.
- Describe the use of the eyeblink conditioning procedure in respondent conditioning.
- Clarify how taste aversion occurs.
- Clarify how we acquire food preferences.
- Describe how respondent conditioning can be used to partially explain and treat PTSD.
- Propose ways to use respondent conditioning in advertising/marketing.

5.1. Fear Conditioning

Section Learning Objectives

- Describe how fears are learned citing the Watson and Rayner (1920) study.
- Outline factors affecting fearfulness.
- Describe phobias in general and then specific types from the perspective of clinical psychology.
- Describe the counterconditioning method.
- Describe exposure treatments.
- Describe flooding.
- Outline the conditioned emotional response (CER) technique.
- Define the suppression ratio.

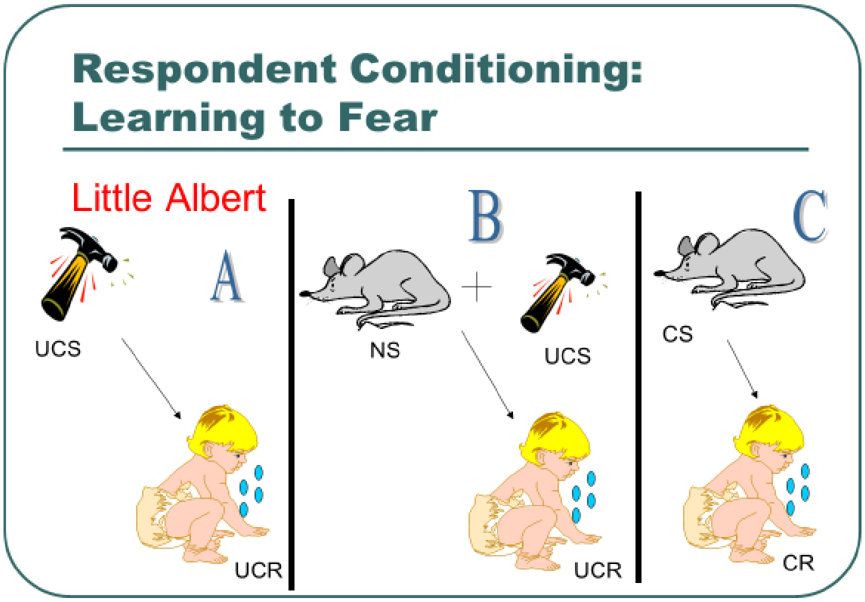
5.1.1. Learning Phobias

One of the most famous studies in psychology was conducted by John B. Watson and graduate student Rosalie Rayner (1920). Essentially, they wanted to explore the possibility of conditioning various types of emotional responses. The researchers ran a 9-month-old child, known as Little Albert, through a series of trials in which he was exposed to a white rat to which no response was made outside of curiosity (NS — no response not shown).

In Panel A of Figure 10.2, we have the naturally occurring response to the stimulus of a loud sound. On later trials, the rat was presented (NS) and followed closely by a loud sound as Albert touched it (US; Panel B). In the first trial, Albert "jumped violently and fell forward, burying his face in the mattress. He did not cry, however" (pg. 4). In subsequent trials, his reaction was similar except that he whimpered. The level of fear he displayed to the rat increased over conditioning trials, resulting in the child responding with fear to the mere presence of the white rat (Panel C). It should be noted that Little Albert's fear of the rat generalized to similar objects such as a Santa Claus mask, a fur coat, a rabbit, and a dog.

To read the Watson and Rayner (1920) article entitled, "*Conditioned Emotional Reactions*," for yourself, please visit: https://psychclassics.yorku.ca/Watson/emotion.htm

Figure 5.1. Learning to Fear



Note: UCS is the same as US and UCR is the same as UR

5.1.1.1. Factors affecting fearfulness. Several factors affect the degree to which a person or animal will become fearful. First, Seligman (1971) proposed the idea of **biological preparedness** which says that organisms tend to learn some associations more readily than others. One reason why this might occur is that these more easily learned CS-US relationships aid in survival and is one reason why we might learn to avoid a hot stove quicker than a butterfly. In a classic study, rhesus monkeys were shown videotapes of model monkeys exhibiting either an intense fear or no fear of fear-relevant stimuli (toy snakes or a toy crocodile) or to fear-irrelevant stimuli (flowers or a toy rabbit). The observer monkeys were placed into one of four conditions (fear reaction with fear-relevant stimuli; no fear reaction with fear-relevant stimuli; fear reaction with fear-irrelevant stimuli; no fear reaction with fear-irrelevant stimuli) for 12 sessions. Results showed that the observer monkeys acquired a fear of fear-relevant stimuli but not the fear-irrelevant stimuli. Hence, they were prepared to learn to fear snakes or crocodiles before flowers or rabbits (Cook & Mineka, 1989).

Another factor involves the organism's **temperament** or base level of emotionality and reactivity to stimulation. Temperament can, therefore, affect how easily a CR, such as fear, can be acquired (Clark, Watson, & Minkeka, 1994). Young infants display three types of temperament. *Easy* children are happy, have regular sleep and eating habits, are adaptable and calm, and not easily upset. *Difficult* children have irregular feeding and eating habits, are fearful of new people and situations, fussy, easily upset by noise and stimulation, and intense in their reactions. Finally, *slow to warm* children are less active and fussy, withdraw and react negatively to new situations, but over time may become more positive with repeated exposure to novel people, objects, and situations.

Third, having a **history of control** over events in our lives immunizes an organism from displaying elevated fear when faced with new stimuli. Before 6 months of age, infants are not upset by the presence of people they do not know. As they learn to anticipate and predict events, strangers cause anxiety and fear. This is called **stranger anxiety**. Not all infants respond to strangers in the same way though. Infants with more experience show lower levels of anxiety than infants with little experience. Also, infants are less concerned about strangers who are female and those who are children. The latter probably has something to do with size as adults may seem imposing to children.

Finally, **modeling** is another behavioral explanation of the development of fears. In modeling, an individual acquires a fear though observation and imitation (Bandura & Rosenthal, 1966). For example, when a young child observes their parent display irrational fears of an animal, the child may then begin to display similar behaviors. Similarly, observing another individual being ridiculed in a social setting may increase the chances of the development of social anxiety, as the individual may become fearful that they would experience a similar situation in the future. It is speculated that the maintenance of these phobias is due to the *avoidance* of the feared item or social setting, thus preventing the individual from learning that the item/social situation is not something that should be feared. We will talk more about modeling in Module 8.

While modeling and classical conditioning largely explain the development of phobias, there is some speculation that the accumulation of a large number of these learned fears will develop into **Generalized Anxiety Disorder**, a disorder characterized by an underlying excessive worry related to a wide range of events or activities. Through stimulus generalization**,** a fear of one item (such as a dog) may become generalized to other items (such as all animals). As these fears begin to grow, a more generalized anxiety will appear, as opposed to a specific phobia.

5.1.2. Respondent Conditioning Approaches to Treating Phobias (and Anxiety Disorders)

5.1.2.1. Phobias from the perspective of clinical psychology. Before we discuss treating phobias, a distinction is needed. The hallmark symptoms of anxiety-related disorders are excessive fear or anxiety related to behavioral disturbances. Fear is considered an adaptive response, as it often prepares your body for an impending threat. Anxiety, however, is more difficult to identify as it is often the response to a *vague* sense of threat. The two can be distinguished from one another as fear is related to either a real or perceived threat, while anxiety is the *anticipation* of a future threat (APA, 2013). So what form can phobias take?

Specific phobia is distinguished by an individual's fear or anxiety specific to an object or a situation. While the amount of fear or anxiety related to the specific object or situation varies among individuals, it also varies related to the proximity of the object/situation. When individuals are face-to-face with their specific phobia, immediate fear is present. It should also be noted that these fears are more excessive and more persistent than a "normal" fear, often severely impacting one's daily functioning (APA, 2013).

Individuals can experience multiple specific phobias at one time. In fact, nearly 75% of individuals with a specific phobia report fear in more than one object (APA, 2013). When making a diagnosis of specific phobia, it is important to identify the specific phobic stimulus. Among the most commonly diagnosed specific phobias are animals, natural environments (height, storms, water), blood-injection-injury (needles, invasive medical procedures), or situational (airplanes, elevators, enclosed places; APA, 2013). Given the high percentage of individuals who experience more than one specific phobia, all specific phobias should be listed as a diagnosis in efforts to identify an appropriate treatment plan.

Agoraphobia is defined as an intense fear triggered by a wide range of situations. Agoraphobia's fears are related to situations in which the individual is in public situations where escape may be difficult. In order to receive a diagnosis of agoraphobia, there must be a presence of fear in at least two of the following situations: using public transportation such as planes, trains, ships, buses; being in large, open spaces such as parking lots or on bridges; being in enclosed spaces like stores or movie theaters; being in a large crowd similar to those at a concert; or being outside of the home in general (APA, 2013). When an individual is in one (or more) of these situations, they experience significant fear, often reporting panic-like symptoms (see Panic Disorder below). It should be noted that fear and anxiety-related symptoms are present *every* *time* the individual is presented with these situations. Should symptoms only occur occasionally, a diagnosis of agoraphobia is not warranted.

Due to the intense fear and somatic symptoms, individuals will go to great lengths to avoid these situations, often preferring to remain within their home where they feel safe, thus causing significant impairment of one's daily functioning. They may also engage in active avoidance, where the individual will intentionally avoid agoraphobic situations. These avoidance behaviors may be behavioral, including having food delivered to avoid going to the grocery store or only taking a job that does *not* require the use of public transportation, or cognitive, by using distraction and various other cognitive techniques to successfully get through the agoraphobic situation.

For **social anxiety disorder**, the anxiety is directed toward the fear of social situations, particularly those in which an individual can be evaluated by others. More specifically, the individual is worried that they will be judged negatively and viewed as stupid, anxious, crazy, boring, unlikeable, etc. Some individuals report feeling concerned that their anxiety symptoms will be obvious to others via blushing, stuttering, sweating, trembling, etc. These fears severely limit an individual's behavior in social settings. For example, an individual may avoid holding drinks or plates if they know they will tremble in fear of dropping or spilling food/water. Additionally, if one is known to sweat a lot in social situations, they may limit physical contact with others, refusing to shake hands.

Unfortunately, for those with social anxiety disorder, all or nearly all social situations provoke this intense fear. Some individuals even report significant anticipatory fear days or weeks before a social event is to occur. This anticipatory fear often leads to avoidance of social events in some individuals; others will attend social events with a marked fear of possible threats. Because of these fears, there is a significant impact in one's social and occupational functioning.

It is important to note that the cognitive interpretation of these social events is often excessive and out of proportion to the actual risk of being negatively evaluated. There are instances where one may experience anxiety toward a real threat such as bullying or ostracism. In this instance, social anxiety disorder would not be diagnosed as the negative evaluation and threat are real.

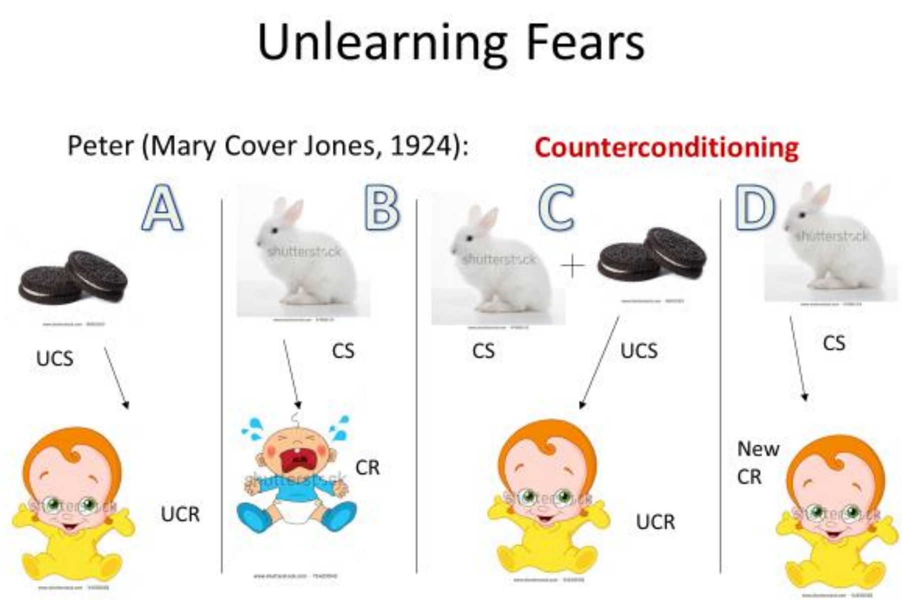
Panic disorder consists of a series of recurrent, unexpected panic attacks coupled with the fear of future panic attacks. A **panic attack** is defined as a sudden surge of fear or impending doom along with at least four physical or cognitive symptoms (listed below). The symptoms generally peak within a few minutes, although it seems much longer for the individual experiencing the panic attack.

There are two key components to panic disorder—the attacks are *unexpected*, meaning there is nothing that triggers them, and they are *recurrent*, meaning they occur multiple times. Because these panic attacks occur frequently and essentially "out of the blue," they cause significant worry or anxiety in the individual as they are unsure of when the next attack will occur. In some individuals, significant behavioral changes such as fear of leaving their home or attending large events occur as the individual is fearful an attack will happen in one of these situations, causing embarrassment. Additionally, individuals report worry that others will think they are "going crazy" or losing control if they were to observe an individual experiencing a panic attack. Occasionally, an additional diagnosis of agoraphobia is given to an individual with panic disorder *if* their behaviors meet diagnostic criteria for this disorder as well.

The frequency and intensity of these panic attacks vary widely among individuals. Some people report panic attacks occurring once a week for months on end, others report more frequent attacks multiple times a day, but then experience weeks or months without any attacks. Intensity of symptoms also varies among individuals, with some patients reporting experiencing nearly all 14 symptoms and others only reporting the minimum 4 required for the diagnosis. Furthermore, individuals report variability within their panic attack symptoms, with some panic attacks presenting with more symptoms than others. It should be noted that at this time, there is no identifying information (i.e. demographic information) to suggest why some individuals experience panic attacks more frequently or more severely than others.

5.1.2.2. Counterconditioning. As fears can be learned, so too they can be unlearned. Consider the follow-up to Watson and Rayner (1920), Jones (1924; Figure 5.2), who wanted to see if a child who learned to be afraid of white rabbits (Panel B) could be conditioned to become unafraid of them. This direct conditioning method involved associating a fear-object with a stimulus/object that could arouse a positive (pleasant) reaction. The hunger motive was used in conjunction with the fear motive and the subject, Peter, was placed in a highchair and given something to eat during a period of food craving. The rabbit was brought to within 4 feet of Peter causing a negative response. But when he asked for the rabbit to be taken away, it was moved to 20 feet away. At this point, he stopped crying but did continue to fuss and said, “I want you to put Bunny outside.” Then, he resumed eating some pleasant food (i.e., something sweet such as cookies [Panel C]; remember the response to the food is unlearned, i.e., Panel A). Jones writes, “The relative strength of the fear impulse and the hunger impulse may be gauged by the distance to which it is necessary to remove the fear-object” (pg. 127). The procedure in Panel C continued with the rabbit being brought in a bit closer each time to eventually the child did not respond with distress to the rabbit (Panel D). Since Peter was one of her most serious problem cases, he was treated once or twice daily for nearly two months (from March 10 to about April 29) and at the mid-morning lunch since it almost always guaranteed some interest in the food. By the last days, he would ask, "Where is the rabbit?" It would be brought in and placed at his feet resulting in him petting, picking up (or at least trying), and playing with him for several minutes. The success of this method is conditional on hunger level, and as it grows so does the success of the method, at least to a certain point.

Figure 5.2. Unlearning Fears



To read the article for yourself, please visit:

https://pdfs.semanticscholar.org/3859/cafa35c27d0abb0e6a9164186a9c05bb9034.pdf

5.1.2.3. Exposure treatments. While there are many treatment options for specific phobias, research routinely supports behavioral techniques as the most effective treatment strategies. Seeing as behavioral theory suggests phobias are developed via respondent conditioning, the treatment approach revolves around breaking the maladaptive association developed between the object and fear. This is generally accomplished through **exposure treatments**. As the name implies, the individual is *exposed* to their feared stimuli. This can be done in several different approaches: *systematic desensitization, flooding, and modeling.*

Systematic desensitization (Wolpe, 1961) is an exposure technique that utilizes relaxation strategies to help calm the individual as they are presented with the fearful object. The notion behind this technique is that both fear and relaxation cannot exist at the same time; therefore, the individual is taught how to replace their fearful reaction with a calm, relaxing reaction.

To begin, the patient, with assistance from the clinician, will identify a *fear hierarchy*, or a list of feared objects/situations ordered from least to most feared. After learning intensive relaxation techniques, the clinician will present items from the fear hierarchy, starting from the least feared object/subject, while the patient practices using the learned relaxation techniques. The presentation of the feared object/situation can be in person — **in vivo exposure,** or it can be imagined — **imaginal exposure.** Imaginal exposure tends to be less intensive than in vivo exposure; however, it is less effective than in vivo exposure in eliminating the phobia. Depending on the phobia, in vivo exposure may not be an option, such as with a fear of a tornado. Once the patient is able to effectively employ relaxation techniques to reduce their fear/anxiety to a manageable level, the clinician will slowly move up the fear hierarchy until the individual does not experience excessive fear of all objects on the list.

5.1.2.4. Flooding. Another respondent conditioning way to unlearn a fear is what is called **flooding** or exposing the person to the maximum level of stimulus and as nothing aversive occurs, the link between CS and UCS producing the CR of fear should break, leaving the person unafraid. That is the idea at least and if you were afraid of clowns, you would be thrown into a room full of clowns. Similar to systematic desensitization, flooding can be done in either *in vivo* or imaginal exposure. Clearly, this technique is more intensive than the systematic or gradual exposure to feared objects. Because of this, patients are at a greater likelihood of dropping out of treatment, thus not successfully overcoming their phobias. Flooding is an extinction procedure, and not a counterconditioning procedure, it should be noted.

5.1.2.5. Modeling. Finally, **modeling** is another common technique that is used to treat phobias (Kelly, Barker, Field, Wilson, & Reynolds, 2010). In this technique, the clinician approaches the feared object/subject while the patient observes. Like the name implies, the clinician models appropriate behaviors when exposed to the feared stimulus, implying that the phobia is irrational. After modeling several times, the clinician encourages the patient to confront the feared stimulus with the clinician, and then ultimately, without the clinician.

5.1.3. The Conditioned Emotional Response Technique (CER)

Behaviorists also use what is called the **conditioned emotional response (CER) technique**, or **conditioned suppression**. This method involves the following procedure:

1. A rat is trained to press a bar in a Skinner box and for doing so, receives a food reward. This follows standard operant conditioning procedures described in Module 6.

2. Once the level of pressing response is occurring at a regular rate, an NS is introduced in the form of a light, tone, or noise.
3. The NS is paired with a US of a mild foot shock lasting about 0.5 seconds.
    a. This causes the UR of fear. Note that the bar pressing has nothing to do with the delivery of a shock or with the presentation of NS/CS and US.
4. This pairing occurs several times (NS and US or light/tone/noise and shock) resulting in a CS leading to a CR. The CR, in this case, takes the form of the rat stopping pressing the bar or freezing. The CR is not the same as the UR (fear).

The procedure allows for the calculation of what is called the **suppression ratio.** The number of bar presses made during the CS are counted, as well as the number made during a period of equal length right before the CS, called the *pre-CS period*. The formula for suppression ratio is:

$$\frac{\text{\# of behaviors made during CS}}{\text{\# of behaviors made during CS + \# of behaviors made during pre-CS period}}$$

This ratio has a range of values from 0 to 0.5. A value of 0.5 indicates that the number of bar presses has not changed from the pre-CS to CS period. If 10 bar presses were made pre-CS this value would be the same during the CS. So, 10 /10+10 = 10/20 = 0.5. But what if suppression did occur and the number of bar presses falls to 5? The suppression ratio would be 5/5+10 or 5/15 = 0.33. If there was complete suppression, then: 0/0+10 = 0.00.

5.2. Eyeblink Conditioning

Section Learning Objectives

- Describe the eyeblink procedure used in respondent conditioning experiments.

Another application of respondent conditioning includes the eyeblink reflex. Rabbits are commonly used in this procedure as the stimulus and timing parameters that lead to optimal learning have been clearly worked out in them (Vogel et al., 2009). To start, rabbits are habituated to a stock that keeps them restrained. Exposure to brief (about a half-second) tones and light NS occur and are paired with the US of either a puff of air to the cornea of the eye or a mild electric shock near the eye, which causes the rabbit to blink (UR). With repeated pairings, the rabbit blinks (CR) to the tone/light (CS). Unlike other conditioning paradigms, the CR is easy to observe and measure and an interstimulus-interval (ISI) of about 200-500 ms is optimal for rabbit eyeblink conditioning (Schniderman & Gormezano, 1964).

Previous research has shown that the eyeblink response is supported by clear neural circuits such that the pairing of CS to US requires the cerebellum and interpositus nucleus specifically (Christian & Thompson, 2003). More recent research has confirmed changes in synaptic number or structure in the interpositus nuclei following eye-blink conditioning such that there was a significant increase in the length of the excitatory synapses in conditioned animals as well as an increase in synaptic number (Weeks et al., 2007).

5.3. Taste Aversion

Section Learning Objectives

- Describe the typical conditioned taste aversion paradigm.
- Clarify why such a ‘skill’ is needed.

Organisms will tend to reject a food type if it makes them nauseated. This basic idea was put forth by Garcia, Kimeldorf, and Koelling (1955) when they paired a solution of saccharin (CS), which rats generally prefer, with gamma radiation (US) which makes them sick (UR). Relatively quickly, the rats associated the saccharin solution (CS) with getting sick (CR) and avoided it. So how quick is quick? Well, a strong aversion can be learned in as little as one trial and the ISI can be several hours in length!!!

Why would this skill be needed? Welzl et al. (2000) writes, “To survive in a world with varying supplies of different foods animals have to learn which are safe and which are not safe to eat. Most foods are characterized by a specific flavor, i.e. a unique combination of taste and smell. Thus, learning which flavors signal ‘safe to eat’ and which ‘causes nausea’ is important for making use of all the safe foods while at the same time avoiding potentially hazardous ones. Taste is an especially critical information because if it signals ‘causes nausea’ the animal has a last chance to refrain from eating the food” (pg. 205).

Food for Thought — Why might an awareness and understanding of conditioned taste aversion be important in relation to cancer patients?

5.4. Food Preferences

Section Learning Objectives

- Discuss support for food preferences being learned.

In the previous section, we saw how we can learn to not like certain foods or to develop taste aversions. Likewise, we can develop a preference for certain foods through respondent conditioning. Across two experiments, Dickinson and Brown (2007) employed a sample of volunteer undergraduate students and induced flavor aversion by mixing banana and vanilla with a bitter substance (Tween20) and flavor preference by mixing the same neutral flavors with sugar. Results showed that students reported increased liking of the flavor that was paired with sugar and a reduced liking of the flavor paired with the bitter substance. These results fit into a body of literature suggesting the existence of **evaluative conditioning** or when our initial evaluation of a stimulus changes due to it being associated with another stimulus that we already like or dislike.

5.5. PTSD

Section Learning Objectives

- Define and outline the diagnostic criteria of PTSD.
- Describe respondent conditioning approaches to treating PTSD.

5.5.1. What is PTSD?

Posttraumatic stress disorder, or more commonly known as PTSD, is identified by the development of physiological, psychological, and emotional symptoms following exposure to a traumatic event. While the presentation of these symptoms varies among individuals, there are a few categories in which these symptoms present.

One category is *recurrent experiences* of the traumatic event. This can occur via flashbacks, distinct memories, or even distressing dreams. In order to meet the criteria for PTSD, these recurrent experiences must be specific to the traumatic event or the moments immediately following. The dissociative reactions can last a short time (several seconds) or extend for several days. They are often initiated by physical sensations similar to those experienced during the traumatic events, or even environmental triggers such as a specific location. Because of these triggers, individuals with PTSD are known to avoid stimuli (i.e. activities, objects, people, etc.) associated with the traumatic event.

Another symptom experienced by individuals with PTSD is *negative alterations* in cognitions or mood. Often individuals will have difficulty remembering an important aspect of the traumatic event. It should be noted that this amnesia is not due to a head injury, loss of consciousness, or substances, but rather, due to the traumatic nature of the event. Individuals may also have false beliefs about the causes of the traumatic event, often blaming themselves or others. Because of these negative thoughts, those with PTSD often experience a reduced interest in previously pleasurable activities.

Because of the negative mood and increased irritability, individuals with PTSD may be *quick-tempered* and act out in an *aggressive manner*, both verbally and physically. While these aggressive responses may be provoked, they are also sometimes unprovoked. It is believed these behaviors occur due to the heightened sensitivity to potential threats, especially if the threat is similar in nature to their traumatic event. More specifically, individuals with PTSD have a heightened startle response and easily jump or respond to unexpected noises such as a telephone ringing or a car backfiring.

Memory and concentration difficulties may also occur. Again, these are not related to a traumatic brain injury, but rather due to the physiological state the individual may be in as a response to the traumatic event. Given this heightened arousal state, it should not be surprising that individuals with PTSD also experience significant sleep disturbances, with difficulty falling asleep, as well as staying asleep due to nightmares.

Although somewhat obvious, these symptoms likely cause significant distress in social, occupational, and other (i.e. romantic, personal) areas of functioning. Duration of symptoms is also important, as PTSD cannot be diagnosed unless symptoms have been present for at least one month.

5.5.2. Respondent Conditioning Approaches to Treating PTSD

While exposure therapy is predominately used in anxiety disorders, it has also shown great assistance in PTSD related symptoms as it helps individuals extinguish fears associated with the traumatic event. There are several different types of exposure techniques — imaginal, in vivo, and flooding are among the most common types of exposure (Cahill, Rothbaum, Resick, & Follette, 2009).

In imaginal exposure, the individual is asked to re-create, or imagine, specific details of the traumatic event. The patient is then asked to repeatedly discuss the event in more and more detail, providing more information regarding their thoughts and feelings at each step of the event. With in-vivo exposure, the individual is reminded of the traumatic event through the use of videos, images, or other tangible objects related to the traumatic event, that induces a heightened arousal response. While the patient is re-experiencing cognitions, emotions, and physiological symptoms related to the traumatic experience, they are encouraged to utilize positive coping strategies, such as relaxation techniques to reduce their overall level of anxiety.

Imaginal exposure and in vivo exposure are generally done in a gradual process, with imaginal exposure beginning with few details of the event, and slowly gaining more and more information over time; in vivo starts with images/videos that elicit lower levels of anxiety, and then the patient slowly works their way up a fear hierarchy, until they are able to be exposed to the most distressing images. Another type of exposure therapy, flooding, involves disregard for the fear hierarchy, presenting the most distressing memories or images at the beginning of treatment. While some argue that this is a more effective treatment method, it is also the most distressing, thus placing patients at risk for dropping out of treatment (Resick, Monson, & Rizvi, 2008).

5.6. Advertising

Section Learning Objectives

- Clarify whether respondent conditioning can be used in advertising/marketing.

Could respondent conditioning be used in marketing and advertising? In a study of 202 business and psychology undergraduate students, Stuart et al. (1987) hypothesized that "Attitude toward a brand will be more positive for subjects following repeated conditioning trials in which a neutral CS (brand) is paired with a positively valenced US (a pleasant advertising component) than for subjects exposed to the neutral CS and the US in random order with respect to each other" (H1; pg. 336). Brand L toothpaste was presented several times and followed by pleasant scenes (a mountain waterfall, a sunset over an island, blue sky and clouds seen through the mast of a boat, and a sunset over the ocean) for an experimental group but followed by neutral scenes for a control group. The results showed that Brand L was rated significantly higher, or more positively, when paired with pleasant scenes. The authors conclude that "…conditioned learning of brand-specific attitudes is indeed demonstrable under laboratory conditions" (pg. 346).

Module Recap

In this module, we discussed six applications of respondent conditioning to include fear acquisition, the eyeblink paradigm, matters related to taste preferences and aversions, PTSD, and advertising. With this done, Part II is complete, and we now move to our discussion of the associative learning model of operant conditioning championed by Thorndike and Skinner.

Note to Student: To read more about PTSD and phobias from a clinical psychology perspective, please visit the *Abnormal Psychology* (2nd edition) Open Education Resource (OER) by Alexis Bridley and Lee W. Daffin Jr. at https://opentext.wsu.edu/abnormal-psych/. Excerpts were included in this book, though they may have been altered slightly to fit the content and context of a textbook on the principles of learning.

Part III. Associative Learning: Operant Conditioning

Part III. Associative Learning: Operant Conditioning

Module 6:

Operant Conditioning

Module 6: Operant Conditioning

Module Overview

With respondent conditioning covered and applications discussed, we now begin the very tall order of describing Skinner's operant conditioning which was based on the work of Edward Thorndike. The four behavioral contingencies, factors on operant learning, reinforcement schedules, theories related to reinforcement, stimulus control, avoidance, punishment, and extinction will all be covered. Take your time working through this module and be sure to ask your instructor if you have any questions.

Module Outline

Module Learning Outcomes

- Outline historical influences/key figures on the development of operant conditioning.
- Clarify what happens when we make a behavior and outline the four contingencies.
- Outline key factors in operant learning.
- Clarify how reinforcement can occur continuously or partially.
- Describe the various partial schedules of reinforcement.
- Compare theories of reinforcement.
- Describe what stimulus control is and the different ways to gain it.
- Clarify why avoidance is important to learning.
- Describe punishment procedures.
- Describe what extinction and spontaneous recovery are.

6.1. Historical Background

Section Learning Objectives

- Describe the work of Thorndike.
- Describe Skinner's work leading to the development of operant conditioning.

6.1.1. The Work of Thorndike

Influential on the development of Skinner's operant conditioning, Edward Lee Thorndike (1874-1949) proposed the **law of effect** (Thorndike, 1905) which says if our behavior produces a favorable consequence, in the future when the same stimulus is present, we will be more likely to make the response again because we expect the same favorable consequence. Likewise, if our action leads to dissatisfaction, then we will not repeat the same behavior in the future.

He developed the law of effect thanks to his work with the Puzzle Box. Cats were food deprived the night before the experimental procedure was to occur. The next morning, they were placed in the puzzle box and a small amount of food was positioned outside the box close enough to be smelled, but the cat could not reach the food. To get out, the cat could manipulate switches, buttons, levers, or step on a treadle. Only the treadle would open the gate though, allowing the cat to escape the box and eat some of the food. But just some. The cat was then placed back in the box to figure out how to get out again, the food being its reward for doing so. With each subsequent escape and re-insertion into the box, the cat became faster until he/she knew exactly what had to be done to escape. This is called **trial and error learning** or making responses randomly until the solution is found. Think about it as *trying* things out to see what works, or what does not (making a mistake or *error*) and then by doing this enough times you figure out the solution to the problem, as the cat did. The process of learning in this case is gradual, not sudden. The response of stepping on the treadle produces a favorable consequence of escaping the box meaning that the cat will step on the treadle in the future if it produces the same consequence. Behaviors that produce favorable consequences are “stamped in” while those producing unfavorable consequences are “stamped out,” according to Thorndike.

Thorndike also said that stimulus and responses were connected by the organism and this lead to learning. This approach to learning was called **connectionism** and is similar to Locke’s idea of associationism. We more so use the latter term today as we talk about associative learning.

6.1.2. The Work of Skinner

B.F. Skinner (1904-1990) chose to study behavior through the use of what he called a Skinner box. Versions were created for rats and pigeons. In the case of the former, rats earned food pellets when they pressed a lever or bar and for the latter, pigeons earned food reinforcers when they pecked a response key. The Skinner box was known as a “free operant” procedure because the animal could decide when to make the desired response to earn a food pellet (or access to the food) and is not required to respond at a pre-established time. Consider that in maze learning the experimenter initiates a trial by placing a rat in the start box and opening the door for it to run the maze. Skinner’s development of such a procedure showed that the animal’s rate of response was governed by the conditions that he established as the experimenter and was in keeping with the strict standards of the scientific study of behavior established by Pavlov.

Skinner described two types of behaviors — respondent and operant. **Respondent behaviors** describe those that are involuntary and reflexive in nature. These are the types of behavior Pavlov described in his work and can be conditioned to occur in new situations (i.e. the NS and US relationship). In contrast, **operant behaviors** include any that are voluntary and controlled instead by their consequences. We will focus on operant behaviors for the duration of this module.

6.2. Basics of Operant Conditioning

Section Learning Objectives

- Clarify what happens when we make a behavior (the framework).
- Define operant conditioning.
- Clarify what operant behaviors are.
- Define contingency.
- Contrast reinforcement and punishment.
- Clarify what positive and negative mean.
- Outline the four contingencies of behavior.
- Distinguish primary and secondary reinforcers.
- Define generalized reinforcer.
- Define discriminative stimuli.

6.2.1. What is Operant Conditioning?

Before jumping into a lot of terminology, it is important to understand what operant conditioning is or attempts to do. But before we get there, let's take a step back. So what happens when we make a behavior? Consider this framework:

Stimulus → Response → Consequence

Stimulus, also called an *antecedent*, is whatever comes before the behavior, usually from the environment. Response is a behavior. And of course, consequence is the result of the behavior that makes a behavior more or less likely to occur in the future. Presenting this framework is important because operant conditioning as a learning model focuses on the person making some response for which there is a consequence. As we learned from Thorndike's work, if the consequence is favorable or satisfying, we will be more likely to make the response again (when the stimulus occurs). If not favorable or unsatisfying, we will be less likely. Recall that respondent or classical conditioning, which developed thanks to Pavlov's efforts, focuses on stimulus and response, and in particular, the linking of two types of stimuli – NS and US. Before moving on let's state a formal definition for operant conditioning:

Operant conditioning is a type of associative learning that focuses on consequences that follow a response that we make and whether it makes a behavior more or less likely to occur in the future.

Return to our discussion of operant behaviors from Section 6.1.2. Operant behaviors are voluntary and controlled by their consequences. Let's say a child chooses to study and does well on an exam. His parents celebrate the grade by taking him out for ice cream (the positive outcome of the behavior of studying). In the future, he studies harder to get the ice cream. But what if his brother decides to talk back to his parents and is scolded for doing so. He might lose television privileges. In the future, the brother will be less likely to talk back and stay quiet to avoid punishment. In both cases, the behavior was freely chosen and the likelihood of making that behavior in the future was linked to the consequence in the present. These operant behaviors are sometimes referred to as *operants*.

Operant behaviors are *emitted by the organism* such as in the case of the child studying or the child talking back. In contrast, respondent behaviors are *elicited by stimuli* (either the US or CS) such as a dog salivating to either the sight of food (US) or the sound of a bell (CS/NS). Also, operant behaviors can be thought of as a class of responses, all of which are capable of producing a consequence. For instance, studying is a general behavior, but it could include spaced study sessions such as spending 30 minutes after each class going over what was covered that day or massed studying the night before the exam. Both are studying behavior and it is easier to predict their occurrence than an exact type of behavior. In the case of talking back, consider that a child could just make a snide comment at the parent or engage in argumentative behavior. The result is the same (negative consequence) for engaging in this behavior, whatever form it may take exactly (the topography of the behavior).

6.2.2. Behavioral Contingencies

As we have seen, the basis of operant conditioning is that you make a response for which there is a consequence. Based on the consequence you are more or less likely to make the response again. Recall that a **contingency** is when one thing occurs due to another. Think of it as an *If-Then* statement. If I do X, then Y will happen. For operant conditioning, this means that if I make a behavior, then a specific consequence will follow. The events (response and consequence) are linked in time (more on this in a bit).

What form do these consequences take? There are two main ways they can present themselves.

- **Reinforcement** — Due to the consequences, a behavior/response is more likely to occur in the future. It is strengthened.
- **Punishment** — Due to the consequence, a behavior/response is less likely to occur in the future. It is weakened.

Reinforcement and punishment can occur as two types — positive and negative. These words have no affective connotation to them meaning they do not imply good or bad, or an emotional state. *Positive* means that you are giving something — good or bad. *Negative* means that something is being taken away — good or bad. Check out Table 6.1 below for how these contingencies are arranged. Bear in mind that the actual contingency presented in the cells needs to be inferred from what is along the outside. We know giving is positive and if you are giving some bad or aversive thing, you should be trying to weaken a behavior, which is punishment. Hence, giving something bad that would weaken a behavior is positive punishment. The others work the same. This is one way to teach this concept. If you learned another way and understand the four contingencies, stick with what you learned.

Table 6.1. Contingencies in Operant Conditioning

	Something "Bad" (aversive)	Something "Good" (rewarding)
Giving (positive)	Positive Punishment (behavior is weakened)	Positive Reinforcement (behavior is strengthened)
Taking Away (negative)	Negative Reinforcement (behavior is strengthened)	Negative Punishment (behavior is weakened)

Let's go through each:

- **Positive Punishment (PP)** — If something bad or aversive is given or added, then the behavior is less likely to occur in the future. If you talk back to your mother and she slaps your mouth, this is a PP. Your response of talking back led to the consequence of the aversive slap being delivered or given to your face.
- **Positive Reinforcement (PR)** — If something good is given or added, then the behavior is more likely to occur in the future. If you study hard and earn, or are given, an A on your exam, you will be more likely to study hard in the future. Your parents may also give you money for your efforts. Hence the result of studying could yield two PRs — the 'A' and the money.
- **Negative Reinforcement (NR)** — This is a tough one for students to comprehend because the terms do not seem to go together and are counterintuitive. But it is really

simple and you experience NR all the time. This is when something bad or aversive is taken away or subtracted due to your actions, making you more likely to do the same behavior in the future when some stimulus presents itself. For instance, what do you do if you have a headache? You likely answered take Tylenol. If you do this and the headache goes away, you will take Tylenol in the future when you have a headache. NR can either result in current escape behavior or future avoidance behavior. What does this mean? **Escape behavior** occurs when we are presently experiencing an aversive event and want it to end. We make a behavior and if the aversive event, such as withdrawal symptoms from not drinking coffee for a while, goes away, then we can say we escaped the aversive state. Feeling hungry and eating food is another example. Taking Tylenol helps us to escape a headache. In fact, to prevent the symptoms from ever occurring, we might drink coffee at regular intervals throughout the day. This is called **avoidance behavior**. By doing so we have removed the possibility of the aversive event occurring and this behavior demonstrates that learning has occurred. We might also eat small meals throughout the day to avoid the aversive state of being hungry.

- **Negative Punishment (NP)** — This is when something good is taken away or subtracted making a behavior less likely in the future. If you are late to class and your professor deducts 5 points from your final grade (the points are something good and the loss is negative), you will hopefully be on time in all subsequent classes.

To easily identify contingencies, use the following three steps:

1. Identify if the contingency is positive or negative. If positive, you should see words indicating something was given, earned, or received. If negative, you should see words indicating something was taken away or removed.
2. Identify if a behavior is being reinforced or punished. If reinforced, you will see a clear indication that the behavior increases in the future. If punished, there will be an indication that the behavior decreases in the future.
3. The last step is easy. Just put it all together. Indicate first if it is P or N, and then indicate if there is R or P. So you will have either PR, PP, NR, or NP. Check above for what these acronyms mean if you are confused.

Example:

You study hard for your calculus exam and earn an A. Your parents send you $100. In the future, you study harder hoping to receive another gift for an exemplary grade.

1. P or N — "Your parents send you $100" but also "earn an A" — You are given an A and money so you have two reinforcers that are given which is P
2. R or P — "In the future you study harder…." — behavior increases so R
3. Together — PR

To make your life easier, feel free to underline where you see P or N and R or P. You cannot go wrong if you do.

6.2.3. Primary vs. Secondary (Conditioned)

The type of reinforcer or punisher we use is important. Some are naturally occurring while some need to be learned. We describe these as primary and secondary reinforcers and punishers. **Primary** refers to reinforcers and punishers that have their effect without having to be learned or are unconditioned. Food, water, temperature, and sex, for instance, are primary reinforcers while extreme cold or hot or a punch on the arm are inherently punishing. A story will illustrate the latter. When I was about 8 years old, I would walk up the street in my neighborhood saying, "I'm Chicken Little and you can't hurt me." Most ignored me but some gave me the attention I was seeking, a positive reinforcer. So, I kept doing it and doing it until one day, another kid was tired of hearing about my other identity and punched me in the face. The pain was enough that I never walked up and down the street echoing my identity crisis for all to hear. Pain was a positive punisher and did not have to be learned. That was definitely not one of my finer moments in life.

Secondary or conditioned reinforcers and punishers are not inherently reinforcing or punishing but must be learned. An example was the attention I received for saying I was Chicken Little. Over time I learned that attention was good. Other examples of secondary reinforcers include praise, a smile, getting money for working or earning good grades, stickers on a board, points, getting to go out dancing, and getting out of an exam if you are doing well in a class. Examples of secondary punishers include a ticket for speeding, losing television or video game privileges, being ridiculed, or a fee for paying your rent or credit card bill late. Really, the sky is the limit, especially with reinforcers.

A particular type of secondary reinforcer is called a **generalized reinforcer** (Skinner, 1953) and obtains the name because of being paired with many other reinforcers. Consider the example of money. With it, we can purchase almost anything. Maybe we should even add credit or debit cards to this discussion since most of us carry them and not actual money nowadays. In Module 7 we will discuss applications of operant conditioning, one of which is behavior modification. In the token economy, generalized reinforcers are used in the form of tokens and are used to purchase items called backup reinforcers. More on this later.

6.2.4. Discriminative Stimuli

Sometimes a behavior is reinforced in the presence of a specific stimulus and not reinforced when the stimulus or antecedent is not present. These stimuli signal when reinforcement will occur, or not, and are called **discriminative stimuli** (also called an S^D). Recall our earlier discussion of the S → R → C model or Stimulus-Response-Consequence. Though our focus was on R and C, discriminative stimuli show that S can be important too. Consider the rat in the Skinner box. Lever pushes earn food reinforcers, but what if this is true only if a light above the lever is on? In this case, the light serves as a discriminative stimulus and signals that reinforcement is possible. If the light is not on, reinforcement does not occur no matter how many times the lever is pushed (or how hard).

As a stimulus can signal reinforcement, so too it can signify punishment. At times my dog sprays the trashcan in an effort to mark his territory. When he does this he receives either a soft smack across the rear end or is verbally scolded. But if I see him approaching the trashcan, I can hold up my hand which usually signifies the punishment he will endure if he sprays the trashcan. The sight of my hand (or a newspaper rolled up) signals punishment if a behavior is engaged in.

Before moving on, pause and reflect on what you have learned. It may even be a good idea to take a break for a period of time. Reward your progress so far with a television or game break. But don't take too long. You do have a lot more to cover.

6.3. Factors on Operant Learning

Section Learning Objectives

- Clarify why the concept of contingency is important to operant learning.
- Define contiguity.
- Clarify whether a reinforcer should be delivered immediately or delayed.
- Explain why the magnitude of a reinforcer is important.
- Define motivating operations and describe the two types.
- Contrast intrinsic and extrinsic reinforcement.
- Clarify the importance of individual differences.
- Contrast natural and contrived reinforcers.

6.3.1. Contingency, Again

One key issue related to reinforcers and punishers is contingency. The reinforcer or punisher should be unique to the situation. So, if you do well on your report card, and your parents give you $25 for each A, and you ***only*** get money for school performance, the secondary reinforcer of money will have an even greater effect. This ties back to our discussion of contingency, or those *If-Then* statements related to behavior. It would be presented as such: *If* I earn all As in school, *then* my parents will give me $25 per A and only for engaging in this behavior. In other words, I will not earn the money if I join a club or other student group on campus as an extracurricular activity.

6.3.2. Contiguity

Contiguity refers to the time between when the behavior is made and when its consequence occurs. Do you think learning is better if this period is short or long? Research has shown that shorter intervals produce faster learning (Okouchi, 2009). If the time between response and consequence is too long, another behavior could occur that is reinforced instead of the target behavior.

6.3.3. Immediate vs. Delayed

It should not be surprising to know that the quicker you deliver a reinforcer or punisher after a response, the more effective it will be. This is called **immediacy**. Don't be confused by the word. If you notice, you can see immediately in it. If a person is speeding and you ticket them right away, they will stop speeding. If your daughter does well on her spelling quiz, and you take her out for ice cream after school, she will want to do better. Delayed reinforcement or punishment has a relatively weak effect on behavior. Think about the education you are pursuing right now. The reinforcer is the degree you will earn, but it will not be conferred for at least four years from the time you start. That is a long way off and you can engage in behaviors now that produce immediate reinforcement such as hanging out with friends, watching television, playing video games, or taking a nap. So, what do you do to stay focused and keep your eye on the prize (the delayed reinforcement of the degree)? More on this in Module 7.

6.3.4. Magnitude of a Reinforcer or Punisher

Are you more likely to work hard for $25 an A or $5 an A? The answer is likely $25 an A. Premeditated homicide or murder is another example. If the penalty is life in prison and possibly the death penalty, this will have a greater effect on deterring the heinous crime than just giving 10 years in prison with the chance of parole. This factor on operant learning is called **magnitude**, or how large a reinforcer or punisher is, and it has a definite effect on behavior.

6.3.5. Motivating Operations

At times, events make a reinforcer or punisher more or less reinforcing or punishing. We call these **motivating operations**, and they can take the form of an establishing or an abolishing operation. First, an **establishing operation** is when an event makes a reinforcer or punisher <u>more</u> potent. Reinforcers become more reinforcing (i.e. behavior is more likely to occur) and punishers more punishing (i.e. behavior is less likely to occur). Second, an **abolishing operation** is when an event makes a reinforcer or punisher <u>less</u> potent. Reinforcers become less reinforcing (i.e. behavior is less likely to occur) and punishers less punishing (i.e. behavior is more likely to occur). See Table 6.2 below for examples of establishing and abolishing operations.

Table 6.2. Examples of Establishing and Abolishing Operations

Type of Motivating Operation	As used with Reinforcement	As used with Punishment
Establishing	Your favorite restaurant is Olive Garden. As such, you build into your behavior modification plan the opportunity to go to the restaurant once you have lost your first 20 lbs. This makes it more likely you will engage in the target/desirable behavior of eating less calories so you can eat there (i.e. the reinforcer is more potent). If we go to the store when hungry or in a state of *deprivation*, food becomes even more reinforcing and we are more likely to pick up junk food (i.e. a problem behavior).	You tell a child they will not be able to play video games after dinner if they do not finish their homework before dinner. Since video games are the child's favorite activity the punisher becomes more potent and should discourage problem behavior such as allowing themselves to be distracted. (Do not use punishment if the child has a lot of homework and cannot finish by dinner. They would simply have to continue homework after they eat).
Abolishing	The person looks up the caloric content of fatty foods and understands how eating it will undermine their weight loss plan. The fatty foods (i.e. chips or chocolate) lose their appeal or reinforcing value for the person (i.e. the reinforcer is less potent). If we go to the grocery store full or in a state of *satiation,* junk food would not sound appealing and we would not buy it.	Cheating on your taxes can lead to very high fines from the government. Though this should be an establishing operation for most of us, a wealthy person may be willing to take the fine since they can afford it and so the penalty loses its effectiveness or is less potent. (As a note, threatening jail time instead may deter their problem behavior making it an establishing behavior. The thought of losing their freedom may make cheating not worth the risk.)

6.3.6. Intrinsic vs. Extrinsic

For some of us, we obtain enjoyment, or reinforcement, from the mere act of engaging in a behavior, called **intrinsic reinforcement**. For instance, I love teaching, and apparently writing books. The act of writing or teaching is rewarding by enhancing my self-esteem, making me feel like I am making a difference in the lives of my students, and helping me to feel accomplished as a human being. Despite this, I also receive a paycheck for teaching (and side pay for writing the books — OER) which is admittedly important too as I have bills to pay. This is called **extrinsic reinforcement** and represents the fact that some sources of reinforcement come from outside us or are external.

Before moving on, consider the question of whether receiving an extrinsic reinforcer when you are already deriving intrinsic reinforcement from a behavior can reduce your overall intrinsic reinforcement. Consider college baseball or football players who play for the love of the game (intrinsic reinforcement). What happens if they go pro and are making millions of dollars suddenly and being showered with praise and attention from fans and the media (extrinsic reinforcement)? To answer the question, do a quick literature search using intrinsic reinforcement and external rewards as keywords, or related words. What do you come up with?

6.3.7. Individual Differences

The example of the video games demonstrates establishing and abolishing operations, but it also shows one very important fact — all people are different. Reinforcers will motivate behavior. That is a universal occurrence and unquestionable. But the same reinforcers will not reinforce all people. This shows diversity and *individual differences*.

6.3.8. Natural vs. Contrived Reinforcers

Reinforcers can be classified as to whether they occur naturally in our environment, or whether they are arranged to modify a behavior or are considered artificial. The former are called **natural reinforcers** while the latter are called **contrived reinforcers**. An example should clarify any confusion you might have. Let’s say you want to help a roommate who is incredibly shy learn to talk to other people. You might set up a system whereby for every new person he talks to, he receives a reinforcer such as getting out of doing the dishes that night. Specifically, this is a negative reinforcer because it is taking away something aversive, which is dish duty, and is contrived since it is arranged by his roommate. Continency is also present as there is a condition on receiving the reinforcer — if he talks to a new person, then he gets out of doing the dishes. Now consider that he actually takes a chance and talks to someone new. Let’s say he gathers the courage needed to talk to a girl he really likes. If the conversation goes well, he will come out of it feeling very good about himself, gain confidence, and if lucky, get a date with her or at least the chance to engage in conversation again in the future. This is not arranged by anyone but occurs naturally as a result of the positive interaction, and so is a natural reinforcer.

So which type of reinforcer — natural or contrived — do you think is more effective? Is getting out of dishes more effective to establish the behavior of talking to new people (and overcoming a potential social phobia) than feeling excited after a positive interaction? Not likely, and Skinner (1987) stated that natural reinforcers are stronger than contrived reinforcers.

6.4. Schedules of Reinforcement

Section Learning Objectives

- Contrast continuous and partial/intermittent reinforcement.
- List the four simple reinforcement schedules and exemplify each.
- Describe duration schedules.
- Describe noncontingent schedules.
- Describe progressive schedules.
- Outline the complex schedules.
- Define differential reinforcement.
- Outline the five forms differential reinforcement can take.

6.4.1. Continuous vs. Partial Reinforcement

In operant conditioning, the rule for determining when and how often we will reinforce a desired behavior is called the **reinforcement schedule.** Reinforcement can either occur *continuously,* meaning that every time the desired behavior is made the person or animal will receive a reinforcer, or *intermittently/partially,* meaning that reinforcement does not occur with every behavior. Our focus will be on partial/intermittent reinforcement. In terms of when continuous reinforcement might be useful, consider trying to train your cat to use the litter box (and not your carpet). Every time the cat uses the litter box you would want to give it a treat. This will be the trend early in training. Once the cat is using the litter box regularly you can switch to an intermittent schedule and eventually just faze out reinforcement. So how might an intermittent schedule look?

6.4.2. Simple Reinforcement Schedules

Figure 6.1. shows that that are two main components that make up a reinforcement schedule — when you will reinforce and what is being reinforced. In the case of when, it will be either *fixed*, or at a set rate, or *variable*, and at a rate that changes. In terms of what is being reinforced, we will either reinforce *responses* or the first response after a period of *time*.

Figure 6.1. Key Components of Reinforcement Schedules

Two Key Components		
When you reinforce	Fixed	Reinforcement occurs at a set rate
	or	
	Variable	Rate of reinforcement changes
What you reinforce	Ratio	The number of correct responses
	or	
	Interval	Time elapsed between correct responses

These two components pair up as follows:

6.4.2.1. Fixed Ratio Schedule (FR). With this schedule, we reinforce some set number of responses. For instance, every twenty problems (fixed) a student gets correct (ratio), the teacher gives him an extra credit point. A specific behavior is being reinforced — getting problems correct. Note that if we reinforce each occurrence of the behavior, the definition of continuous reinforcement, we could also describe this as an FR1 schedule. The number indicates how many responses have to be made and, in this case, it is one.

FR schedules are characterized by a high rate of performance with short pauses called *post-reinforcement pauses*. A rat, for instance, will press the lever quickly and until a food pellet drops, eat it, walk around the chamber for a bit, and then return to the business of lever pressing.

The pause to walk around the chamber represents taking a break, and when rats (or people) are asked to make more behaviors the break is longer. In other words, the pause after making 50 lever presses (FR 50) will be longer than after making 20 lever presses (FR 20). See Figure 6.2 for the typical response pattern on an FR schedule.

6.4.2.2. Variable Ratio Schedule (VR). We might decide to reinforce some varying number of responses such as if the teacher gives the student an extra credit point after finishing an average of 5 problems correctly (VR 5). We might reinforce after 8 correct problems, then 5, then 3, and then 4 problems. The total number of correct problems across trials is 20. To obtain the average, divide by the number of trials which is 4 and this yields an average of 5 problems answered correctly. This is useful after the student is obviously learning the material and does not need regular reinforcement. Also, since the schedule changes, the student will keep responding in the absence of reinforcement.

VR schedules yield a high and steady rate of responding and typically produce fewer and shorter post-reinforcement pauses. Like an FR schedule, the payoff is the same. An animal on an FR 25 schedule will receive the same amount of food pellets as a different animal on a VR 25 schedule. See Figure 6.2 for the typical response pattern on a VR schedule.

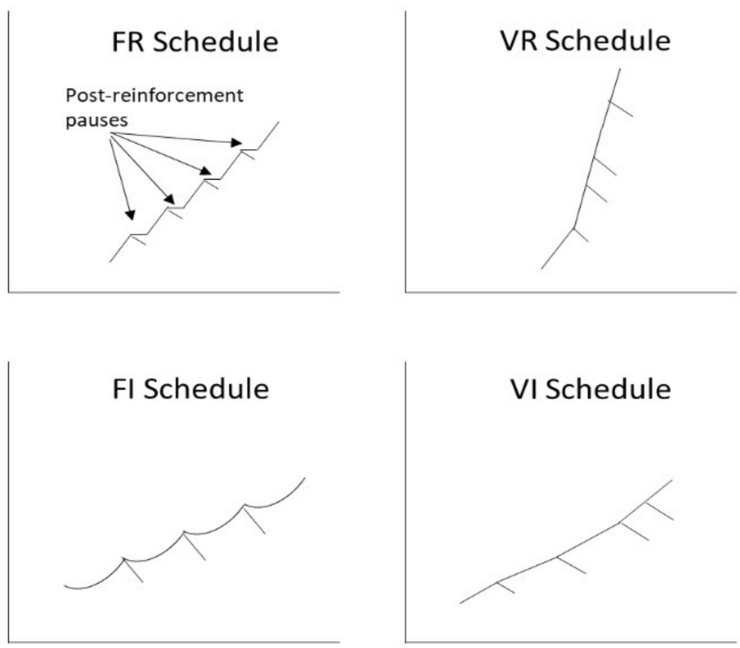
6.4.2.3. Fixed Interval Schedule (FI). With an FI schedule, you will reinforce the first behavior made after some set amount of time. Let's say a company wanted to hire someone to sell their products. To attract someone, they could offer to pay them $10 an hour 40 hours a week and give this money every two weeks. Crazy idea but it could work. ☺ Saying the person will be paid *every* indicates fixed, and *two weeks* is time or interval. So, FI. Rats in a Skinner box will be reinforced when they make the first lever press after 20 seconds of time has passed. Hence, the rat would be on a FI 20(sec) schedule and would not receive any food until another 20 seconds has passed (and then it pushed the lever).

FI schedules produce a response pattern best described as scalloped shape. At the beginning of the interval, responses are almost non-existent but as time passes the rate of responding increases, especially as the end of the interval nears. The FI schedule has a post-reinforcement pause, like the FR schedule. Consider your study habits for a minute. When a new unit starts, you are not likely to study. As the unit progresses, you may start to study your notes, and as the unit nears the end, your rate of studying will be very high as you know the exam will be soon. This process is repeated when the next unit starts. See Figure 6.2 for the typical response pattern on a FI schedule.

6.4.2.4. Variable Interval Schedule (VI). Finally, you could reinforce the first response after some changing amount of time. Maybe employees receive payment on Friday one week, then three weeks later on Monday, then two days later on Wednesday, then eight days later on Thursday. Etc. This could work, right? Maybe not for a normal 9-5 job, but it could if you are working for a temp agency. VI schedules reinforce the first response after a varying amount of time. Let's say our rat in the FI schedule example was moved to a VI 20(sec) schedule. He would be reinforced for the next response after an average of 20 seconds. The actual intervals could be 30 seconds, 15 seconds, 25 seconds, and 10 seconds (30+15+25+10/4 = 20).

VI schedules produce almost no post-reinforcement pauses and a steady rate of responding that is predictable. For humans, waiting in line at the DMV is a great example of a VI schedule. Each person ahead of us that completes his or her business and leaves reinforces our waiting, but how long each person ahead of us takes when they make it to the counter will vary. We may be reinforced for our waiting after just 30 seconds with one customer but after several minutes with another customer. The amount of time we wait for <u>each</u> customer to have their problem solved produces an average amount of time after which we are reinforced for our response of waiting (and gradually sliding forward). See Figure 6.2 for the typical response pattern on a VI schedule.

Figure 6.2. Intermittent Schedules of Reinforcement Response Patterns



6.4.3. A Way to Easily Identify Reinforcement Schedules

To identify the reinforcement schedule, use the following three steps:

1. When does reinforcement occur? Is it at a set or varying rate? If fixed (F), you will see words such as set, every, and each. If variable (V), you will see words like sometimes or varies.
2. Next, determine what is reinforced — some number of responses or the first response after a time interval. If a response (R), you will see a clear indication of a behavior that is made. If interval (I), some indication of a specific or period of time will be given.
3. Put them together. First, identify the rate. Write an F or V. Next identify the what and write an R or I. This will give you one of the pairings mentioned above — FI, FR, VI, or VR.

Example:

You girlfriend or boyfriend display affection about every three times you give him/her a compliment or flirt.

1. F or V — "about every three times" which is V.
2. R or I — "give him/her a compliment or flirt" which is a response or R.
3. Together — VR

To make your life easier, feel free to underline where you see F or V and R or I. You cannot go wrong if you do, as with the contingencies exercise.

6.4.4. Other Types of Simple Schedules

Though the four simple schedules mentioned above are the most commonly investigated by researchers, several other simple schedules exist and do receive attention as well. We will now cover them.

6.4.4.1. Fixed and variable duration schedules. In a **fixed duration (FD) schedule**, the organism has to make the behavior continuously for a period of time after which a reinforcer is delivered. An example would be a child practicing shooting hoops for 60 minutes before he receives a reinforcer such as playing a video game (FD 60-min). In a **variable duration (VD) schedule**, the behavior must be made continuously for some varying amount of time. A coach may have his players running drills on the football field and provide the reinforcement of a refreshing drink at different times. This could occur after 5, 12, 7, and 16 minutes of practice but on average, the athletes will practice 10 minutes before they receive reinforcement (VD 10-min). Interestingly, as I write this module, I realized that I have done all of my textbook writing on an FD schedule. I generally sit down and write for a designated period of time each day. Once this time is complete, I provide myself reinforcement such as getting to go to the gym, reading my current science fiction novel, or taking a break to watch a movie. The reinforcement comes no matter how productive I am, and some days I am not as productive as others. I can write 20 pages in 2 hours when properly motivated but other days may just write 5 pages in the same period. Should I write according to an FR schedule though? Instead of writing for a fixed period of time (FD 120-min), I could decide to complete a certain number of sections in a module. For my current project, I may decide to write 2 sections in a module per day or a FR 2-sections schedule, before receiving one of the aforementioned reinforcers. How do you tackle studying or writing a large term paper? Do you use an FD or FR schedule and does it work for you?

6.4.4.2. Noncontingent schedules (FT/VT). **Noncontingent Reinforcement Schedules** involve delivering a reinforcer after an interval of time, regardless of whether the behavior is occurring or not. In this respect they are *response-independent schedules* which should make sense given the fact that they are noncontingent, meaning there is no *If-then* condition. In a **fixed time (FT) schedule** an organism receives reinforcement after a set amount of time such as a pigeon having access to food after 30 seconds (FT 30-sec) whether it is pecking a key or not. In an FI 30-sec schedule, the pigeon would have to peck the key after the 30-second interval was over to receive access to the food. FT schedules are useful in token economies as you will come to see in Module 7.

In a **variable time (VT) schedule**, reinforcement occurs after a varying amount of time has passed, regardless of whether the desired behavior is being made. In a VT 20-sec schedule, the rat receives a food pellet after an average of 20 seconds whether it is pushing the lever or not. This reinforcement could occur after 18, 34, 7, 53, etc. seconds with the average being 20 seconds.

6.4.4.3. Progressive schedules. In a **progressive schedule**, the rules determining what the contingencies are change systematically (Stewart, 1975). One such schedule is called a **progressive ratio (PR) schedule** (Hodos, 1961) and involves the requirement for reinforcement increasing in either an arithmetic or geometric way, and after each reinforcement has occurred. For instance, a rat may receive reinforcement after every 4, 6, 8, 10, and 12 lever pushes (arithmetic) or after 6, 12, 24, 48, and 96 times. The reinforcer may even change such as the quality of the food declining with each reinforcement. Eventually, the rate of behavior will decrease sharply or completely stop, called the **break point**. Roane, Lerman, and Vorndran (2001) utilized a PR schedule to show that reinforcing stimuli may be differentially effective as response requirements increase. Stimuli associated with more responding as the schedule requirement increased were more effective in the treatment of destructive behaviors than those associated with less responding. The authors note, “practitioners should therefore consider arranging reinforcer presentation according to task difficulty based on the relation between reinforcer effectiveness and response requirements” (pg. 164).

6.4.5. Complex Schedules

Unlike simple schedules that only have one requirement which must be met to receive reinforcement, **complex schedules** are characterized by being a combination of two or more simple schedules. They can take on many different forms as you can see below.

First, the **multiple schedule** includes two or more simple schedules, each associated with a specific stimulus. For instance, a rat is trained to push a lever under a FR 10 schedule when a red light is on but to push the lever according to a VI 30 schedule when a white light is on. Reinforcement occurs after the condition for that schedule is met. So the organism receives reinforcement after the FR 10 and VI 30 schedules. Similar to a multiple schedule, a **mixed schedule** has more than one simple schedule, but they are <u>not</u> associated with a specific stimulus. The rat in our example could be under a FR 10 schedule for 30 seconds and then the VI 30 schedule for 60 seconds. The organism has no definitive way of knowing that the schedule has changed.

In a **conjunctive schedule**, two or more simple schedules must have their conditions met before reinforcement is delivered. Using our example, the rat would have to make 10 lever presses (FR 10) and a lever press after an average of 30 seconds has passed (VI 30) to receive a food pellet. The order that the schedules are completed in does not matter; just that they are completed.

In a **chained schedule**, a reinforcer is delivered after the last in a series of schedules is complete, and each schedule is controlled by a specific stimulus (a discriminative stimulus or S^D). The chain must be completed in the pre-determined order. A rat could be on a FR 10 VR 15 FI 30 schedule, for instance. When a red light is on, the rat would learn to make 10 lever presses. Once complete, a green light would turn on and the rat would be expected to make an average of 15 lever presses before the light turns yellow indicating the FI 30 schedule is in effect. Once the 30 seconds are up and the rat makes a lever press, reinforcement occurs. Then the light turns red again indicating a return to the FR 10 schedule. Similar to the multiple-mixed schedule situation, this type of schedule can occur without the discriminative stimuli and is called a **tandem schedule**.

A schedule can also **adjust** such that after the organism makes 30 lever presses, the schedule changes to 35 presses, and then 40. So, the schedule moves from FR 30 to FR 35 to FR 40 as the organism demonstrates successful learning. Previous good performance leads to an expectation of even better performance in the future.

In an interesting twist on schedules, a **cooperative schedule** requires two organisms to meet the requirements together. If we place rats on a FR 30 schedule, any combination of 30 lever presses would yield food pellets. One rat could make 20 of the lever presses and the other 10 and both would receive the same reinforcement. Of course, we could make it a condition that both rats make 15 presses each, and it would not matter if one especially motivated rat makes more lever presses than the other. You might be thinking this type of schedule sounds familiar. It is the essence of group work whereby a group is to turn in, say, a PowerPoint presentation on borderline personality disorder. The group receives the same grade (reinforcer) no matter how the members chose to divide up the work.

Finally, a **concurrent schedule** presents an organism with two or more simple schedules at one time and it can choose which to follow. A rat may have the option to press a lever with a red light on a FR 10 schedule or a lever with a green light on a FR 20 schedule to receive reinforcement. Any guesses which one it will end up choosing? Likely the lever on the FR 10 schedule as reinforcement comes quicker.

Table 6.3. Comparison of Complex Schedules

Type of Schedule	Does the contingency for each simple schedule have to be met before reinforcement can occur?	Do the simple schedules have to be completed in a specified order?	Can the organism choose which simple schedule to follow?	Does a discriminative stimulus control reinforcement of the simple schedules?	How many organisms are involved in the reinforcement contingency?
Multiple	No	No	No	Yes	1
Mixed	No	No	No	No	1
Conjunctive	Yes	No	No	No	1
Chained	Yes	Yes	No	Yes	1
Tandem	Yes	Yes	No	No	1
Adjusting	No	Yes	No	No	1
Cooperative	Yes	No	No	No	2 (or more)
Concurrent	No	No	Yes	No	1

6.4.6. Differential Reinforcement

Consider the situation of a child acting out and the parent giving her what she demands. When this occurs, the parent has reinforced a bad behavior (a PR) and the tantrum ending reinforces the parent caving into the demand (NR). Now both parties will respond the same way when in the same situation (child sees a toy which is her antecedent to act out and the screaming child is the stimulus/antecedent for the parent to give the girl the toy). If the same reinforcers occur again, the behavior will persist. Most people near the interaction likely desire a different outcome. Some will want the parent to discipline the girl, but others might handle the situation more like this: these individuals will let the child have her tantrum and just ignore her. After a bit, the child should calm down and once in a more pleasant state of mind, ask the parent for the toy. The parent will praise the child for acting more mature and agree to purchase the toy, so long as the good behavior continues. This is an example of **differential reinforcement** in which we attempt to get rid of undesirable or problem behaviors by using the positive reinforcement of desirable behaviors. Differential reinforcement takes on many different forms.

6.4.6.1. DRA or Differential Reinforcement of Alternative Behavior — This is when we reinforce the desired behavior **and** do not reinforce undesirable behavior. Hence, the desired behavior increases and the undesirable behavior decreases to the point of extinction. The main goal of DRA is to increase a desired behavior and extinguish an undesirable behavior such as a student who frequently talks out of turn. The teacher praises the child in front of the class when he raises his hand and waits to be called on and does not do anything if he talks out of turn. Though this may be a bit disruptive at first, if the functional assessment reveals that the reinforcer for talking out of turn is the attention the teacher gives, not responding to the child will take away his reinforcer. This strategy allows us to use the reinforcer for the problem behavior with the desirable behavior. Eventually, the child will stop talking out of turn making the problem behavior extinct.

6.4.6.2. DRO or Differential Reinforcement of Other Behavior — What if we instead need to eliminate a problem behavior – i.e. reducing it down to no occurrences? DRO is the strategy when we deliver a reinforcer contingent on the absence of an undesirable behavior for some period. We will need to identify the reinforcer for the problem behavior and then pick one to use when this behavior does not occur. Determine how long the person must go without making the undesirable behavior and obtain a stopwatch to track the time. Do not reinforce the problem behavior and only reinforce the absence of it using whatever reinforcer was selected, and if it is gone for the full-time interval. If the problem behavior occurs during this time, the countdown resets. Eventually the person will stop making the undesirable behavior and when this occurs, increase the interval length so that the procedure can be removed.

For instance, if a child squirms in his seat, the teacher might tell him if he sits still for 5 minutes he will receive praise and a star to put on the star chart to be cashed in at a later time. If he moves before the 5 minutes is up, he has to start over, but if he is doing well, then the interval will change to 10 minutes, then 20 minutes, then 30, then 45, and eventually 60 or more. At that point, the child is sitting still on his own and the behavior is not contingent on receiving the reinforcer.

6.4.6.3. DRL or Differential Reinforcement of Low Rates of Responding — There are times when we don't necessarily want to completely stop a behavior, or take it to extinction, but reduce the occurrence of a behavior. Maybe we are the type of person who really enjoys fast-food and eats it daily. This is of course not healthy, but we also do not want to go cold turkey on it. We could use DRL and decide on how many times each week we will allow ourselves to visit a fast-food chain. Instead of 7 times, we decide that 3 is okay. If we use *full session DRL* we might say we cannot exceed three times going to a fast-food restaurant in a week (defined as Mon to Sun). If we eat at McDonalds, Burger King, and Wendy's three times on Monday but do not go again the rest of the week we are fine. Full session simply means you do not exceed the allowable number of behaviors during the specified time period. Eating fast-food three times in a day is definitely not healthy, and to be candid, gross, so a better approach could be to use *spaced DRL*. Now we say that we can go to a fast-food restaurant every other day. We could go on Monday, Wednesday, and Friday. This works because we have not exceeded 3 behaviors in the specified time of one week. If we went on Sunday too, this would constitute four times going to a fast-food restaurant and we would not receive reinforcement. Spaced DRL produces paced responding.

6.4.6.4. DRI or Differential Reinforcement of Incompatible Behavior — There are times when we need to substitute Behavior A with Behavior B such that by making B, we cannot make A. The point of DRI is to substitute a behavior. If a child is made to sit appropriately in his seat they cannot walk around the room. Sitting is incompatible with walking around. DRI delivers a reinforcer when another behavior is used instead of the problem behavior. To say it another way, we reinforce behaviors that make the undesirable or problem behavior impossible to make. DRI is effective with habit behaviors such as thumb sucking. We reinforce the child keeping his hands in his pocket. Or what if a man tends to make disparaging remarks at drivers who cut him off or are driving too slowly (by his standard). This might be a bad model for his kids, and so the man's wife tells him to instead say something nice about the weather or hum a pleasant tune when he becomes frustrated with his fellow commuters. These alternative behaviors are incompatible with cursing and she rewards him with a kiss when he uses them.

6.4.6.5. DRH or Differential Reinforcement of High Rates of Responding. In this type of differential reinforcement, we reinforce a behavior occurring at a high rate or very often or seek to increase a behavior. Many jobs use this approach and reward workers who are especially productive by giving them rewards or special perks. For instance, I used to work for Sprint Long Distance when selling long distance to consumers was a thing. Especially good salespeople, such as myself, would win quarterly trips paid for 100% by Sprint and then the annual trip if we were consistent all year. We won the trips because we sold large numbers of long-distance plans, and other products such as toll-free numbers, in a designated period of time (every 3 months or every 12 months). Hence, a high rate of responding (i.e. engaging in the behavior of selling lots of plans) resulted in the reinforcement of quarterly or annual trips, and other benefits such as time off work and gift cards for local food establishments.

Table 6.4: Expected Outcome and Type of Differential Reinforcement to Use

Expected Outcome	**Type of Behavior Involved**	**Differential Reinforcement Procedure Used**
Increase a desired behavior **AND** eliminate a problem behavior	There are two behaviors involved – one deficit and one excess	DRA
Eliminate a problem behavior	Excess	DRO
Reduce the occurrence of a problem behavior	Excess	DRL
Substitute a problem behavior	The problem behavior is an excess	DRI
Increase the occurrence of a desired behavior	Deficit	DRH

6.5. Theories of Reinforcement

Section Learning Objectives

- Describe Hull's drive reduction theory of reinforcement.
- Describe the Premack principle.
- Describe the response deprivation hypothesis.

6.5.1. Hull's Drive Reduction Theory

Within motivation theory, a **need** arises when there is a deviation from optimal biological conditions such as not having enough calories to sustain exercise. This causes a **drive** which is an unpleasant state such as hunger or thirst and leads to motivated behavior. The purpose of this behavior, such as going to the refrigerator to get food or taking a drink from a water bottle, is to reduce or satisfy the drive. When we eat food, we gain the calories needed to complete a task or take a drink of water to sate our thirst. The need is therefore resolved. Hull (1943) said that any behavior we engage in that leads to a reduction of a drive is reinforcing and will be repeated in the future. So, if we walk to the refrigerator and get food which takes away the stomach grumbles associated with hunger, we will repeat this process in the future when we are hungry. Eating food to take away hunger exemplifies Negative Reinforcement.

Hull said there were two types of drives, which mirrors our earlier discussion of primary and secondary reinforcers and punishers. **Primary drives** are associated with innate biological needs states that are needed for survival such as food, water, urination, sleep, air, temperature, pain relief, and sex. **Secondary drives** are learned and are associated with environmental stimuli that lead to the reduction of primary drives, thereby becoming drives themselves. Essentially, secondary drives are like NS in respondent conditioning and become associated with primary drives which are US. They lead to a reduction in the uncomfortable state of hunger, thirst, being cold/hot, tired, etc. and so in the future we engage in such behavior when a need-drive arises. Hull said these S-R connections are strengthened the more times reinforcement occurs, and called this **habit strength** or **formation** (Hull, 1950). He wrote, "If reinforcements follow each other at evenly distributed intervals, everything else constant, the resulting habit will increase in strength as a positive growth function of the number of trials…" (pg. 175).

Though Hull presents an interesting theory of reinforcement, it should be noted that not all reinforcers are linked to the reduction of a drive. Sometimes we engage in a reinforcer for the sake of the reinforcer such as a child playing a video game because he/she enjoys it. No drive state is reduced in this scenario.

6.5.2. Premack Principle

Operant conditioning involves making a response for which there is a consequence. This consequence is usually regarded as a stimulus such that we get an A on an exam and are given ice cream by our parents (something we see, smell, and taste — YUMMY!!!!). But what if the consequence is actually a behavior? Instead of seeing the consequence as being presented, such as with the example of the stimulus of the ice cream, what if we really thought of it as being given the chance to <u>eat</u> ice cream which is a behavior (the act of eating)? This is the basic premise of the **Premack principle**, or more specifically, viewing reinforcers (the consequence) as behaviors and not stimuli, which leads to high-probability behavior being used to reinforce low-probability behavior (Premack, 1959). Consider that in many maze experiments, we obtain the behavior of running the maze (i.e. navigating through it from start to goal box) by food or water depriving a rat the night before. The next day the rat wants to eat something and to do so it needs to complete the maze. The maze running is our low probability behavior (or the one least likely to occur and the one the rat really does not want to do) and upon finishing the maze the rat is allowed to eat food pellets (the consequence of the behavior of running and the high probability behavior, or the one most likely to occur as the rat is hungry). Eating (high) is used to reinforce running the maze (low) and both are behaviors.

Sometimes I wake up in the morning and am excited to go to the gym (high probability behavior) but I know if I don't eat something (the low probability behavior) before I go, I will not have a good work out. So, I eat something (low) and then get to go to the gym to run on the treadmill (the consequence and high probability behavior). For me, going to the gym reinforced eating breakfast.

6.5.3. Response Deprivation Hypothesis

A third theory of reinforcement comes from Timberlake and Allison (1974) and states that a behavior becomes reinforcing when an organism cannot engage in the behavior as often as it normally does. In other words, the **response deprivation hypothesis** says that the behavior falls below its baseline or preferred level. Let's say my son likes to play video games and does so for about two hours each night after his homework is done (of course). What if I place a condition on his playing that he must clean up after dinner each night, to include doing the dishes and taking out the trash. He will be willing to work to maintain his preferred level of gameplay. He will do dishes and take the trash out so he can play his games for 2 hours. You might even say that a condition was already in place — doing homework before playing games. The games are reinforcement for the behavior of doing homework….and then later cleaning up after dinner….and this situation represents a contingency (*If-Then scenario).* If my son does not do his chores, then he will not be allowed to play games, resulting in his preferred level falling to 0.

Consider that the Premack principle and relative deprivation hypothesis are similar to one another in that they both establish a contingency. For the Premack principle, playing video games is a high probability behavior and doing chores such as cleaning up after dinner is a low probability behavior. My son will do the chores (low) because he gets to play video games afterward (high). So high reinforces the occurrence of low. The end result is the same as the response deprivation hypothesis. How these ideas differ is in terms of what is trying to be accomplished. In the Premack principle scenario, we are trying to increase the frequency of one behavior in relation to another while in the case of the relative deprivation hypothesis we are trying to increase one behavior in relation to its preferred level.

It's time to take a break and rest. Module 6 is long, and you need your cognitive resources.

Try playing Candy Crush for fun!!!

See you in a bit.

6.6. Stimulus Control

Section Learning Objectives

- Define and exemplify stimulus control.
- Define stimulus discrimination.
- Define and describe discrimination training.
- Define and clarify why stimulus generalization is necessary.
- Describe generalization training and the strategies that can be used.
- Revisit the definition of discriminative stimuli.
- Clarify how stimuli or antecedents become cues.
- List and describe the 6 antecedent manipulations.
- Define prompts.
- List, describe, and exemplify the four types of prompts.
- Define fading.
- List and describe the two major types of fading and any subtypes.
- Define and exemplify shaping.
- Outline steps in shaping.

6.6.1. Stimulus Control

When an antecedent (i.e. stimulus) has been consistently linked to a behavior in the past, it gains **stimulus control** over the behavior. It is now more likely to occur in the presence of this specific stimulus or a **stimulus class**, defined as antecedents that share similar features and have the same effect on behavior. Consider the behavior of hugging someone. Who might you hug? A good answer is your mother. She expects and appreciates hugs. Your mother is an antecedent to which hugging typically occurs. Others might include your father, sibling(s), aunts, uncles, cousins, grandparents, spouse, and kids. These additional people fall under the stimulus class and share a similar feature of being loved ones. You could even include your bff. What you would not do is give the cashier at Walmart a hug. That would just be weird.

Do you stop when you get to a red octagonal sign? Probably, and the Stop sign has control over your behavior. In fact, you do not even have to think about stopping. You just do so. It has become automatic for you. The problem is that many of the unwanted behaviors we want to change are under stimulus control and happen without us even thinking about them. These will have to be modified for our desired behavior to emerge.

6.6.2. Stimulus Discrimination

We have established that we will cease all movement of our vehicle at a red octagonal stop sign and without thinking. A reasonable question is why don't we do this at a blue octagonal sign, ignoring the fact that none exist? **Stimulus discrimination** is the process of reinforcing a behavior when a specific antecedent is present and only it is present. We experience negative reinforcement when we stop at the red octagonal sign and not a sign of another color, should a person be funny and put one up. The NR, in this case, is the avoidance of something aversive such as an accident or ticket, making it likely that we will obey this traffic sign in the future.

Discrimination training involves the reinforcement of a behavior when one stimulus is present but extinguishing the behavior when a different stimulus is present. From the example above, the red stop sign is reinforced but the blue one is not.

In discrimination training we have two stimuli:

- The S^D or discriminative stimulus whose behavior is reinforced.
- and an S^Δ (*S-delta)* whose behavior is not reinforced and so is extinguished.

When a behavior is more likely to occur in the presence of the S^D and not the S^Δ, we call this a **discriminated behavior**. And this is where stimulus control comes in. The discriminated behavior should be produced by the S^D only. In terms of learning experiments, we train a pigeon to peck an oval key but if he pecks a rectangular one, no reinforcer is delivered.

6.6.3. Stimulus Generalization

As a stimulus can be discriminated, so too can it be generalized. **Stimulus generalization** is when a behavior occurs in the presence of similar, novel stimuli and these stimuli can fall on a *generalization gradient*. Think of this as an inverted u-shaped curve. The middle of the curve represents the stimulus that we are training the person or animal to respond to. As you move away from this stimulus, to the left or right, the other stimuli become less and less like the original one. So, near the top of the inverted U, a red oval or circle will be like a red octagon but not the same. Near the bottom of the curve, you have a toothbrush that has almost zero similarity to a stop sign.

In behavior modification (the applied side of learning), we want to promote generalization meaning that if we teach someone how to make a desirable response in a training situation, we want them to do that in all *relevant* environments where that behavior can occur, whether that be a child in a classroom, at home at the dinner table or in his/her bedroom, on the playground at recess, at the park, with the grandparents, etc. This is called **generalization training** and is when we reinforce behavior across situations until generalization occurs for the stimulus class. The desirable behavior should generalize from the time with a therapist or applied behavior analyst and to all other situations that matter. To make this happen you could/should:

- Always reinforce when the desirable behavior is made outside of training. By doing this, the desirable behavior is more likely.
- Teach other people to reinforce the desirable behavior such as teachers and caregivers. The therapist cannot always be with the client and so others have to take control and manage the treatment plan. Be sure they are trained, understand what to reinforce, and know what the behavioral definition is.
- Use natural contingencies when possible. Let's say you are trying to teach social skills to a severely introverted client. In training, she does well and you reinforce the desirable behavior. Armed with new tactics for breaking the ice with a fellow student in class, she goes to class the next day and strikes up a conversation about the weather or the upcoming test. The fellow student's response to her, and the continuation of the conversation, serve as reinforcers and occur naturally as a byproduct of her initiating a conversation. Another great example comes from a student of mine who was trying to increase her behavior of eating breakfast before class. She discovered that she felt more alert and energetic when she ate breakfast then when she did not, which are positive reinforcers, and naturally occurring. In fact, she was so happy about this, she jumped four goals and went from her initial goal of eating before class two times a week, to eating breakfast 6-7 times a week. Her behavior generalized beyond simply eating before class to eating breakfast every day when she woke up. It should be noted that her distal goal was 5 days, so in her first week of treatment she had already exceeded this goal. Way to go.

- Practice making the desirable response in other environments during training. You can achieve this by imagining these environments, role-playing, or setting up the environments to some extent.
- Related to the previous strategy, use common stimuli that are present in other environments as much as possible. An example is a stuffed animal that a child has at home. Or have the special education teacher bring the child's desk to the training environment and have them sit in it.
- Encourage the client to use cues to make the desirable response outside of the training environment. These are reminders to engage in the correct behavior and can be any of the antecedent manipulations already discussed.

6.6.4. Stimulus Control Procedures: Antecedent Manipulations

One critical step is to exert control over the cues for the behavior and when these cues bring about a specific behavior, which, if you recall, are termed *discriminative stimuli* (also called an S^D). So, what makes an antecedent a cue for a behavior? Simply, the behavior is reinforced in the presence of the specific stimulus and not reinforced when the stimulus or antecedent is not present.

The strategies we will discuss center on two ideas: we can modify an existing antecedent or create a new one. With some abusive behaviors centered on alcohol, drugs, nicotine, or food, the best policy is to never even be tempted by the substance. If you do not smoke the first cigarette, eat the first donut, take the first drink, etc. you do not have to worry about making additional problem behaviors. It appears that abstinence is truly the best policy.

But what if this is not possible or necessary? The following strategies could be attempted:

- **Create a Cue for the Desirable Behavior** — If we want to wake up in the morning to go to the gym, leave your gym clothes out and by the bed. You will see them when you wake up and be more likely to go to the gym. If you are trying to drink more water, take a refillable water bottle with you to classes. Hiking around campus all day can be tough and so having your water bottle will help you to stay hydrated.
- **Remove a Cue for the Undesirable or Problem Behavior** — In this case, we are modifying an existing antecedent/cue. Let's say you wake up in the morning, like I do, and get on your phone to check your favorite game. You initially only intend to spend a few minutes doing so but an hour later you have done all the leveling up, resource collecting, candy swiping, structure building, etc. that you can and now you do not have the time to do a workout. In this case, phone use is a problem behavior because it interferes or competes with the execution of the desirable behavior of going to the gym. What do you do? There is a simple solution – do not leave your phone by your bed. If it is not in the room, it cannot be a reminder for you to engage in the problem behavior. The phone usage in the morning already exists as a behavior and the phone serves as a cue for playing games. You enjoy playing the games and so it is reinforcing. If the phone is not present, then the behavior of playing the game cannot be reinforced and the cue loses its effectiveness. In the case of water, if we do not carry tea with us, we cannot drink it, but can only drink our water bottle, thereby meeting our goal.

- **Increasing the Energy Needed to Make a Problem Behavior** — Since the problem behavior already exists and has been reinforced in the past, making its future occurrence likely in the presence of the stimulus, the best bet is to make it really hard to make this unwanted behavior. Back to the gym example. We already know that our phone is what distracts us and so we remove the stimuli. One thing we could do is place the phone in the nightstand. Out of sight. Out of mind, right? Maybe. Maybe not. Since we know the phone is in the nightstand, we could still pull it out in the morning. If that occurs, our strategy to remove the cue for phone usage fails. We can still remove it, but instead of placing it in the nightstand, place it in the living room and inside our school bag. So now it is out of sight, out of mind, but also far away which will require much more physical energy to go get than if it was in the nightstand beside us. Think about this for a minute. The strategy literally means that we expend more energy to do the bad behavior, than…..
- **Decreasing the Energy Needed to Engage in the Desirable Behavior** — …we would for the good behavior. Having our clothes by our bed is both a cue to go to the gym, but also, by having them all arranged in one place, we do not have to spend the extra time and energy running around our bedroom looking for clothes. We might also place our gym bag and keys by the door which saves us energy early in the morning when we are rushing out to the gym. What about for drinking water? Instead of carrying a water bottle with us we could just drink water from the water fountains at school. Okay. But let's say that you are standing in the hallway and the nearest water fountain is

all the way up the hallway and near the door to exit the building. You have to walk up the hall, bend over, push the button, drink the water, remove your hand from the fountain, walk back down the hall, re-enter the classroom, and then take your seat. Not too bad, right? WRONG. If you had your water bottle in your backpack, you would only need to reach down, pick it up, open the bottle, take a drink, cap the bottle, and set it back down on the floor or on the desk. You never have to leave your seat which means you are making far fewer behaviors in the overall behavior of drinking water, and so expending much less energy. Now you can use this energy for other purposes such as taking notes in class and raising your hand to ask a question.

Another way you can look at antecedents is to focus on the consequences. Wait. What? Why would that be an antecedent manipulation? Consider that we might focus on the motivating properties of the consequence so that in the future, we want to make the behavior when the same antecedent is present. Notice the emphasis on *want*. Remember, you are enhancing the motivating properties. How do we do this? From our earlier discussion, we know that we can use the motivating operations of establishing and abolishing operations. See Section 6.3.5 for the discussion. But they make up the last two antecedent manipulations that can be employed to bring about the desired behavior.

6.6.5. Transfer of Stimulus Control: Prompting and Fading

One way to help a response occur is to use what are called **prompts**, or a stimulus that is added to the situation and increases the likelihood that the desirable response will be made when it is needed. The response is then reinforced. There are four main types of prompts:

- **Verbal** — Telling the person what to do
- **Gestural** — Making gestures with your body to indicate the correct action the person should engage in
- **Modeling** — Demonstrating for the person what to do
- **Physical** — Guiding the person through physical contact to make the correct response

These are all useful and it is a safe bet to say that you have experienced all of them at some point. How so? Let's say you just started a job at McDonald's. You were hired to work the cash register and take orders. On your first day, you are assigned a trainer and she walks you through what you need to do. She might give you verbal instructions as to what needs to be done and when, and how to work the cash register. As you are taking your first order on your own, you cannot remember which menu the Big Mac meal fell under. She might point in the right area which would be making a gesture. Your trainer might even demonstrate the first few orders before you take over so that you can model or imitate her later. And finally, if you are having problems, she could take your hand and touch the Big Mac meal key, though this may be a bit aversive for most and likely improper. The point is that the trainer could use all of these prompts to help you learn how to take orders from customers. Consider that the prompts are in a sort of order from the easiest or least aversive (verbal) to the hardest or most aversive (physical). This will be important in a bit.

It is also prudent to reinforce the person when they engage in the correct behavior. If you told the person what to do, and they do it correctly, offer praise right away. The same goes for them complying with your gesture, imitating you correctly, or subjecting themselves to a physical and quite intrusive or aversive prompt.

When you use prompts, you also need to use what is called **fading**, which is the gradual removal of the prompt(s) once the behavior continues in the presence of the S^D. Fading establishes a discrimination in the absence of the prompt. Eventually, you transfer stimulus control from the prompt to the S^D.

Prompts are not a part of everyday life. Yes, you use them when you are in training, but after a few weeks, your boss expects you to take orders without even a verbal prompt. To get rid of prompts, you can either fade or delay the prompts. **Prompt fading** is when the prompt is gradually removed as it is no longer needed. *Fading within a prompt* means that you use just one prompt and once the person has the procedure down, you stop giving them a reminder or nudge. Maybe you are a quick study, and the trainer only needs to demonstrate the correct procedure once (modeling). The trainer would simply discontinue use of the prompt.

You can also use what is called *fading across prompts*. This is used when two or more prompts are needed. Maybe you are trying to explain an algebraic procedure to your child who is gifted in math. You could start with a verbal prompt and then move to gestural or modeling if he/she has a bit of an issue. Once the procedure is learned, you would not use any additional prompts. You are fading from least to most intrusive. But your other child is definitely not math-oriented. In this case, modeling would likely be needed first and then you could drop down to gestural and verbal. This type of fading across prompts moves from most to least intrusive. Finally, **prompt delay** can be used and is when you present the S^D and then wait for the correct response to be made. You delay delivering any prompts to see if the person engages in the desirable behavior on their own. If he or she does, then no prompt is needed, but if not, then you use whichever prompt is appropriate at the time. For instance, you might tell your child to do the next problem and then wait to see if he/she can figure it out on their own. If not, you use the appropriate prompt.

6.6.6. Shaping

Sometimes there is a *new(ish)* behavior we want a person or animal to make but they will not necessarily know to make it, or how to make it. As such, we need to find a way to mold this behavior into what we want it to be. The following example might sound familiar to you. Let's say you want a friend to turn on the lights in the kitchen. You decide not to tell them this by voice but play a game with them. As they get closer to the light switch you say "Hot." If they turn away or do not proceed any further, you say "Cold." Eventually, your statements of "Hot" will lead them to the switch and they will turn it on which will lead to the delivery of a great big statement of congratulations. "Hot" and "Thank you" are reinforcers and you used them to make approximations of the final, desired behavior of turning on the light. We called this 'hot potato-cold-potato' when we were a kid but in applied behavior analysis, this procedure is called **shaping by successive approximations** or **shaping** for short.

To use shaping, do the following:

- Identify what behavior you want the person or animal to make. Be sure you create a precise and unambiguous behavioral definition.

- Determine where you want them to start. This can be difficult but consider what others have done for the same problem behavior. When all else fails, start very low and make your steps small. More frequent reinforcement will help you too.
- Determine clear shaping steps; the successive approximations of the final behavior.
- Identify a reinforcer to use and reinforce after reaching the end of each step. This steady delivery of reinforcers, due to successfully moving to the next step, is what strengthens the organism's progression to the final, target behavior.
- Continue at a logical pace. Don't force the new behavior on the person or animal.

For shaping to work, the successive approximations must mimic the target behavior so that they can serve as steps toward this behavior. Skinner used this procedure to teach rats in a Skinner box (operant chamber) to push a lever and receive reinforcement. This was the final behavior he desired them to make and to get there, he had them placed in the box and reinforced as they moved closer and closer to the lever. Once at the lever the rat was only reinforced when the lever was pushed. Along the way, if the rat went back into parts of the chamber already explored it received no reinforcement. The rat had to move to the next step of the shaping procedure. We use the shaping procedure with humans in cases such as learning how to do math problems or learning a foreign language.

We are almost finished with our coverage of operant conditioning. Before moving onto the final two sections, take a break. Section 6.6 was pretty long and full of a ton of information. Go do something fun, get some food, take a nap, etc. but return once you head is clear, and you are ready to finish up.

6.7. Aversive Control — Avoidance and Punishment

Section Learning Objectives

- Describe the discriminated avoidance procedure.
- Contrast avoidance and escape trials.
- Contrast two-process and one-process theories of avoidance.
- Revisit what forms punishment can take.
- Define and exemplify time outs.
- Clarify what a response cost is.
- Define overcorrection.
- Describe contingent exercise, physical restraint, and guided compliance.
- Compare the various theories of punishment.
- Clarify what the problems are with punishment.
- Clarify what the benefits of punishment are.
- Explain how to use punishment effectively.

6.7.1. Discriminated Avoidance Procedure

In what is called the **discriminated avoidance procedure** an animal is provided with a signal that an aversive event is about to occur but has enough time to engage in a behavior to avoid this event. Such procedures are conducted in what is called the **shuttle box** or an apparatus consisting of two compartments separated by a wall with an opening at floor level. The animal is placed on the left side, let's say, and when the trial starts a light or tone occurs (the CS). If the animal moves from the left side to the right side through the opening, then nothing happens, and this is considered an **avoidance trial**. If it does not move (i.e. it does not engage in avoidance behavior), it receives a shock (US) which continues until the expected behavior occurs (moving to the right side). This is considered an **escape trial**. The next trial has the rat or mouse starting on the right side and having to move to the left side and then this back and forth behavior continues resulting in what is called **shuttle avoidance** and represents *two-way shuttle avoidance*. Of course, the animal could be placed on the same side for each trial, called *one-way avoidance*. Early in training, the animal makes more escape behaviors but as it learns, it makes more avoidance behaviors. Also, learning is easier in the one-way avoidance paradigm than in two-way shuttle avoidance since in the latter the animal is returned to the side that was previously dangerous.

6.7.2. Theories of Avoidance

Mowrer (1947) proposed his **two-process theory of avoidance** which states that to learn an avoidance response, two processes are involved — respondent (or classical) conditioning and operant conditioning. First, *respondent conditioning* is needed to condition an organism to emit a fear response to a CS. In the case of Little Albert, he became afraid first due to a loud sound (US) and then later to the presence of the white rat (CS; and presented before the loud sound was made). Second, *operant conditioning* is needed to produce avoidance behavior or moving away from the CS which results in a reduction of the fear behavior, which recall would be classified as negative reinforcement (NR). If Little Albert sees the rat but moves away from it such as across the room, then his fear should decline. If we are afraid of heights, then not walking up a ladder should produce no fear. If we have to go up a ladder, the higher we get the greater our fear would be, like if we have to paint the gables and belly bands on the exterior of our house, compared to say just gaining some height to clean out the gutters. The gutter chore would likely require walking up one or two steps while the painting chore would require using a tall ladder and maybe 20 steps.

There is a problem with Mowrer's two-process theory though. The results of two studies show that the avoidance response persists even though a CS loses its aversiveness. The CS was a very intense electric shock and dogs were trained to avoid it by jumping over a barrier from one compartment to another. Once they learned to avoid the shock, the dogs came to show no fear of it. In fact, after the equipment was disconnected meaning no shock would occur and the avoidance behavior was not necessary, dogs continued to engage in the avoidance response (Solomon, Kamin, & Wynne, 1953; Solomon & Wynne, 1953). Hence, the avoidance behavior persisted and did not extinguish (extinction will be covered in Section 6.8).

One possible answer to this dilemma is what is called **one-process theory of avoidance** (Hernstein, 1969). It states that avoidance behavior is negatively reinforced due to aversive stimulation with which it is associated occurring at a lower rate (i.e. being reduced). A decrease in the emotion of fear has nothing to do with the occurrence of the avoidance behavior. The theory utilizes operant conditioning only.

6.7.3. Punishment and Its Forms

As you well know already there are two types of consequences — reinforcement, which we have spoken about quite a lot already, and punishment, which we have not discussed in much detail. Section 6.7.3 covers the control of behavior via punishment and several strategies will be discussed.

As a reminder from Section 6.2, positive punishment (PP) is based on the idea that if something bad or aversive is given or added, then the behavior is less likely to occur in the future. Negative punishment (NP) occurs if something good is taken away or subtracted so that a behavior is less likely in the future. Notice that these are contingencies as we described for reinforcement and were presented in *If-Then* format.

Before we move to types of punishments, be advised that escape and avoidance are not forms of punishment. They result in an increase in behavior, not a decrease as is the point of punishment. Recall also that punishers can be primary, or unlearned, or secondary, and learned, just like reinforcers. For a review of this discussion, please visit Section 6.2.3.

6.7.3.1. Time-outs. Probably the most well-known of all punishment procedures is the time-out. Simply, a **time-out** is when a person is removed from an activity because they are engaging in an undesirable or problem behavior. If effective, the time-out should result in a reduction of the problem behavior in the future and so functions as a negative punishment (NP; taking away something good — the fun activity which serves as a reinforcement — making a behavior less likely in the future). The length of time needs to be determined and the person told how long he/she is expected to "sit this one out." At the end of the time, if the problem behavior has not occurred, he or she can be released from the time-out. This reinforces the good behavior by serving as an NR. If the behavior is occurring and the person released, you just reinforced the problem behavior by taking away the aversive time-out. Be careful with implementing the time-out procedure. Notice that an NR occurs in both cases. The aversive stimulus is the time out and is what is removed. But what behavior are you reinforcing? Proper use of a time out reinforcers the desirable behavior while the misuse of the procedure reinforcers the problem behavior.

Time-outs take two forms — exclusionary or non-exclusionary. *Exclusionary time-outs* are when the person is removed from the actual location where the problem behavior is occurring. The best example, and the one you might be thinking of, is when a teacher sends a child to the principal's office. Obviously then, a child is not removed from the situation in a *non-exclusionary time-out* but cannot partake in the reinforcing activity. Depending on what the activity is, I might say that non-exclusionary is more punishing. Why is that? If a child misbehaves on the playground and the teacher makes him sit on the side, he still can see all the fun the other kids are having but cannot participate. This is worse than being sent inside to sit at a table or talk with the principal, and not being able to see and hear all the fun that is going on.

One major concern with the time-out is the function of the problem behavior. Maybe the child is acting out so that he or she can get out of doing math work. When the teacher sends the child to the principal's office, the punisher is actually not punishing, but reinforcing future acting out. Essentially, the acting out and being removed from the room is an NR — taking away something aversive (the math work) which makes a behavior (the acting out) more likely to occur in the future.

6.7.3.2. Response costs. Simply, a **response cost** is a type of negative punisher in which some amount of a reinforcer is removed when a problem/undesirable behavior is engaged in. You could take away Netflix time later that day as a response cost. In this case, Netflix time is a PR and its loss makes playing on the phone less likely in the future (NP). In Module 7 we will discuss the token economy and response costs that can be built into it.

6.7.3.3. Overcorrection. Did you ever throw a tantrum and trash your room? Have you become so upset at someone that you yelled at them for a period of time? If so, you engaged in a problem behavior and likely were punished for doing so. If in the context of your childhood home, your parents may have made you clean your room up and make it look better than it did before or be extra nice to your sibling. These are types of **overcorrection procedures** or when a person is expected to engage in effortful behavior for an extended period after the occurrence of an undesirable behavior. The example of cleaning the room is called **restitution** or restoring the environment to a condition that is better than it was before the undesirable behavior, and being super nice is called **positive practice**, or engaging in the correct form of behavior over and over again.

6.7.3.4. Other forms of punishment. In the military, it is quite common to have a soldier (and his whole company) who has not followed instructions or engaged in a behavior unbecoming a solider, to engage in push-ups, sit-ups, jogging in place, holding a rifle above the head, running extra laps around a track, etc. These forms of **contingent exercise** should decrease the problem behavior in the future (as will the heckling by the rest of the company after the exercise is over and the sergeant is gone).

Sometimes a person is engaging in self-injurious problem behavior and needs to be **physically restrained** or held down. The restraint is not pleasant and results in the loss of voluntary control (taking away something good) which makes the behavior of hitting oneself in the head less likely to occur in the future (the person should remember the discomfort of being restrained and the loss of control).

And finally, I think we all have been in the situation of not listening to our parents and being picked up or walked into our room and shown how to clean it. This form of **guided compliance**, or physically guiding the person through the activity, is aversive and in the future he or she should engage in the desired behavior to avoid the discomfort of being guided (avoidance behavior in the future; once you are doing the correct behavior in the present, the guidance compliance ends, which is NR and an escape behavior).

6.7.4. Theories of Punishment

6.7.4.1. Conditioned suppression theory of punishment. This theory asserts that punishment does not occur due to a weakening of a behavior, but because an emotional response is produced that interferes with the behavior's occurrence (Skinner, 1938). An organism may become upset when a punisher is delivered and refrain from the problem behavior due to that reason only. Once the punisher is gone, and it calms down, the unwanted behavior returns.

6.7.4.2. Avoidance theory of punishment. Based on our earlier discussion of avoidance to start this section, we know that an animal may come to avoid an aversive stimulus by engaging in the required behavior (i.e. moving to the other part of the shutter box) or not making an undesirable one. If talking back results in a scolding or loss of a privilege from a parent, the child will avoid talking back in the future. Basically, any behavior will be engaged in except the behavior that results in punishment.

6.7.4.3. Two-process theory of punishment. Like with avoidance, this theory states that both respondent and operant conditioning are involved in punishment. In the case of the example for avoidance, a light (or tone) being turned on (CS) indicates the shock to come (US). If the animal does not avoid and is shocked, it experiences fear (CR). Moving to the other chamber leads to the shock being turned off and in the future, it will associate moving out of the chamber in which a light is on with avoiding the fear and make that response (NR and operant conditioning).

6.7.4.4. Premack principle. And finally, the Premack principle can be used to explain punishment. In this view, low probability behavior is used to punish high probability behavior (Premack, 1971). For example, one day my wife said, after eating dinner, that she wanted to go for a walk. I was famished and so ate a lot (high). The walk (low) made my stomach upset (a punisher) and so the next night I ate less food so that I could walk comfortably if she said we were going out. The low probability behavior of walking punished the high probability behavior of eating. In a way, this is a great way to avoid overeating.

6.7.5. Problems with Punishment

The use of punishment presents a few issues that question its use in the first place, or at least how it is used. First, it is often *administered inappropriately*. In a blind rage, people often apply punishment broadly such that it covers all sorts of irrelevant behaviors. At times, parents take out their frustrations at work on their kids, and what would not have upset them much one day, angers them immensely another. Second, the recipient of the punishment often *responds with anxiety, fear, or rage* and these emotional side effects generalize to the entire situation. You can see this in animals when they have been punished for soiling the carpet and are disciplined.

Third, the effectiveness of punishment is often *temporary*, depending on the presence of the punishing person or circumstances. When the punisher is not there, the punished misbehaves again. This is captured in the cliché, "When the chiefs away the cat will play." Fourth, most behavior is hard to punish *immediately,* and during the delay, the behavior may be reinforced several times — i.e. not getting a speeding ticket every time you speed. As you will see, in a token economy, the response cost can be delivered immediately as is the case with the reinforcer in the form of the token, but token economies are used in select situations.

Fifth, punishment *conveys little information*. It does not tell the person how to act. If you want them to display desirable behavior, they have to know what it is. Sixth, an action meant to punish *may instead be reinforcing* as when a child acts out for attention. For them, it is a positive reinforcer. What about the case of the child acting out to get out of math work? In this case, the behavior leads to a consequence and specifically negative reinforcement.

6.7.6. Its Benefits and Effective Use

As with all things in life, there are pros and cons of engaging in a behavior. In the case of punishment, consistency is most important. If you punish *every time* the person engages in the undesirable or problem behavior, he or she will stop making the behavior (i.e. speeding). Also, it can be *unquestionably effective*. Punishment can deter some criminals from repeating their crimes. Third, *avoidance training* is key. Sometimes, after punishment has been administered a few times, it is not needed anymore for the mere threat of it is enough to elicit the desired behavior. It is also worth pointing out that you do not have to be punished yourself. By seeing someone else, such as a sibling, be punished for a behavior you engage in or want to engage in, you can learn to not engage in that behavior. Finally, if you are going to use punishment, use a strong enough punisher from the start to suppress the behavior, and in general, stronger punishers produce a greater reduction in the unwanted behavior (Azrin & Holz, 1966). In fact, negative punishment appears to be more effective than positive punishment. Taking away a child's video game time can be devastating to the child, especially if he/she looks forward to it.

So, what is the final verdict on punishment? The list of cons is much more extensive than the list of pros, and the first pro, consistency, is not practical most times leading to the fourth con. This might make us think that punishment is not useful. It can be if the following is adhered to:

1. Do not use physical abuse (takes care of Con 1 and 2).
2. Tell the person how to behave (takes care of Con 5).
3. Reinforce the desired behavior when it occurs.

6.8. Extinction

Section Learning Objectives

- Define extinction.
- Clarify which type of reinforcement extinguishes quicker.
- Clarify what the partial reinforcement effect is and an explanation for it.
- Define extinction burst.
- Define spontaneous recovery.

6.8.1. Extinction

First, **extinction** is when something that we do, say, think/feel has not been reinforced for some time. As you might expect, the behavior will begin to weaken and eventually stop when this occurs. Does extinction just occur as soon as the anticipated reinforcer is not there? The answer is yes and no, depending on whether we are talking about continuous or partial reinforcement. With which type of reinforcement would you expect a person to stop responding to immediately if reinforcement is not there? Do you suppose continuous? Or partial?

The answer is continuous. If a person is used to receiving reinforcement every time the correct behavior is made and then suddenly no reinforcer is delivered, he or she will cease the response immediately. Obviously then, with partial, a response continues being made for a while, called the **partial reinforcement effect**. The person may think the schedule has simply changed. ‘Maybe I am not paid weekly now. Maybe it changed to biweekly and I missed the email.’ Due to this, we say that intermittent or partial reinforcement shows **resistance to extinction**, meaning the behavior does weaken, but gradually. One explanation for why this occurs is the **discrimination hypothesis** which says that it is more difficult to discriminate between extinction and the partial schedule than it is extinction and the continuous schedule (Mowrer & Jones, 1945).

As you might expect, if reinforcement “mistakenly” occurs after extinction has started, the behavior will re-emerge. Consider your parents for a minute. To stop some undesirable behavior you made in the past surely they took away some privilege. I bet the bad behavior ended too. But did you ever go to your grandparent’s house and grandma or grandpa, or worse, BOTH….. took pity on you and let you play your video games for an hour or two (or something equivalent)? I know my grandmother used to. What happened to that bad behavior that had disappeared? Did it start again and your parents could not figure out why? Don’t worry. Someday your parents will get you back and do the same thing with your kid(s). ☺

When extinction first occurs, the person or animal is not sure what is going on and begins to make the response more often (frequency), longer (duration), and more intensely. This is called an **extinction burst**. We might even see novel behaviors such as aggression. I mean, who likes having their privileges taken away? That will likely create frustration which can lead to aggression.

One final point about extinction is important. You must know what the reinforcer is and be able to eliminate it. Say your child bullies other kids at school. Since you cannot be there to stop the behavior, and most likely the teacher cannot be either if done on the playground at recess, the behavior will continue. Your child will continue bullying because it makes him or her feel better about themselves (a PR).

With all this in mind, you must have wondered if extinction is the same as punishment. With both, you are stopping an undesirable behavior, correct? Yes, but that is the only similarity they share. Punishment reduces unwanted behavior by either giving something bad or taking away something good. Extinction is simply when you take away the reinforcer for the behavior. This could be seen as taking away something good, but the good in punishment is not usually what is reinforcing the bad behavior. If a child misbehaves (the bad behavior) for attention (the PR), then with extinction you would not give the PR (meaning nothing happens) while with punishment, you might slap his or her behind (a PP) or taking away tv time (an NP).

6.8.2. Spontaneous Recovery

You might have wondered if the person or animal will try to make the response again in the future even though it stopped being reinforced in the past. The answer is yes and is called **spontaneous recovery.** One of two outcomes is possible. First, the response is made and nothing happens. In this case, extinction continues. Second, the response is made and a reinforcer is delivered. The response re-emerges. Consider a rat that has been trained to push a lever to receive a food pellet. If we stop delivering the food pellets, in time, the rat will stop pushing the lever. The rat will push the lever again sometime in the future and if food is delivered, the behavior spontaneously recovers. Hence, we can say that spontaneous recovery shows that extinction is not simply forgetting to make the response to receive reinforcement. The learning is still there and can be accessed again if needed.

Module Recap

Well, if you made it this far you survived a pretty heavy discussion of operant conditioning. In it, we discussed reinforcement and punishment and the four contingencies of positive and negative reinforcement and positive and negative punishment. Several factors affect operant learning such as contiguity, the contingency itself, magnitude, individual differences, and motivating operations. Reinforcement schedules can take the simple form of fixed and variable ratio and fixed and variable interval, as well as schedules focused on duration (or making the behavior for some interval), time (or the simple passage of time – no response required), and progressive schedules. Complex schedules also occur and are simply the combination of simple schedules. We discussed theories related to both reinforcement, avoidance, and punishment, and outlined ways to exert stimulus control such as discrimination, generalization, prompts and fading, antecedent manipulations, and shaping. Punishment was discussed and its many forms. We also critiqued its use, described benefits related to punishment, and then outlined a way to use it effectively. Finally, extinction was discussed, and it was shown that spontaneous recovery proves that extinction is more than just mere forgetting.

With this done, we will move to one key application of operant conditioning — behavior modification — in Module 7. This was a complex module and so if you still have lingering confusion or questions, consult your instructor.

Part III. Associative Learning: Operant Conditioning

Module 7:

Applications of Operant Conditioning

Module 7: Applications of Operant Conditioning

Module Overview

In Module 6 we discussed operant conditioning from the perspective of pure/basic science. In Module 7 we will now turn our attention to the applied side of operant conditioning — applied behavior analysis. We will tackle the issue of behavioral change by stating why we might be willing to change, define the behavior to be changed, talk about setting goals, discuss how we would conduct a functional assessment to identify the ABCs of behavior, arrange strategies into a plan, implement the plan, and then evaluate its effectiveness. Once we have met our final goal, we move into the maintenance phase. Issues related to relapse are discussed briefly.

Content Links to: PSYCH 328: Self-Control at Washington State University which covers behavior modification. Be advised that this is a snapshot of the course and not the whole course. The material is also derived from my textbook/OER, *Principles of Behavior Analysis and Modification* (4th edition; Daffin, 2021, first published 2017). The full text can be accessed by clicking here.

Module Outline

Module Learning Outcomes

- Describe self-regulation and self-control and state their importance for behavioral change.
- Clarify stages people go through when deciding to bring about behavior change.
- Clarify the role of self-efficacy in behavior change.
- Clarify what a behavioral definition is and why it is important to applied behavior analysts.
- State the importance of setting clear goals in terms of what behavior you want to change.
- Describe the who, what, when, where, and why of recording and data collection.
- Clarify what is learned through a functional assessment and describe how to conduct one.
- Clarify the importance of the baseline phase.
- Identify strategies to help bring about change.
- Discuss the importance of the treatment phase in a behavior modification plan.
- Discuss why you need to evaluate and adjust your plan.
- State the importance of the maintenance phase.
- Explain the concept of relapse.

7.1. Overview of the Process of Change

Section Learning Objectives

- Differentiate self-regulation and self-control.
- Outline the process of change and its steps.

7.1.1. Self-control

Before we dive into the process of change, I wanted to briefly comment on the fact that to make a change we must have discipline. In some cases, we adjust our behavior based on the feedback we receive from others. Joking around with our significant other after he or she had a long and hard day at work will be perceived differently than a day in which he/she received an exemplary performance evaluation and a raise. Or the feedback may come from ourselves, such that we stop working out because we notice our heart rate has reached dangerous levels or we turn off the television because we are distracted. Our ability to carefully consider our actions and the effect they have on others or ourselves, and to make such adjustments, is called **self-regulation.** We self-regulate or self-direct more than just our actions. We can also control our thoughts, feelings, attitudes, and impulses. You might think of self-regulation as a form of behavior modification but in the short term. It could be long term too. To lose weight, we have to exercise on a regular basis, watch what we eat, drink water, manage our stress, and get enough sleep. A few days of doing this will not produce the results we seek. We need to stay committed for many months or even years.

This leads to the topic of **self-control** and avoiding temptations. It takes a great deal of discipline to not sleep in, get fast food for dinner, stay up late watching Netflix, or let demands in our environment overwhelm us. This is sometimes called *brute self-control* (Cervone, Mor, Orom, Shadel, & Scott, 2011) and if it goes on for too long can leave us in a weakened state and cause giving in to our desires (McGonigal, 2011).

Note that Skinner (1953) did not see self-control as willpower, the term that is commonly used, but more so involving outcomes or the consequences of engaging in a behavior. If we eat ice cream after a hard day and it makes us feel better (NR — taking away an aversive feeling or say the frustration from the day) we will be more likely to eat ice cream again as comfort food. If we are on a diet, this can wreak havoc. Though we may feel better in the short-term, we will feel guilty in the long-term when faced with weight gain. He discussed things we do to alter how often a response occurs. The altered response itself is called the **controlled response** and the responses that do the altering are called **controlling responses**. If we decide to watch a funny movie to feel better after a hard day instead of eating ice cream, then the movie is a controlling response and the ice cream is the controlled response. We might also use something discussed in a bit called self-instructions and talk ourselves through a better way to deal with the stress of the day (also a controlling response). We will discuss numerous types of controlling responses in this Module. Some were discussed in Module 6.

7.1.2. Steps in the Process of Change

The process of change involves the following steps. Be advised that these are not universal but my conceptualization of the order, though most other textbook authors use similar steps. Some parts of the process must occur in a specific order. For instance, you cannot implement your plan without first having an idea of what strategies you would use. You cannot do that without having an idea of the ABCs of the behavior. And to start the whole process off you have to know what behavior you want to change, by identifying the target behavior. A plan concludes with a maintenance phase and you have to know when to go to it by evaluating your success. So again, there can be some variability with some steps and their order, such as determining the plan to record and establishing goals. They generally occur about the same time and 5 could go before 4.

Figure 7.1. Steps in the Process of Change

Planning for Change

1. Identify the Target Behavior
2. Conduct a Pros and Cons Analysis and Assess Self-Efficacy
3. State the behavioral definition
4. Establish goals and criterion
5. Determine a plan to record data
6. Conduct a baseline phase and functional assessment, to include an identification of temptations
7. Select strategies
8. State the plan rules, identify potential mistakes, and develop a behavioral contract

Implementation and Behavior Change

9. Implement the plan and collect data as you go - Treatment phase
10. Re-evaluate the plan and see if it is working. Make adjustments as needed
11. Once you have achieved your final goal move to maintenance phase. Engage in relapse prevention

7.2. A Willingness to Change

Section Learning Objectives

- Outline the steps of change according to Prochaska et al. (1995).
- Define self-efficacy.
- Contrast those high and low in self-efficacy.
- Clarify how self-efficacy affects the success of a behavior modification plan

7.2.1. Thinking About Changing

Prochaska, Norcross, and DiClemente (1995), in their book, *Changing for Good*, state that "Change is unavoidable, part of life. Few changes are under our control. But some things we can intentionally change." How so? We must initiate change to help modify thoughts, feelings, or behaviors. They also say, "In change, timing is everything" and nine processes are involved. A few of interest are *countering* in which we substitute healthy responses for unhealthy ones, *helping relationships* or asking for help from your loved ones so you don't have to go it alone, *rewards* or giving yourself a special prize when you achieve your goal and minimizing the use of punishment, *commitment* or accepting responsibility for the change on a personal level and then "announcing to others your firm commitment to change," and *conscious awareness* or bringing unconscious motivations to a conscious level.

Knowing when to change is key because if you are not ready, you will inevitably fail. Likewise, if you spend too much time trying to understand your problem you might put off change indefinitely. Change unfolds through a series of six stages and successful self-changers follow the same road for each problem they desire to modify. These stages include:

precontemplation, contemplation, preparation, action, maintenance, and termination. Let's look closely at each.

7.2.1.1. Precontemplation stage. This is when the person is not considering making a change and even resists the idea. Control of the problem is shifted to outside the person and they do not want to be nagged about the problem from family and friends. The individual even denies responsibility for the problem and justifies the behavior.

Prochaska, Norcross, and DiClemente (1995) suggest the individual answer the following questions to help them see the difference between problem behaviors and lifestyle choices:

- Do you discuss your behavior pattern?
- Are you well informed about your behavior?
- Are you willing to take responsibility for the consequence of your behavior?

Individuals move out of the precontemplative stage when they realize that their environment no longer supports their unhealthy lifestyle, when there is social pressure to make the change, or they receive direct requests from others such as employers.

7.2.1.2. Contemplation stage. This is when change is seriously considered, but within the next six months. Many people stay stuck in this stage for a long period of time due to a fear of failure and so postpone and procrastinate. We have made the decision to change, but when the time is right. Of course, we all know there is no such time. We also engage in wishful thinking and desire to live as we always have but with different consequences such as eating what we want and not gaining any additional weight.

The authors state that you know you are ready to move on when your focus is on the solution and not the problem. We need to engage in consciousness-raising by asking the right questions such as understanding how many calories we really need to consume each day or what the effects of smoking are on the body and how long it will take to recover from them, if we can at all. We might also set goals, collect data, and do a functional assessment. In any case, it is critical to engage in this task during the contemplation stage as it helps us to be more aware of our problem behavior, "gain insight into how your thinking and feeling maintain the problem, and begin to develop a personal conviction of the value of change" (Prochaska, Norcross, and DiClemente, 1995).

You can even engage in a process of self-reevaluation, which if successful, will show that your fundamental values conflict with the problem behavior. We might assess how unhappy we are with the habit or behavior in the present, and then engage in an appraisal of our happier, healthier changed selves in the future. We could also think before we act especially with problems involving overeating, smoking, or drinking; create a new image of a changed you; and evaluate the pros and cons of changing.

7.2.1.3. Preparation stage. This is when the person gets ready to change within the next month. Make your intention to change public and develop a firm, detailed plan for action. In terms of the plan, be specific about what steps you will take to solve the problem. Commitment involves a willingness to act and a "belief/faith in your ability to change." Engage in social support also at this time, even if you decide not to make your plan for change public.

7.2.1.4. Action stage. Now fully committed to change, we enter the action stage. This requires a great deal of time, energy, and sacrifice. We must be aware that the action stage is "not the first or last stop in the cycle of change." The action stage lasts for months and involves being aware of potential pitfalls we may encounter.

It is during this stage we engage in the process of change called *countering*, or substituting a problem behavior with a healthy behavior. Of course, all we may do is substitute one problem behavior for another, but to minimize that possibility, we could engage in active diversion by keeping busy or refocusing energy into an enjoyable, healthy, and incompatible activity. We might exercise, relax, counterthink by replacing troubling thoughts with more positive ones, or be assertive, especially if others in your life are triggering the problem behavior. Though resisting temptation is an accomplishment, it is not rewarding enough, and so we need to be rewarded when we counter, exercise, relax, counterthink, or be assertive. Helping relationships are also important to make our success more likely.

7.2.1.5. Maintenance stage. This is when change continues after the first goals have been achieved. To be successful, your change must last more than just a few days or months. It should last a lifetime. To be successful at maintenance Prochaska, Norcross, and DiClemente (1995) state that you should have long-term effort and a revised lifestyle. Relapse is a possibility if you are not strongly committed to your change.

How do you maintain your positive gains? Stay away from situations or environments that are tempting. Our former problems will still be attractive to us, especially in the case of addictive behaviors. What threatens us most are "social pressures, internal challenges, and special situations." In terms of internal challenges, the authors state that these include overconfidence, daily temptation, and self-blame. Creating a new lifestyle is key too. If we are under a great deal of stress, exercise or practicing relaxation techniques instead of engaging in our former behavior of comfort eating or drinking alcohol.

7.2.1.6. Termination stage. This is when the ultimate goal has been achieved but relapse is still possible. Actually, Prochaska, Norcross, and DiClemente (1995) note that, "Recycle is probably a more accurate and compassionate term than relapse. Recycling gives us opportunities to learn." How so? They note that people pass through the stages <u>not</u> in a linear fashion but more in a spiral. It may seem like we are not making progress, but the spiral is ever pushing upward. Also, few changers ever terminate the first time around unless they have professional help or a clear understanding of the process of change.

See also: McConnaughy, DiClemente, Prochaska, and Velicer (1989) and Prochaska and DiClemente (1992)

7.2.2. Self-Efficacy

Change is not easy and the more of a change we have to make, the more difficult or stressful. This is where Albert Bandura's concept of self-efficacy (Bandura, 1982, 1986, 1991a, 199b) comes in. **Self-efficacy** is our sense of self-esteem and competence and feeling like we can deal with life's problems. It includes our beliefs about our ability to complete a task and affects how we think, feel, and what motivate ourselves. When our self-efficacy is high, we feel like we can cope with life events and overcome obstacles. Difficult tasks are seen as challenges and we set challenging goals. In contrast, if it is low, we feel hopeless, helpless, and that we cannot handle what life throws at us. We avoid difficult tasks and throw in the towel quickly when things get tough. These individuals are easily depressed and stressed.

Consider this in relation to how successful we might be with achieving our goal of changing an unwanted behavior or establishing a positive behavior. The pros and cons of changing the behavior (Note: I skipped this for the purposes of this book) if weighing heavier on the side of making a change, give us the motivation or desire to make a change. But having the desire does not mean that change will occur. We need the ability and, possibly more important, we have to believe we can make the change. The change itself is the obstacle to overcome and is challenging for us. If it was not, we would have made the change already. Those high in self-efficacy will be more likely to move from the action stage to maintenance and termination of the treatment plan compared to those low in self-efficacy.

An example will hopefully help you to understand the relationship between willingness and ability. In terms of losing weight, many people genuinely desire to shed unwanted pounds. They engaged in a pros and cons analysis and the pros won out. But many do not understand how to lose weight in terms of making sense of caloric intake, the impact of specific foods they eat, consumption of sugars and protein, the role of sleep and water intake, etc. Armed with this knowledge they can be successful. Their ability would match their desire to make a change. But many do not know these important facts and so lose some weight early on but then stagnate and give up. Losing the pounds is motivational or reinforces the weight reduction behaviors being used, leading to a continued commitment to the plan (a type of NR). But when weight loss stagnates, we become frustrated and return to the behaviors that caused the problem in the first place.

7.3. Defining the Behavior

Section Learning Objectives

- Define and exemplify a behavioral definition.
- Define goals and outline their features.
- Describe the process of setting goals.
- Clarify how a criterion is used to move from one goal to the next.

7.3.1. Behavioral Definitions

It is critical to clearly define what the behavior is you wish to change. In behavioral modification, we call this a behavioral definition. A **behavioral definition** is a precise, objective, unambiguous description of the target behavior or a competing behavior. Our behavior may be an *excess* and something we need to decrease, or a *deficit* and something we need to increase. No matter what type of behavior we need to change, we must state it with enough precision that anyone can read our behavioral definition and be able to accurately measure the behavior when it occurs. Let's say you want to exercise more. You could define it as follows:

- 1 behavior = going to the gym and using a cardio machine (elliptical, treadmill, or stationary bike) for 20 minutes.

Okay, so if you went to the gym and worked out for 40 minutes, you would have made 2 behaviors. If you went to the gym for 60 minutes, you made 3 behaviors. What if you went to the gym for 30 minutes? Then you made 1.5 behaviors, correct? No. It does not make sense to count behaviors by the half.

Behavioral definitions should be simple. Do not make it reflect whatever your end goal will be. For instance, if your overall goal is to run for 60 minutes, do not make your behavioral definition to be 1 behavior = 60 minutes of running. Since we do not count partial behaviors, you will show no behaviors made until you finally reach 60 minutes of running. How low should you go then? If 60 is too high, do you define it as 1 behavior = 1 minute of running? Likely not. Think about what is the least amount of time you would run. If it is 5 minutes, you could set it at 1 behavior = 5 minutes of running. Then if you run 30 minutes you would have made 6 behaviors. With defining running as 20 minutes of continuous exercise you can only count 1 behavior and the other 10 minutes are unaccounted for. Think about what denomination of time is most practical for your situation and where you are starting out at. If you have never run before, a smaller increment of time might be better. If you run about 30 minutes a few days per week and want to simply double your time, then you could use a greater increment such as 10, 15, or 20 minutes.

We should always create behavioral definitions for the target behavior but also any competing behaviors that may occur. If we want to go to the gym more often, we might discover when examining our antecedents that playing games on our phone in the morning or talking to our roommate in the afternoon leaves us with not enough time to work out. We would then define this **competing behavior**, or a behavior that interferes with the successful completion of a target behavior, and then when developing our plan, implement strategies that make the distractor less, well, distracting.

7.3.2. Goal Setting

Once you have an idea of exactly what the behavior is you want to change, the next task is to set goals about the behavior. In behavior modification, you have your distal goal and to get there, use proximal or subgoals. How so? First, a **goal** is an objective or result we desire that clearly indicates how our time and physical and psychological energy will be spent.

Goals have several interesting features. They can be *large in scope*. Obtaining a bachelor's degree is a relatively large goal but if your terminal educational goal is to earn your Ph.D., then this is even larger in scope. Reading for pleasure is likely a small goal but losing 100 pounds is large and will take much more dedication. Goals can be *complex* and take *planning* to achieve. This is definitely the case with behavior modification. Even if you want to do something as simple as read for pleasure, you might have to implement quite a few additional changes in your life to make that happen. Obtaining a degree is complex and requires a great deal of planning and coordination with people like your major professor or adviser. Goals are more likely to be completed when they are linked to *incentives*. If your goal is to lose 100 pounds, reward yourself as you hit various milestones along the way. And finally, you can have *more than one goal at a time*. Maybe your goal is to exercise more and to restrict your calories. Or maybe you want to run both longer and faster (measures of frequency and intensity).

A few other properties of goals are worth mentioning here:

- The more *difficult* the goal, the more rewarding it is when we achieve it.
- Goals can be *ranked* in order of importance and higher-level goals have more value to us when achieved.
- The more *specific* the goal, the better our planning can be, and the more likely that we will achieve the goal.

- Goal *commitment* is key and if you want to make it more likely that you will achieve your goal, publicly announce the goal (Salancik, 1977). Commitment tends to be higher when the goal is more difficult too.
- If you *fail* at a goal, you can either try again, quit and move on, reduce the level of the goal, or revise the goal.

Another option to overcome goal failure might be to consider the use of **subgoals**, or waypoints toward the final goal. This leads to a discussion of distal vs. proximal goals. **Distal goals** are far off in the future whereas **proximal** are nearer in time. Go back to the example of changing our behavior such that we run for 60 minutes at a time. We will likely not start running 60 minutes, especially if we never ran a day in our life (except of course to the bathroom in times of crisis…enough said). Our distal or final goal would be to run for 60 minutes. We might create three additional goals of running for 15 minutes continuously, then running for 30 minutes continuously, and then running for 45 minutes continuously.

In this scenario, we have 3 subgoals leading up to our final goal. Notice that we are expecting to run three days a week and so the frequency is set. What is going up is the duration. There is no indication of an intensity expectation, at least at this point. Once all goals are achieved, we can always create a new set of goals such as running a half marathon. This goal will, therefore, be high in our hierarchy, difficult to obtain since we have not run before but we also hope (in the long run, pardon the pun) to run 13 miles at one time which takes more than just 60 minutes (this will be our starting point though to acclimate ourselves to running and increase our conditioning and stamina), need to be committed to the goal and so join a running club (public commitment), and engage in very specific planning. As we achieve each distal goal, we should reward ourselves in some way (an incentive).

But how do we know when to advance from one goal to the next? The specific “trigger” for when to advance from Goal 1 to Goal 2 is called the **criterion**. Our first goal states that we will run for 15 minutes 3 days a week. Achieved. When do we move to running for 30 minutes for 3 days a week? That depends on the behavior we are trying to change. In exercise-related projects or plans, it is prudent to make sure you can truly engage in that level of behavior for at least two weeks. Listen to your body, a trainer or doctor, and then move to the next goal when it is safe to do so. For other projects such as pleasure reading, you could move to the next goal as soon as the current goal has been achieved. There is no need to wait as no serious harm can come from increasing the number of pages you read a night from 5 to 10, other than a few minutes of lost sleep.

7.4. Determining the ABCs of Behavior via a Functional Assessment

Section Learning Objectives

- Define self-monitoring.
- Clarify what the observation period is.
- Differentiate between a natural setting and an analogue setting.
- Clarify the use of the ABC chart in data collection.
- Describe the importance of the baseline phase.
- Define functional assessment.
- Outline what information is gained from a functional assessment.
- Define temptation.
- Explain how people and things can be temptations.
- Clarify the significance of situations and places and how they might lead you to engage in the undesired behavior.
- Propose ways to avoid giving in to temptations.

7.4.1. Collecting Data

7.4.1.1. Who does the recording? In terms of who does the measuring, this may be a professional or other individual routinely associated with the individual such as a teacher, work supervisor, counselor, school bus driver, caregiver, or sibling. In the case of self-management or self-modification, you are doing the measuring and recording which is called **self-monitoring.** One issue in behavior modification is what we call *reactivity*, or when the process of recording a behavior causes the behavior to change, even before treatment is applied. This may make obtaining baseline data to compare with treatment data difficult. If the nutritionist wants to reduce the consumption of high fat, salty foods in her client's diet to help with weight loss she will need to know what the client eats normally. If the client alters his behavior upon knowing what the focus of the nutritionist is, then comparison data will not be possible. Of course, in the case of self-monitoring, the actual monitoring itself is part of the treatment and so we expect that keeping a food journal or using an app such as Fitbit will alter one's behavior.

7.4.1.2. When do we record? In terms of when we record, we will have a clearly defined **observation period** and should choose a time when the behavior is likely to occur.

7.4.1.3. Where do we record? In terms of where, we can choose a *natural setting* or place where the behavior typically occurs, or an *analogue setting* or one that is not part of the person's daily routine. This is the equivalent to naturalistic and laboratory observation, respectively. Finally, we can choose structured or unstructured events to observe which refers to whether or not there is a specific event or activity to observe and record.

7.4.1.4. With what do we record? Recording can be done in many ways. You might record instances of the behavior using low tech options such as paper and pencil, moving coins from the left pocket to the right pocket, or tearing a sheet of paper. Alternatively, you can go high tech with a computer, phone, using barcodes, or tablets. Middle of the road alternatives include a pedometer, stopwatch, or golf stroke counter. No matter which method you use, you will ultimately want to record on what are called *ABC charts* (also called *structured diaries*). These tools record what environmental or internal events led to the occurrence of the behavior or the antecedent, what form the behavior took, and what happened afterward or the consequences. ABC charts can look like the following:

Figure 7.2. ABC Chart

Date: ___________________________ Time: __________ AM PM

Observer: ________________________ Location: ______________________

Antecedents: (Describe any environmental or internal events that led to the occurrence or non-occurrence of the desired behavior)	Description:
Behavior: (Describe the behavior that was made and any relevant dimensions: frequency, duration, intensity)	Description:
Consequences: (Describe the results of the behavior using terminology learned in this course such as PR, NR, PP, and NP)	Description:

7.4.2. The Baseline Phase

The **baseline phase** is when we collect data but do not attempt to change our behavior. No strategies are in place. We are trying to find out how often, long, or intensely we engage in our target/desirable behavior or a problem behavior. In cases when we are not making the desirable behavior at all, such as going to the gym or using a planner to organize our school work, a baseline phase is still useful for determining why we do not engage in the desired behavior and/or why we make a problem behavior. Typically, we continue with the baseline phase until a clear pattern emerges and this can take a few days at least.

After your behavior modification plan has run its course, you will compare the level of your behavior after the strategies were used against the level of the behavior before they were used. As such, the baseline phase serves as a *comparison* with the treatment phase.

7.4.3. What is Functional Assessment

A **functional assessment** is when we much more closely scrutinize the antecedents and consequences to see what affects the occurrence or nonoccurrence of a desired or problem behavior, all to maximize how effective our plan/strategies will be. This data comes from an analysis of what we recorded on our ABC charts during the baseline phase. This scrutiny involves gathering several important types of information about the behavior, antecedents, consequences, and previous interventions.

7.4.3.1. The behavior. What makes up the problem behavior or the desired behavior. It may be that in the case of a problem behavior, several sub-behaviors are included. For instance, earlier we described a student being disruptive in class. This is fairly general and could include the sub-behaviors of getting out of his seat without permission, talking without being called on, verbally or physically harassing other students, being uncooperative, ignoring directions from the teacher, or acting aggressively on the playground or during gym. These behaviors would be recorded on a baseline ABC chart.

7.4.3.2. The antecedents. What stimuli in the environment, or thoughts/feelings in the person, lead to the behavior's occurrence/non-occurrence. These stimuli will actually *predict* the behavior in the future. To develop an effective plan, you must know what cues there are for the behavior but also make sure you go back far enough in time to find the true cue. If a person does not socialize, it could be due to worry about embarrassing him or herself but examining deeper reveals a parent who told the individual he was worthless and no one would ever like him. This reason would obviously need more work undoing/correcting than simply worry about looking foolish. Either way, it is safe to say or is predictable, that the individual will not strike up a conversation with another student waiting in line to pay for his textbooks early in the semester if there is concern about being embarrassed or subconsciously, you hear your parent’s voice and condescension. You will also want to know if there are certain situations, events, times, etc. that lead to the desired behavior or problem behavior.

7.4.3.3. The consequences. These are any events that follow the problem or desired behavior and maintain it. Face it. If you do not derive some benefit from making the behavior, there is simply no reason to make it. This goes for problem or desirable behaviors. If you wake up in the morning, play games on your phone, and really enjoy it, you will not be as concerned about getting to the gym to workout. The consequences are particularly reinforcing for you and maintain the problem behavior. If during the process of deciding to engage in behavioral change you decide that being in shape and losing weight is more important, you will encounter stronger reinforcers for working out then you do for playing games on your phone. You might even realize that while you are on the recumbent bike, you can spend a few minutes on your favorite game so you are not losing out on this fun activity while you get in shape. In short, motivation is key and centers on consequences. You can look at your baseline phase ABC charts for indicators of motivators to engage in the desired or problem behavior or if anything negative occurred which led you to avoid the target behavior.

7.4.3.4. Previous interventions. It may be this is not your first time attempting to change the behavior. Maybe years ago you changed it, maintained that success for several years, but then relapsed for any number of reasons. You will want your current applied behavior analyst to know what was part of your treatment plan before. Some elements may have worked while others may not have…then. Times change and so do people and you might find that video games were reinforcing 10 years ago but not so much today. Analyzing these interventions will help you to figure out what might work again, all while acknowledging a new approach may be needed. This information is not present in the baseline phase ABC charts but embedded in the client's (or your) personal history.

7.4.4. Temptations – What You'd Rather Be Doing

Temptations are anything or anyone that might lead you to engage in the undesired or problem behavior and not make the desired or target behavior. What forms do temptations take? First, they can be a *person* such as a friend, who instead of encouraging you to watch your calories, asks you to go on late night Taco Bell run with them a couple times a week. Though you can always refuse to get food, you feel awkward being the only one not eating and make a purchase too. A *thing* can be an item that reminds you to engage in the problem behavior such as seeing the candy bars in the pantry or on the kitchen counter. The presence of the object (i.e. the candy) tempts you to pick it up and eat it, violating your weight loss plan. *Situations* are the conditions during which a temptation is likely to occur while *places* are the physical locations where temptations most likely will be present. An example of a situation might be sitting around and watching your favorite reality television show. When you do, you tend to pull out the popcorn, chips, ice cream, etc. In terms of places, let's say you always eat fatty foods such as hot dogs, hamburgers, chips, candy, etc. and drink soda when you go to see your favorite football team play. You only do this when you are at the stadium and not when home watching the game. If you eat fatty foods while watching football in any location, then it is no longer a place but a situation.

Let's try another example – drinking soda – using all four types of temptations:

- *Person* – Your best friend always has soda with him throughout the day and offers you one. It does not matter where he is or what time of day it is.
- *Thing* – You want a soda because you see an ad on television or in a magazine you like. It might also be seeing the Freestyle machine at your local restaurant. Or maybe you see a totally random person drinking a Cherry Pepsi and now you want one.
- *Situation* – You drink soda when you go to the movies because you like to have it with your popcorn. You also drink soda at home when you watch a movie and eat popcorn. Soda drinking is linked to watching movies specifically.
- *Places* – You only drink soda when you go to your town's local movie theater. You love movie theater popcorn and need the soda to combat the saltiness of the popcorn, and the fact that you drown the poor popcorn pieces in the bucket in an ocean of butter (P.S. If you are concurrently running a weight loss behavior modification plan, STAY AWAY from the movie theater or at least the butter machine. Thank you. Now back to our regularly scheduled example). Or maybe you hate popcorn but love getting a soda at the movies because they have the Freestyle machine, and you love the seemingly endless options you have at a push of a button. No other establishment in your town has such a machine and so you purchasing a soda is linked to this one location/place.

7.4.4.1. What to do about temptations. Eventually you will give in to temptation if you need to exert self-control long enough. You only have so much and if you must constantly use it, you will run out. So even the "best" among us succumb to temptation at some point. The trick is to figure out ways to delay or manage this as much as possible. How so?

The simplest solution is to ask your friends not to tempt you. Let your friends know about your behavior modification plan and that you need their support. Make them stakeholders in your success so that they do not tempt you, or at least as much, and offer encouragement when you do a good job. But if you do give in, don't blame them completely. You ultimately have the right to say no. Also, self-instructions are a great way to keep your goal in mind…or to keep your eye on the prize. In the moments when you are tempted, use positive affirmations or other statements about making the desired behavior.

You should also take note of anything you said to yourself when you gave in to the temptation. If you said something like, "just this one time," then you might find yourself using the same logic on subsequent occasions when you are tempted. Realizing that you have done this in the past, and may do this again in the future, can help you to avoid the pitfall when it occurs.

Of course, the best advice that I can give is to not go to places where you know you will be tempted or enter into situations that you know always lead you to the problem behavior. It is sort of like obtaining a STD – you cannot get one if you practice abstinence. If you have to be in the situation, make it less tempting. If you are trying to lose weight and eating out late at night with friends is undermining your plan, then go out with friends but drink a protein drink before you leave so you are not hungry when you are there. Also, get water to keep your stomach mostly full.

7.5. Strategies to Bring about Motivated Change

Section Learning Objectives

- Outline all strategies used to establish a new behavior or reduce/eliminate a problem behavior focusing on antecedent, behavior, and consequence focused strategies.
- Clarify the use of self-instructions in behavior modification.
- Clarify the use of social support in behavior modification.
- Describe strategies used to modify habit behaviors.
- Describe strategies used to modify maladaptive cognitions.
- Describe and exemplify the use of the token economy in a treatment plan.

7.5.1. Overview

To start, recall that antecedents are the stimuli that lead to our behavior. We have seen this presented as S → R → C or A → B → C. The frameworks are the same. S and A are stimuli and antecedents and refer to environmental or internal causes of our behavior. R and B are the behavior(s) we are making and can include both the desirable behavior and any problem behavior(s). C is the consequence(s) of our behavior. When coming up with a treatment plan, you will likely use at least one strategy for each of the three components. Antecedents are especially important because if you have all the right triggers or cues in place, you are more likely to make the desired behavior and avoid making undesirable ones.

Table 7.1. Summary of Behavior Modification Strategies

Antecedent Focused	Behavior Focused	Consequence Focused
Goal Setting	Shaping	Token economy
Antecedent Manipulations: • Using Cues • Response Effort • Motivational Strategies – establishing and abolishing operations	Fear and Anxiety Procedures: • Relaxation Techniques • Desensitization (systematic and in-vivo) • Flooding • Modeling	Differential Reinforcement: • DRA • DRO • DRL • DRI
Discrimination and Generalization	Habit Reversal	Self-Praise
Prompting to include verbal, gestural, modeling, and physical Fading of prompts • Fading within a prompt • Fading across prompts • Prompt delay	Cognitive Behavior Modification: • Cognitive Restructuring • Cognitive Coping Skills Training • Acceptance Techniques	Punishment Procedures: • Time Out: exclusionary and non-exclusionary • Response Cost • Overcorrection: positive practice and restitution • Physical Restraint • Guided Compliance • Contingent Exercise
Programming		Social Support
Self-Instructions		General use of reinforcers and punishers
Social Support		

In the sections to follow, I will cover strategies not included in Module 6. Please review the strategies covered already.

7.5.2. Antecedent Focused Strategies

Look at Table 7.1 for the full list of antecedent focused strategies. Be advised that goal setting was covered earlier in this module. Antecedent manipulations, discrimination and generalization, and prompting and fading were covered in Module 6. Programming is not covered in this book, but if you want to learn more about it, see the behavior modification book referenced at the start of this module.

7.5.2.1. Self-instructions. In Module 6, I indicated that leaving cues for you to make the desired behavior is an effective antecedent manipulation. **Self-instructions**, or statements you write or say to yourself as positive affirmations and motivational tools, could be used too. These statements should remind yourself of what the desirable behavior is, why you are doing it, and what you hope to gain from it (your final goal). This may seem like a simple strategy and it is. It is low cost, low stakes, but very important. People use motivational statements all the time and even buy posters with such words printed on them and hang them up. This is no different and you can hang these self-instructions of what to do around your house, in your car, have them on your phone, etc. If you are developing a self-modification plan, write them yourself and if you are working with a client on a behavior modification/ intervention plan, have them develop the statements. Then hang them up. Use them to also replace self-defeating statements such as saying, “I am fat.” Instead, say, “I can lose the weight and be healthy.” When you need your statements, say them out loud. If you are having a moment of weakness in the grocery store (i.e. you forgot to go satiated), then use the statements to walk right by the junk food aisle.

7.5.2.2. Social support. Social support is a crucial strategy to implement in behavior modification. When executing a self-modification plan, we all will have moments of weakness and need reassurance from those closest to us. Or better yet, maybe we are doing really well and compliments and ‘likes’ on social media motivate us all the more. Social support has been shown to buffer against the negative effects of stress and when we make a public declaration of our goal, we are more likely to stick with it. Prompts require another person's involvement in our plan and so go hand-in-hand with social support. Cues and self-instructions do not.

Be careful with social support though. It may be that the desired behavior we wish to make is being thwarted by tempting situations and people. In this case, you would likely not want to engage in social support, especially with the person bringing temptation into your plan. Maybe you want to stop eating Taco Bell late at night but your roommate is always hungry late at night. This individual would likely not be a useful player in your behavior modification plan. *Be aware of the effect other people have on your behaviors.*

7.5.3. Behavior Focused Strategies

Now that we have covered procedures to use for controlling or manipulating the antecedent let's move to what can be done about the behavior. This is really a set of unique procedures particular to special situations such as creating a behavior that a person or animal would not normally know to do (called shaping and covered in Module 6), reducing fear and anxiety (covered in Module 5), stopping bad habits, and replacing or removing unproductive thoughts. We will cover habit behaviors and maladaptive cognitions in this section. Look at Table 7.1 for the full list of behavior focused strategies.

7.5.3.1. Habit behaviors. Dictionary.com defines a **habit** as "an acquired behavior pattern regularly followed until it has become almost involuntary" (http://www.dictionary.com/browse/habit). The habits do not harm anyone, other than possibly the person making them, but can be annoying for others if they increase in frequency, duration, and/or intensity. When this occurs, we are said to have a **habit disorder**. Habit behaviors take three main forms: nervous habits such as tapping one's foot or twirling hair, tics (whether verbal or motor), and stuttering.

So how do we go about ending or reducing habit behaviors? Treatment includes the use of a habit reversal procedure with two main steps or components: awareness training and a competing or incompatible response.

To start, the client must be aware of exactly what the habit is, when it occurs, in what situations, and with whom around. A clear behavioral definition must be stated and explained to the client so that he or she can identify when the behavior is about to start or is occurring. This stage or step is called **awareness training.**

Next, a **competing response** must be identified that is incompatible with the habit and makes its occurrence nearly impossible or difficult. If you are trying to stop nail-biting, you can use a clenched fist, sitting on one's hands, or holding a pencil as a competing response. You could even just groom your nails instead. If you have problems with motor tics, tense the affected body part and keep it still such as with head twitching. Tensing neck muscles and placing your chin against your chest will make head shaking or neck turning difficult to do. If you bite your lips, keep your lips and bottom teeth slightly separate. As a child, I stuttered and though today I do not daily, I find that there are certain trigger words that will elicit stuttering. Unfortunately, two of these trigger words are ones I at times use on a regular basis in classes – statistics and organizational (as in I/O psychology). Statistics is the main issue and to stop the stuttering before it starts, I will substitute statistics with stats, a one-syllable word and much easier to say or will pause in between saying the word such as 'Sta' and 'tistics." The pause is very brief and I do not make it noticeable. I then continue with my lecture as normal. This competing response allows me to say the word statistics in class and not endure any embarrassment from stuttering the word, which I have done in front of large lecture halls before. In terms of organizational, I usually just say I/O psychology and have the full word, with an acronym, on the slide being displayed. This way I can get away with the shorthand and if a student asks what it means, I just point to it on the slide.

The competing response should be made by the same body part involved in the nervous habit or tic and should be **practiced** in imagined situations. Imagine being in the situation that causes the habit, which you would have identified in your functional assessment, and rehearse making the competing response in your mind, called "mental practice." This increases the likelihood of making the competing response when the habit occurs and so leads to generalization.

Now move to **making the competing response in real life**. Social support is key and significant others can offer the encouragement needed to make the competing response, deliver reinforcers once you made it, but maybe more importantly, they can utilize prompts to do so. Keep your reasons for making the behavior change in mind and utilize self-instructions as reminders when your motivation is low. Provide your own reinforcers to encourage making the competing response, and if they are something you really enjoy or are looking forward to, they can serve as establishing operations.

Finally, review how things went with your **therapist**. Remember, he or she cannot be with you 24/7 and so you need to talk about both your successes and failures and how they made you feel. If you were not able to make the competing response did the habit cause you embarrassment as stuttering or a tic might do, or just lead to frustration as any of the three might? Figure out if there are other antecedent triggers for the habit that might have been missed by the functional assessment. Then you can always practice making the competing response in these situations before doing it in real life.

7.5.3.2. Procedures for maladaptive cognitions. The final set of procedures focus specifically on what we think or feel, as part of the definition of behavior. The word **cognition** is used, which is the same as saying a thought. We will discuss several strategies that can be used to change these unwanted, maladaptive cognitions, whether they are present as an *excess* such as with paranoia, suicidal ideation, or feelings of worthlessness; or as a *deficit* such as with self-confidence and self-efficacy.

According to the National Alliance on Mental Illness (NAMI), **cognitive behavioral therapy** "focuses on exploring relationships among a person's thoughts, feelings and behaviors. During CBT a therapist will actively work with a person to uncover unhealthy patterns of thought and how they may be causing self-destructive behaviors and beliefs." CBT attempts to identifying negative or false beliefs and restructure them. They add, "Oftentimes someone being treated with CBT will have homework in between sessions where they practice replacing negative thoughts with more realistic thoughts based on prior experiences or record their negative thoughts in a journal." For more on CBT, visit: https://www.nami.org/Learn-More/Treatment/Psychotherapy. Some commonly used strategies include cognitive restructuring, cognitive coping skills training, and acceptance techniques.

A second major strategy is to use what is called **cognitive coping skills training**. This strategy teaches social skills, communication, and assertiveness through direct instruction, role-playing, and modeling. For social skills, identify appropriate social behavior such as making eye contact, saying no to a request, or starting up a conversation with a stranger and whether the client is inhibited from making this behavior due to anxiety. For communication, determine if the problem is with speaking, listening, or both and then develop a plan for use in various interpersonal situations. Finally, assertiveness training aids the client to protect their rights and obtain what they want from others. Those who are not assertive are often overly passive and never get what they want or are overly aggressive and only get what they want. Treatment starts with determining situations in which assertiveness is lacking and coming up with a hierarchy of assertiveness opportunities. Least difficult situations are handled first, followed by more difficult situations, all while rehearsing and mastering all the situations present in the hierarchy. For more on these techniques, visit http://cogbtherapy.com/cognitive-behavioral-therapy-exercises/.

Finally, **acceptance techniques** can be used to reduce a client's worry and anxiety. Life involves a degree of uncertainty and at times we need to just accept this. Techniques might include weighing the pros of fighting uncertainty against the cons of doing so. The cons should outweigh the pros and help you to end the struggle and accept what is unknown. Chances are you are already accepting the unknown in some areas of life and identifying these can help you to see why it is helpful in these areas, and how you can also think like this in more difficult areas. Finally, does uncertainty unnecessarily lead to a negative end? We may think so, but a review of the evidence for and against this statement will show that it does not and reduce how threatening it seems.

7.5.4. Consequence Focused Strategies

Look at Table 7.1 for the full list of consequence focused strategies. Be advised that the punishment procedures and differential reinforcement were covered in Module 6. In this section, we will discuss the token economy. Self-praise is a form of self-reinforcement or delivering PRs. Social support has already been covered and the general use of reinforcers and punishers involves the discussion of PR, NR, PP, and NP from Module 6.

7.5.4.1. Token economy. A **token economy** is a fun system that allows the person to earn up tokens and then cash them in for some type of reinforcer — whether a consumable, activity, privilege, or tangible. The **tokens** are accrued (and accumulated over time) once the target behavior occurs, as described clearly in the behavioral definition, and by themselves have no meaning. That said, it is fine to praise the person as they receive their tokens (a second PR, the first being the receipt of the tokens). Be clear on how many tokens are earned for engaging in the desired behavior(s).

Tokens gain meaning when they are associated with **backup reinforcers** or the regular reinforcers the person has in their life. This association occurs because the individual learns that he or she can take some number of tokens and cash them in for some amount of reinforcer. When we go to the store to purchase milk, we read the label and see that the gallon costs $3.29. We pick it up, go to the cashier, and when prompted, hand the cashier our money to complete the purchase. The token economy operates in the same exact fashion. How many tokens are needed to purchase a backup reinforcer is called the **exchange rate**. What can serve as a *token*? Bingo chips, stars on a chart, points, check marks, or poker chips can all be used, and it must be clear how many tokens are earned for engaging in a certain level of the behavior.

The token economy can be used at home by parents trying to get a child to complete chores, take a bath before playing video games, eat breakfast, behave well with siblings, or leave with enough time to get the bus or arrive at school before the bell rings. In the classroom, a teacher can use a token economy to encourage students to study hard, stay in their seat during quiet time, put away class materials, talk with an inside voice, behave on the playground, throw away their trash at lunchtime, or to walk and not run through the halls. At work, an employer may wish to reward employees for working safely, going above and beyond by serving on committees, being on time, exceeding performance standards, or positively approaching all aspects of their job. In a recovery center, nursing home, or prison setting, tokens may be awarded when patients take their medications or are compliant with the direction of staff members.

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Note to Student: Be advised that before implementing our plan, we need to also need to identify mistakes. Mistakes are just what they sound like — errors we make in designing or implementing our plan.

We also need to establish rules. **Rules** are statements that add order, predictability, and reliability to our plan and can take the *If-Then* format. At the same time, we will develop a **behavioral contract** or a written agreement between two people in which at least one of the two has agreed to engage in a specific level of the target behavior.

Covering these topics is beyond the point of this module. See the *Principles of Behavior Analysis and Modification* (Daffin, 2021) textbook for more information on these topics. The full text can be accessed by clicking here.

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7.6. Implementing the Plan

Section Learning Objectives

- Define the treatment phase.

Now that you have a behavior modification plan to change your target behavior for the good, it is time to implement the plan and see how it works. The **treatment phase** is when you employ all antecedent, behavior, and consequence-focused strategies. In the grand scheme of scientific research and specifically experiments, the treatment phase, but more so the strategies, are your IV or *independent variable*. Remember, this is the one that is manipulated. You have chosen certain strategies and decided to use them in a specific way which is the essence of manipulation. No matter what, manipulation is at work but so is measurement. Behavior is measured via your goals and behavior counts and is the *dependent variable* or DV.

7.7. Evaluating the Plan's Success

Section Learning Objectives

- Clarify what to do if you have to change your target behavior.

As you are going through your plan it is a good idea to see how you are doing. Fortunately, you are collecting a great deal of data and so have all you need to make a determination.

If you need to adjust your plan, you need to figure out what is making your plan difficult to achieve. Likely, you will have at least one issue with your antecedents, behavior, and/or consequences. Look closely at the data you gathered and your notes in the journal which you keep with the ABC chart during the treatment phase. It might be that you set unrealistic goals, had a faulty criterion for when to move from one goal to the next, had issues with how to record your data, your strategies may not have worked, there were temptations in your environment you were not aware of, or your social support really was not supportive. Of course, there can be countless other issues that you may encounter.

Once you have figured out needed changes to your plan, implement them. Continue the process of evaluation and adjustment until your plan works or you just cannot seem to reduce the unwanted behavior or increase a desirable one.

Assuming your plan works, and the behavior has changed in the hypothesized manner, you will proceed to the maintenance phase.

7.8. Maintenance Phase and Relapse Prevention

Section Learning Objectives

- Describe the function of the maintenance phase.
- Differentiate a lapse and a relapse.

7.8.1. Maintenance Phase

When planning to change our behavior we cannot lose sight of the fact that eventually, we will obtain our final goal. At this point, the target behavior is now occurring habitually or without conscious effort, or due to the use of the many strategies we selected. Once this occurs, we need to transition from the treatment phase to the maintenance phase. The strategies used during the treatment phase cannot remain in effect for the duration of our life, so we must phase them out…well, most of them. Some strategies you will want to keep in place. Outside of noting that, a more exhaustive discussion is beyond the scope of this book.

As with all things in life, we hit bumps in the road. We hit them when planning our behavior modification plan, likely hit a few as we employed the treatment, and even in the maintenance phase, we may hit some. In fact, there are two types of issues we may encounter during the maintenance phase:

- **Maintenance Problem** — Though we have gone to great lengths to ensure our target behavior stays at our desired level, based on the final goal, at times we falter. This is not necessarily due to a return to a problem or undesirable behavior, but maybe just a loss of motivation for walking your dog every night, reading at bedtime, going to the gym, drinking water, studying more regularly, etc.

- **Transfer Problem** — Recall that we want to generalize our new behavior beyond just training situations/environments. If we establish good study habits when in our dorm, we want to do the same when studying in the student union or in the library. If we go to the gym regularly while at school, we want to do so at home on break. Or maybe you are studying well in all places, but this positive behavior only occurs for classes in your major. In all other classes, your poor study habits have not changed. So, you are performing as well as you want to in some instances, but not in all instances. The desirable behavior has not transferred or generalized as expected.

7.8.2. Relapse Prevention

Before understanding how to prevent relapse, we have to distinguish the terms lapse and relapse. Simply, a **lapse** is when we make a mistake or slip up. Consider the expression, "Having a lapse in judgment." This implies that we generally make sound decisions but in this one instance we did not. We made a mistake. What we do not want is an isolated incident becoming a pattern of behavior. When this occurs, we have a **relapse**. Do not beat yourself up if a lapse occurs. Our problem behavior will inevitably return at some point. We just do not want it sticking around for the long term.

There are people and things that tempt us and situations or places that lead us to temptation more than others. To avoid a lapse turning into a relapse, take special note of high-risk situations and environments, and the people who are present when we cave into temptation. Keeping good records of the ABCs of behavior, and your journal, will help you to identify these situations and people. Then you can develop new plans to deal with them or to re-establish old ones.

For more information on relapse and how to prevent it, see Module 14 of the behavior modification textbook.

Module Recap

In Module 7, we discussed a willingness to change from the perspective of DiClimente's process of change. We also discussed self-efficacy and how believing in ourselves will make success more likely. Of course, success is never guaranteed and everyone makes mistakes or gives in to temptation. These lost battles do not mean the war is lost though.

We then discussed the need to precisely define our target and competing behaviors. Once a precise definition is in place, we can formulate goals for how much we wish for the behavior to increase or decrease. We can also set short term or proximal goals to help us achieve the much larger or distal goal. Think about writing a 10-page paper. It is easier to say I am going to write the first section today, the next tomorrow, and then the final section the day after. Then I will revise and edit and print the paper to be submitted. These subgoals make the much larger task more manageable and easier to achieve. As this works with writing a paper, so too it can work with changing behavior.

Next, we discussed ways to collect data about the behavior, what causes it, and what maintains it. The baseline phase is when we record occurrences of the behavior before any manipulation/strategies are employed. From this we conduct a functional assessment and discussed what information we can gain from it. We also had a discussion of temptations and what to do about them.

We discussed the strategies used to change an unwanted behavior or to establish a new behavior. These focused on the antecedent and included goal setting, antecedent manipulations, discrimination and generalization, prompting and fading, self-instructions, and social support. Then we discussed the behavior focused strategies of shaping, fear and anxiety procedures, habit reversal, and cognitive behavior modification. We finished up by discussing consequence focused strategies focusing on the use of reinforcement and punishment. Some of these strategies were covered in this module and others in Module 6.

As we winded down Module 7, we discussed the important issue of evaluating the plan and making adjustments as needed. Finally, we discussed the final stage of our behavior modification plan — maintenance. Knowing when to move to this stage is half the battle and the other half is knowing what to do when we have maintenance or transfer issues. Our bad behavior will rear its ugly head and this is to be expected, but what we need to do is prevent it from becoming the norm and not the exception. This is where relapse prevention comes in. Effective stress management can go a long way to helping us to avoid tempting people, things, situations, and environments, and to allow rational processes to govern our behavior.

So that's it. Module 7 showed the applied side of learning theory as it relates to operant conditioning. Our discussion did cover a few strategies related to respondent conditioning (covered earlier in the book) and observational learning (covered in Module 8).

This concludes Part III and our discussion of the form of associative learning called operant conditioning.

Part IV. Observational Learning

Part IV. Observational Learning

Module 8:

Observational Learning

Module 8: Observational Learning

Module Overview

In Module 8, and the only one of Part IV, we will tackle the final learning model – observational learning. Outside of describing it and determining factors on making imitation stronger, we will also see how it links to operant conditioning and can be used in behavior modification.

Module Outline

8.1. What is Observational Learning?

8.2. Bandura's Classic Experiment

8.3. Do We Imitate Everything We See?

8.4. Observational Learning and Behavior Modification

Module Learning Outcomes

- Clarify how we learn by observing others.
- Describe Bandura's Bobo doll experiment.
- Clarify why we do not model everything we see.
- Describe how observational learning could be applied to behavior modification.

8.1. What is Observational Learning?

Section Learning Objectives

- Differentiate observational and enactive learning.
- Describe Bandura's social learning theory.
- Define vicarious reinforcement and punishment.
- Define imitation.

8.1.1. Defining Observational Learning

There are times when we learn by simply watching others. This is called **observational learning,** and is contrasted with **enactive learning**, which is learning by doing. There is no firsthand experience by the learner in observational learning, unlike enactive.

As you can learn desirable behaviors such as watching how your father bags groceries at the grocery store (I did this and still bag the same way today), you can learn undesirable ones too. If your parents resort to alcohol consumption to deal with the stressors life presents, then you too might do the same. What is critical is what happens to the model in all of these cases. If my father seems genuinely happy and pleased with himself after bagging groceries his way, then I will be more likely to adopt this behavior. If my mother or father consumes alcohol to feel better when things are tough, and it works, then I might do the same. On the other hand, if we see a sibling constantly getting in trouble with the law then we may not model this behavior due to the negative consequences.

8.1.2. Social Learning Theory

Observational learning can, in fact, be referred to as *social learning,* and Bandura (1986) proposed a **social learning theory,** which is composed of observational learning and operant conditioning. How so? Consider that you may learn not to rob the local convenience store because you saw your brother get arrested, prosecuted, and is now spending 10 years in prison. You observed his actions and the consequences of those actions. Remember, there is no firsthand experience. This is called **vicarious punishment**. If we see a coworker praised by our supervisor for a job well done (and likely going way above and beyond), we will want to behave this way in the future so that we can receive the praise, plaque, extra time off, or monetary award. According to Bandura, this is called **vicarious reinforcement** and notice that there are both positive and negative reinforcers in the list.

The gist of social learning theory is this: we learn by observing how other people behave and seeing the consequences of their behavior. Later we visualize the consequences (we remember what we saw before) of a particular behavior we would like to make, and decide whether or not to behave in that way. Most likely, if the consequence of the similar behavior was positive then we will make the behavior, but if negative then we will not, in keeping with the principles of operant conditioning.

8.1.3. Imitation

When we use the word **imitation,** we are implying that we behave in a way that resembles or duplicates the behavior of another person, and that our behavior is novel or not the way we usually act. For instance, in the Avenger's: Infinity War (2018), Star-Lord imitates

Thor's Asgardian accent and mannerisms out of jealousy. He is jealous for how well-received Thor is when he is first retrieved from outer space, and how much manlier Thor is. In fact, Rocket even asks Star-Lord, "Are you making your voice deeper?" to which he replies, "No" (in Thor-voice). Mantis then points out that he "just did it again." Star-Lord replies, "This is my voice." The interaction is comical, but an excellent example of true imitation. Star-Lord does not actually talk like an Asgardian, and so the behavior is novel. In fact, Drax even says that he is "imitating the godman."

Sometimes we imitate not only a behavior that is reinforced, but any behavior. This tendency is called **generalized imitation** and is based on the work of Baer and Sherman (1964). In their study, a puppet was used to provide reinforcement in the form of approving comments when children imitated three behaviors that it made — mouthing, head nodding, and speaking nonsense. The puppet did not reinforce level-pressing, a fourth behavior. The more the children imitated the behaviors that were reinforced, the more they imitated the behavior that was not reinforced too. Eventually, the researchers discontinued reinforcing the three behaviors, and the children stopped making them. But the children also stopped pressing the lever. Once reinforcement was re-established for mouthing, head nodding, and speaking nonsense, their frequency increased in the children, as well as the frequency of pressing the lever. The authors concluded that the children had developed a generalized tendency to imitate the model.

8.2. Bandura's Classic Experiment

Section Learning Objectives

- Describe Bandura's classic experiment.

Albert Bandura (1965) conducted the pivotal research on observational learning, and you likely already know all about it. In Bandura's experiment, 66 children (33 boys, 33 girls) aged 42 to 71 months, were randomly assigned to one of three conditions, each with 11 boys and 11 girls. The experiment started with an exposure procedure. Children were brought individually into a room and watched a film of about 5 minutes. It began with a model (an adult male) walking up to an adult-sized plastic Bobo doll and ordered it to clear the way. After glaring for a bit at the non-compliant doll, the model made one of four novel aggressive responses followed by a distinct verbalization.

First, the model laid the Bobo doll on its side, sat on it, and punched it in the nose. While doing this he said, "Pow, right in the nose, boom, boom." The model then stood it up and pommeled it on the head with a mallet. This response was accompanied by, "Sockeroo…stay down." The model then kicked the doll around the room and said, "Fly away." Finally, rubber balls were thrown at the Bobo doll and "Bang" was uttered with each hit. The sequence included both physical and verbal aggression and was repeated twice.

Remember that children were assigned to one of three conditions. In the model-rewarded condition, a second adult male appeared with candies and soft drinks. He told the model that he was a "strong champion" and that his aggressive behavior deserved a generous treat. He poured the model a glass of 7-Up and gave him chocolate bars, Cracker Jack popcorn, and candy. The model ate the treats while being showered with additional positive social reinforcement.

In the model-punished condition, the second adult male appeared on the scene “shaking his finger menacingly and commenting reprovingly, “Hey there, you big bully. You quit picking on that clown. I won’t tolerate it.” The model moved back, tripped and fell, and the other adult sat on him and spanked him with a rolled-up magazine while reminding him that his aggressive behavior was wrong. The model ran off and the other man yelled, “If I catch you doing that again, you big bully, I’ll give you a hard spanking. You quit acting that way” (pg. 591).

Finally, children in the no-consequences condition just viewed the film the children in the other two groups did. There was no reinforcement ending though.

Once the exposure session ended, children were taken to an experimental room which had in it a “Bobo doll, three balls, a mallet and pegboard, dart guns, cars, plastic farm animals, and a dollhouse equipped with furniture and a doll family” (pg. 591). The variety of objects allowed the children to make imitative or nonimitative behaviors. The experimenter told the children they could play with the toys freely and left the room to obtain additional toys. Children were left in the room for 10 minutes, though the experimenter returned about halfway through to tell the children she was still looking for the toys. Two observers recorded the children’s behavior every 5 seconds using predetermined imitative response categories.

The experimenter than returned to the room with an assortment of fruit juices in a colorful juice-dispensing fountain. She also had booklets of sticker-pictures. After a brief juice treat, the children were told that for each imitative response they reproduced, they would receive a pretty sticker-picture to place on a pastoral scene on the wall and the experimenter wanted to see how many stickers they might be able to get. They were also offered additional juice treats. The children were asked to demonstrate what Rocky did in the TV program and to say what he said. Rewards were delivered immediately for correct, matching responses.

Results showed that children who witnessed a model behave aggressively to the Bobo doll tended to do so themselves. The consequences of that action were important too. When the children saw the model get punished for his aggressive behavior, they were less likely to make the same response. If the model was reinforced, they were more likely to engage in aggressive behavior of their own. When children were offered incentives to act in an aggressive manner, they did so.

The authors note though, "Exposing a person to a complex sequence of stimulation is no guarantee that he will attend to the entire range of cues, that he will necessarily select from a total stimulus complex only the most relevant stimuli, or that he will even perceive accurately the cues to which is attention is directed. Motivational variables, prior training in discriminative observation, and the anticipation of positive or negative reinforcements contingent on the emission of matching responses may be highly influential in channeling, augmenting, or reducing observing responses, which is a necessary precondition for imitative learning" (pg. 593; see also Bandura & Walters, 1963 and Bandura, 1962). Let's further examine factors affecting observational learning.

8.3. Do We Imitate Everything We See?

Section Learning Objectives

- Outline factors on observational learning.
- Define stimulus enhancement.
- Define and describe amnesia.

So, do we model everything we see? The answer is no. Why is that? First, we cannot pay attention to everything going on around us. We are more likely to model behaviors by someone who commands our attention. Consider the phenomena of **stimulus enhancement** which says that we will focus our attention on a stimulus if others are paying attention to it. I was walking through Walmart one day in May 2019 and suddenly I noticed that there was a large group of people standing around the jewelry counter and other people were looking that way and walking over to it. I stopped and started to move in that direction, like my fellow shoppers, to see what was going on. My behavior was changed because of the behavior of others. I soon realized Walmart was just giving out "free" jewelry and so I returned to my business of going to the register to check out. Likewise, have you ever noticed a large group of people looking up at the sky? If you altered your behavior to look up to (as what happens in many disaster movies), then you encountered stimulus enhancement.

In terms of the model him or herself, any guess as to whether an attractive or unattractive model will catch our attention? If you said attractive, you are correct (Baker & Churchill, 1977).

We also pay attention to models when trying to gain a new skill. If we want to learn the skill and determine what we need to do to obtain positive results, we can use a *skilled* model. The advantage of using an *unskilled* model, sometimes called a *learning model*, is that he/she will make mistakes maybe as often as they have success, and we can learn from both mistakes and success. If we are learning how to hit a baseball, we could watch a Major League Baseball player take batting practice. Of course, very few balls will be missed and the sound of the crack of the bat will be reinforcing for the model and observer. Alternatively, we might have our father take us out to practice hitting at the batting cage. Unless he is an MLB player, he will likely hit some and miss many more. We can observe which stance works best for him, how high he holds the bat, the timing of when he swings, etc. He will hit the ball sometimes and not on other occasions. In a way, we learn more from success than failure, and you might say that his pattern of success will be more like ours than compared to the MLB player.

Second, we must remember what a model does in order to imitate it. If a behavior is not memorable, it will not be imitated. But what if we have a medical condition that makes remembering information difficult, such as anterograde amnesia? According to the Mayo Clinic's website, when we experience difficulty learning new information since the onset of **amnesia**, or the loss of memories, such as facts, information, and experiences; we are experiencing a specific form called **anterograde amnesia** (not to be confused with **retrograde amnesia** or when we cannot remember past events and previous familiar information).

We must try to convert what we see into action. Consider the phenomena of **deferred imitation**, or when we observe a model but do not show such learning until a later time. A child observes her mother set the dinner table one night but does not go into the kitchen to try and set the table until days later. When she does go in to try, the parent thanks the child for trying to set the table but tells her that she does not know how. The child says, 'Yes I do,' and proceeds to do just that — set the table. The parent is impressed, and the child has shown that she learned by observing the parent either a few nights before or possibly over a few days.

Hopefully, the parent praises the child so that she will be motivated to set the table again in the future. If we are not motivated to perform an observed behavior, we probably will not show what we have learned and may not acquire the behavior at all or will not remember to do it later.

8.4. Observational Learning and Behavior Modification

Section Learning Objectives

- Clarify how observational learning can be used in behavior modification.

Bandura said if all behaviors are learned by observing others and we model our behavior on their behavior, then undesirable behaviors can be altered or relearned in the same way. **Modeling** techniques are used to change behavior by having subjects observe a model in a situation that usually causes them some anxiety. By seeing the model interact nicely with the fear evoking stimulus, their fear should subside. This form of behavior therapy is widely used in clinical, business, and classroom situations. In the classroom, we might use modeling to demonstrate how to do a math problem for a student. Then through a prompt delay, we encourage the student to try the problem for him/herself. If the student can solve the problem, no further action is needed, but if the student struggles we can use any of the four types of prompts — verbal, gestural, modeling, or physical to help them solve it. In fact, in many college classrooms this is exactly what the instructor does.

In the business setting, a model or trainer demonstrates how to use a computer program or run a register for a new employee. Like in the example above, prompt delays and prompts can be used to test the level of learning the employee has gained. Through social support, reinforcers can be delivered.

See Module 6 and 7 for a discussion of behavior modification as it relates to operant conditioning. Keep in mind what you learned about observational learning and how it intersects with operant conditioning through social learning theory. Examples in the clinical setting are given in Module 6 as they relate to learning and unlearning fears.

Module Recap

In Module 8 we discussed the last of the three major learning models called observational learning. We discussed what observational learning was and how it differed from enactive learning, outlined how it intersects with operant conditioning through social learning theory, described imitation, outlined Bandura's classic experiment, explored factors on how likely we are to model/imitate another person, and briefly discussed the application of observational learning to behavior modification.

Part IV consisted of this one module and now with it complete, we can Take a Pause and explore how the three models of how we learn are complementary with one another, and not in competition.

Part V. Take a Pause

Part V. Take A Pause

Module 9:

Complementary, Not Competing

Module 9: Complementary, Not Competing

Module Overview

With Modules 1-8 complete, and before we move into complementary cognitive processes and the limits of learning, we will see how the various learning models are complementary, and not competing, theories of learning. For almost any behavior, all three are involved in some way, whether in acquisition, maintenance, or the extinguishing/limiting of the behavior.

Module Outline

9.1. Complementary, Not Competing Exercise

Module Learning Outcomes

- Apply and practice what you have learned about the three learning models.

9.1. Complementary, Not Competing Exercise

Complete the exercise which brings together the three learning models of respondent conditioning, operant conditioning, and observational learning. Use all that you have learned so far in this course. This exercise will round out the first part of the course. In the second, we look at complementary cognitive processes to learning.

Complementary, Not Competing Exercise

(Exercise 4 at Washington State University)

Directions: For this exercise, you will demonstrate your understanding of respondent conditioning, operant conditioning, and observational learning by showing how, regarding a specific learned behavior, they are complementary and not competing. How might the various models explain acquisition of the behavior, maintenance of it over time, and how might you reduce or extinguish the behavior? Be advised that you do not have to address all three models for each of these phases. Only address the one(s) you feel are appropriate but be creative. Everything you have learned is fair game. Go through Modules 4, 6, and 8 for information on how these learning models work, and then Modules 5 and 7 for applications that may be relevant. You will then write a paper on how you see the models working together.

Make sure you address ACQUISITION, MAINTENANCE, and REDUCING/ EXTINGUISHING the behavior. These should be your section headings.

Behaviors you may discuss for this assignment:

- Drug/Alcohol/Nicotine Addiction – pick one of the three
- Phobias – You can talk about them in general or pick one
- Hate/Racism/Prejudice/Discrimination – This is a package of sorts
- Tantrums/disruptive behavior in children
- Other Behavior – If you have another behavior you would like to explore, you MUST email your instructor for prior approval. This way if it will not work for some reason, the instructor can let you know. If you do not get prior approval and your behavior does not work, you could receive a 0 for the assignment. Just get approval first.

This is meant to be a fun assignment. Creativity is required so please take your time with it.

Expected Learning Outcomes: This assignment will test how well you *know* and *comprehend* the concepts learned so far, can *apply* them to a specific behavior, can *analyze* another student's response and provide meaningful feedback, can *evaluate* their critique of your work and defend or adapt your response accordingly, and finally how you can *synthesize* those comments to form a rewritten response.

Format: This will be a paper of approximately 2-3 pages. It should be written in MS Word but if you do not have the program, write it up in your word processing program and convert it to PDF format to submit to your instructor. Use APA format.

Assignment Sequenced Steps:

1. Complete this exercise by **Wednesday**. You will NOT submit it to your instructor yet.
2. Next, post your answer as a reply to the Discussion Question (DQ) prompt in the Class Discussions area of our course so that others can see how you approached it. The DQ reply is due on **Wednesday**. Posting your answer to the exercise (Exercise 4 in the WSU version of this class) is worth **5 points**. You receive the points for simply posting but if you submit after Wednesday, you will receive NO points. Your instructor will NOT be grading the exercise at this point.
3. Critique ONE other student's post for your participation requirement. The critique is worth **15 points** and is due on **Thursday**. You are expected to analyze all aspects of their response from acquisition, to maintenance, to reducing/extinguishing the behavior. Be advised you will be assigned a peer partner for this step and partners will be posted before the Wednesday due date. Post your critique as a reply to the student in the Class Discussions area.
4. Reply to your peer partner in the Class Discussions area acknowledging what you have learned from their critique of your response by **Friday**. Seriously consider what they have suggested or potentially see wrong in your response. Though they may have good ideas, they could be incorrect. If that is true, reply back and let them know where you think they went wrong in the interpretation of the content in the course. In gray areas, your instructor can clarify misconceptions. Your reply to the peer partner is worth **5 points**.
5. After you have done this, update your answer to the exercise to reflect what you learned from your peer partner in the discussion. Any revisions you make due to peer partner feedback should be identified as such. You could simply say, Peer Partner Feedback Revision: XXX (Start the text). Do call out the feedback in case it is wrong, and you were initially correct. If you note the feedback but that it might be flawed, that would demonstrate your understanding of the topics in this course and contribute positively to your grade on the exercise. If their feedback was correct and you show what you initially thought was wrong, this too can lead to a higher grade.
6. Then submit your FINAL exercise response to me by **Sunday** in the appropriate Assignment drop box (not in the Class Discussions area). Your final version of this exercise is worth **50 points** and IS graded by the Instructor. Be sure to proofread it first.

Check the Course Schedule for Exact Dates

Please Note: It is imperative for this one week in the course that you are active in the class for the duration of the week. Well, at least from Wednesday to Friday. If you and your partner move through this process quicker, that is fine.

If for any reason you are not responsive, the instructor may need to reassign peer partners for active students in the class (based on who submitted on Wednesday). At that point, you will receive a 0 for the critique portion of this assignment, completed in the Class Discussions area. In other words, you will lose 15 points and may lose the 5 points for your reply back if you have no peer partner after the reassignment. You can still submit the exercise on Sunday.

Grading Summary

Do This	By This Day	Earn This Many Points
Post the completed exercise in Class Discussions	Wednesday	5
Critique your peer partner's response in Class Discussions	Thursday	15
Reply to your peer partner's critique of your response in Class Discussions	Friday	5
Submit your final version of the exercise (including peer partner comments) in Assignments	Sunday	50
	TOTAL POINTS	**75**

FINAL Exercise Version Rubric (Submitted to the Instructor)

Criterion	Points Possible	Points Earned
Was ACQUISTION adequately and correctly addressed?	15	
Was MAINTENANCE adequately and correctly addressed?	15	
Was how the behavior will be REDUCED or ELIMINATED adequately and correctly addressed?	15	
Was the paper in correct APA format?	5	
Was the paper submitted late? Deduct 10% or 5 points for each day late, up to three days. After this, the assignment is given a 0 unless there is an arrangement with the Instructor to submit late (or accommodation).		
TOTAL POINTS	50	

Note that the Discussion portion of this assignment is worth 25 points as with all other weeks in the class. The breakdown is different but still adds to 25, and you are only replying to ONE other student. The DQ submission is worth 5 points, the critique 15 points, and the reply 5 points for a total of 25 points.

Part VI. Complimentary Cognitive Processes

Module 10:

Complimentary Cognitive Processes - Sensation (and Perception)

Module 10: Complimentary Cognitive Processes - Sensation (and Perception)

Module Overview

Module 10 is the first of four modules which will cover cognitive processes that work in conjunction with, or are complementary to, learning. Our first topic will be sensation, and we will begin this discussion by covering the communication model of the nervous system, of which sensation is maybe the most important piece. We will also cover the neural impulse, perception and the brain, and sending commands out from the brain to the body via the peripheral nervous system. Do not worry. We will cover these topics at a very basic or introductory level.

Module Outline

Module Learning Outcomes

- Outline how communication occurs in the nervous system.
- Describe how the five sensory systems affect learning.
- Understand how the neural impulse occurs.
- Explain how brain structures and the process of perceptions aids us in learning associations in our environment.
- Clarify the importance of sending commands out to the body for learning.

10.1. Understanding Communication in the Nervous System

Section Learning Objectives

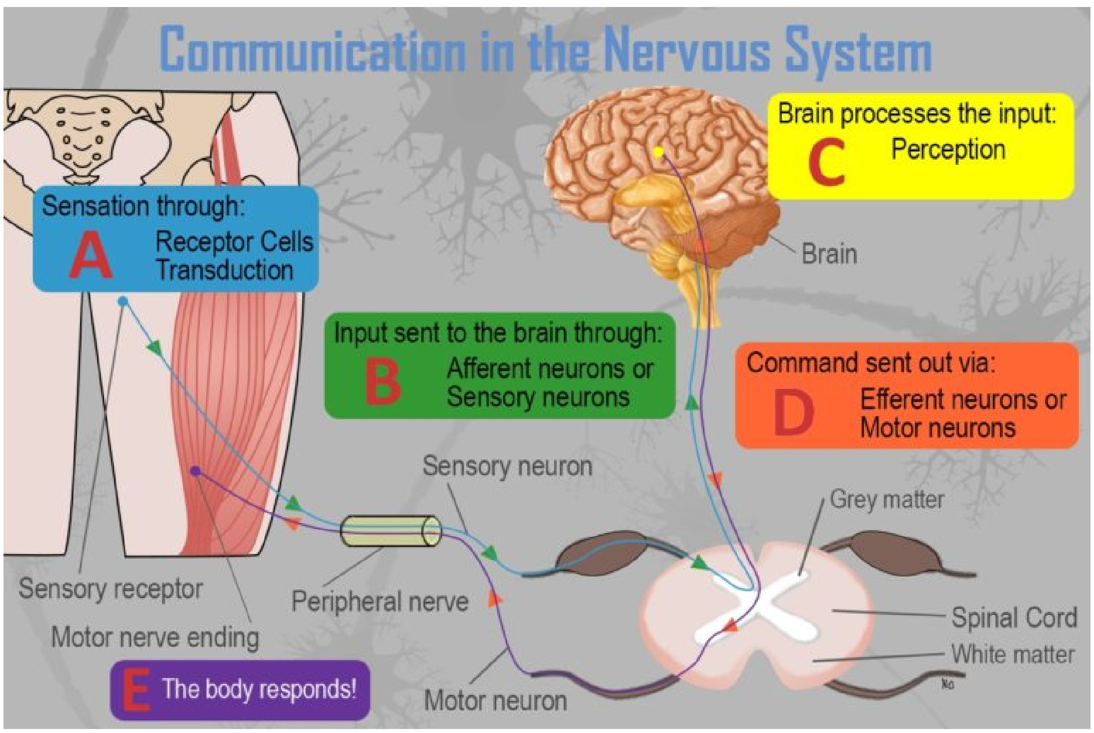
- Revisit the definition of learning.
- Outline how communication in the nervous system occurs.
- Identify the parts of the nervous system.
- Describe the structure of the neuron and all key parts.

To begin our discussion of complimentary cognitive processes to learning, we will take a step back and discuss communication in the nervous system. Why is that? When we use the term *learning* or any relatively permanent change in behavior due to experience and practice, we must first detect something in our environment to learn about or from it. This is where sensation, the neural impulse, and perception and the brain come in. How so?

10.1.1. Communication in the Nervous System

Figure 10.1 gives us an indication of how the universal process of communication in the nervous system works regardless of race, gender, ethnicity, sexual orientation, religion, SES, or any other variable a person could be categorized into. Of course, there can be differences in how well our senses operate, our nervous system carries messages to and from the brain, and/or in how the brain processes the information. But that discussion is for another class.

Figure 10.1. Communication in the Nervous System



A. Receptor cells in each of the five sensory systems detect energy. The detection of physical energy emitted or reflected by physical objects is called **sensation**. The five sensory systems include vision, hearing, smell, taste, and touch. We will discuss each briefly in Section 10.2.

B. This information is passed to the nervous system via the neural impulse and due to the process of **transduction** or converting physical energy into electrochemical codes. *Sensory* or *afferent* neurons, which are part of the peripheral nervous system, do the work of carrying information to the brain. We will explore this process in Section 10.3.

C. The information is received by brain structures (central nervous system) and perception occurs. What the brain receives is a lot of raw sensory data and this has to be interpreted, or have meaning added to it, which is where **perception** comes in. We will discuss the brain and perception in Section 10.4.

D. Once the information has been interpreted, commands are sent out, telling the body how to respond (Step E), also via the peripheral nervous system and the action of *motor* or *efferent* neurons. We will discuss this in Section 10.5.

Just so that we are on the same sheet of music, let us more thoroughly describe the parts of the nervous system, especially since two were mentioned above (central and peripheral).

10.1.2. The Parts of the Nervous System

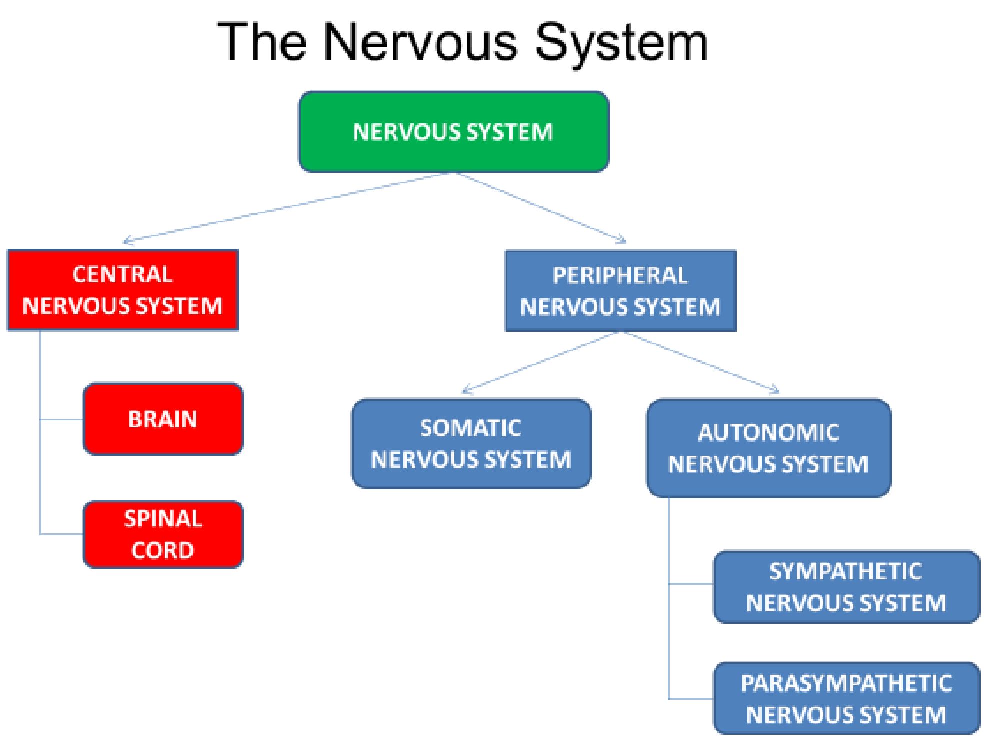
The nervous system consists of two main parts — the central and peripheral nervous systems. The *central nervous system (CNS)* is the control center for the nervous system which receives, processes, interprets, and stores incoming sensory information. It consists of the brain and spinal cord. The *peripheral nervous system* consists of everything outside the brain and spinal cord. It handles the CNS's input and output and divides into the somatic and autonomic nervous systems.

The *somatic nervous system* allows for voluntary movement by controlling the skeletal muscles and carries sensory information to the CNS. The *autonomic nervous system* regulates the functioning of blood vessels, glands, and internal organs such as the bladder, stomach, and heart. It consists of sympathetic and parasympathetic nervous systems.

The *sympathetic nervous system* is involved when a person is intensely aroused. It provides the strength to fight back or to flee (fight-or-flight instinct). Eventually, the response brought about by the sympathetic nervous system must end. The *parasympathetic nervous system* calms the body.

For a visual breakdown of the nervous system, please see Figure 10.2 below.

Figure 10.2. The Structure of the Nervous System



10.1.3. The Neuron

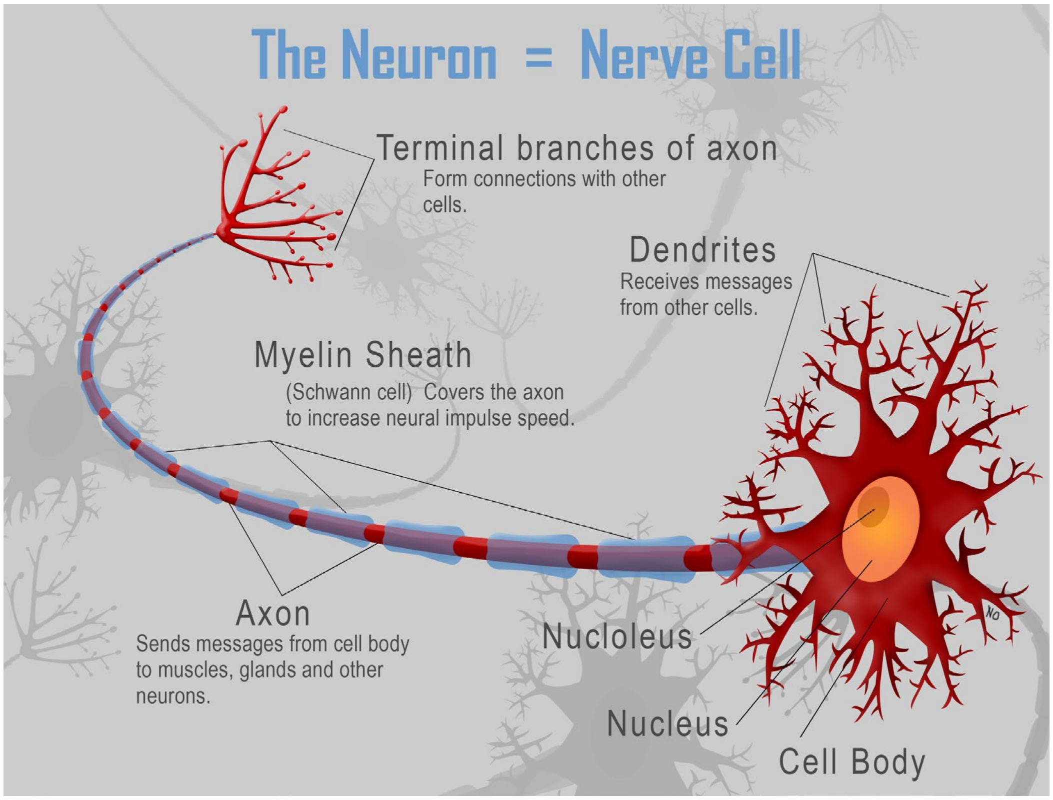
The fundamental unit of the nervous system is the neuron, or nerve cell. It has several structures in common with all cells in the body. The *nucleus* is the control center of the body and the *soma* is the cell body. In terms of structures that make it different, these focus on the ability of a neuron to send and receive information. The *axon* sends signals/information to neighboring neurons while the *dendrites* receive information from neighboring neurons and look like little trees. Notice the *s* on the end of dendrite and that axon has no such letter. In other words, there are lots of dendrites but only one axon. Also, of importance to the neuron is the *myelin sheath* or the white, fatty covering which: 1) provides insulation so that signals from adjacent neurons do not affect one another and, 2) increases the speed at which signals are transmitted. The *axon terminals* are the end of the axon where the electrical impulse becomes a chemical message and is passed to an adjacent neuron.

Though not neurons, *glial cells* play an important part in helping the nervous system to be the efficient machine that it is. Glial cells are support cells in the nervous system that serve five main functions:

1. Acting as a glue to hold the neuron in place.
2. Forming the myelin sheath.
3. Providing nourishment for the cell.
4. Removing waste products.
5. Protecting the neuron from harmful substances.

Finally, *nerves* are a group of axons bundled together like wires in an electrical cable. We will talk about a few of them in Section 10.2.

Figure 10.3. The Neuron



10.2. Sensation

Section Learning Objectives

- Define sensation.
- Identify the two thresholds related to the detection of a stimulus.
- Describe the importance of vision for learning.
- Describe the importance of hearing for learning.
- Describe the importance of taste for learning.
- Describe the importance of smell for learning.
- Describe the importance of touch for learning.

10.2.1. What is Sensation?

Simply, **sensation** is the detection of physical energy that is emitted or reflected by physical objects. We sense the world around us all day, every day. If you are sitting in a lecture you see the slides on the screen and hear the words coming from the professor's mouth. As you sit there, you are likely smelling scents from your classmates (hopefully pleasant ones). You might be chewing gum and tasting its flavors. And your clothes brush up against your skin as you move in your seat. These events are detected using our eyes, ears, mouth, nose, and skin and as you will see in Module 11 are sent to sensory memory first.

Once physical energy is detected by any of the 5 sensory systems, the receptor cells (or transducers) convert that energy into neural energy. Afferent (sensory) neurons or nerve cells in the Somatic Nervous System send the information off to the brain to be interpreted (discussed in subsequent sections in this module).

Sensory thresholds indicate the least amount of energy needed to detect a stimulus to begin with, or a change in a stimulus, at least half (50%) of the time. First, the least amount of energy needed to produce a sensation 50% of the time is called the **absolute threshold**. How far away does a car have to be before you hear it? If you hear it at a half mile away at least 5 of 10 trials, that is the absolute threshold for hearing (at least as this car and the sound it creates is concerned). Second, the smallest change in stimulation that a person can detect 50% of the time is called the **difference threshold**. If you are adding salt to your food, at what point do you notice that it has become saltier? It had some amount of salt in it before, and the addition of salt makes the taste/sensation stronger. You can measure how much is being added and if at the same amount of additional salt you say it is saltier at least 5 of 10 times, this would be your difference threshold for taste (and as salt is concerned). Please note that for both examples, I chose to use 10 times or trials, but this could have been at least 2 of 4 or 10 of 20, etc. The point is that for a threshold to be established, you must identify the stimulus or change in a stimulus at least half of those times. Ten was just an easy number to work with.

10.2.2. Vision

The receptor cells for vision, the *rods* and *cones*, are located in the retina and fovea of the eye. What exactly distinguishes them from each other? First, there are about 120 million rods in the eye but only 8 million cones. Second, rods are needed for night vision while cones are needed for color vision and seeing in the daylight. Third, cones can be found in the *fovea*, a depressed spot on the retina and objects falling here are in sharpest focus, and *retina*, the light-sensitive inner portion of the eye containing the receptor cells for vision. Rods, on the other hand, are found only in the retina (there are none in the fovea). The information gathered by these receptor cells is carried to the brain by the optic nerve. How so? Rods and cones connect to bipolar cells, which in turn connect to ganglion cells. It is the axons of the ganglion cells that come together to form the optic nerve. After nerve fibers making up the optic nerve leave the eye, they separate and some cross to the other side of the head at the *optic chiasm*. Ultimately, this sensory information ends up in the visual cortex. Please note that the exact process for vision (i.e. the structure and function of the eye) is beyond the scope of this textbook.

As for a connection to learning, consider that observational learning is based upon observing others and then repeating what you see (or hear). In respondent conditioning, the stimulus, whether NS/CS or US must be detected. The visual system is used if we see the Golden Arches (CS) and being to salivate (CR) or see a bee flying around a trash can and remember when we were stung in the past (an example of higher-order conditioning). In the case of operant conditioning, we make a response for which there is a consequence. Though we may hear verbal praise from our parents, we may also see them give us money (holding it is tactile). Consider that vicarious reinforcement and punishment involve seeing or hearing another person receive a consequence for their actions. This, in turn, influences our future action though we had no firsthand experience ourselves.

10.2.3. Hearing

Hearing, also called *audition*, is all about the detection of *sound*, or a type of energy arising from vibrations. These vibrations cause air particles to move, bump into other particles close by, and then bump into more particles and so on until they run out of energy. If we are nearby, then our ears may be able to gather up these sound waves.

The actual hearing of a sound starts in the outer ear with the sound waves being collected by the structure we commonly call the ear, but it is more properly termed the *pinna*. The waves travel down the auditory canal to the *eardrum,* or *tympanic membrane,* which then vibrates itself. Three little bones called the *hammer* (malleus), *anvil* (incus), and *stirrup* (stapes) hit each other in succession and amplify the wave. This action occurs in the middle ear. The last bone is attached to the *oval window* and when the stirrup vibrates, it causes the oval window to move, thereby causing the fluid in the *cochlea* to move, part of the inner ear. This movement causes vibrations on the *basilar membrane*, which divides the cochlea lengthwise and has on the top of it the *organ of Corti.* Embedded within the organ of Corti are *hair cells,* the sensory receptors for hearing. These cells bend and transduce the energy into electrochemical codes. This message moves along the *auditory nerve.* Information is then passed to the brain and specifically the thalamus.

This sequence of steps is very important to learning. As noted above, we may repeat racist comments because we heard our parents utter them. This exemplifies observational learning. In respondent conditioning, a dog may hear a bell and then salivate (CS-CR). In terms of operant conditioning, the consequence of our action could be a tirade by our parents or praise by our boss, both delivered verbally and detected through audition.

10.2.4. Taste

Taste, or *gustation*, occurs when chemicals stimulate thousands of receptors in the mouth. When we eat something, chemical substances in the food dissolve in saliva and move into the crevices between the papillae. There they come into contact with the taste receptors. *Papillae* are bumps you see if you look at your tongue in the mirror. Taste buds are embedded in the tongue's papillae. The chemical interaction between food substances and taste cells causes adjacent neurons to fire, sending a nerve impulse to the parietal lobe of the brain and to the limbic system.

Of course, you know there are five basic taste qualities — sweet, salty, bitter, sour, and savory. Sweet helps us identify foods that are healthful or rich in calories. Salty is necessary for all bodily functions. Bitter and sour help us identify foods that are rancid or poisonous. Savory can help us identify protein-rich foods and is best described as the taste of monosodium glutamate (MSG).

As an aside, the experience of flavor results from the combination of taste plus smell, discussed in Section 10.2.5. What happens when you have a cold? How does food taste? Think about the answer for a bit………………… You likely said not as good as it usually does. Why is this? Simply, to detect flavor, we need taste and smell. If your nose is clogged, you cannot effectively use one of the two senses needed to detect flavor and so foods do not taste as good or taste bland.

In terms of learning, consider the case of conditioned taste aversion or learning that a food substance has made us sick in the past and so we stay away from it in the future. Foods that are bitter or sour are most likely to cause such a reaction. Respondent conditioning helps us learn this type of association which is critical for survival. In terms of operant conditioning, our parents may give us a special treat like ice cream after earning an 'A' on a test. We love the taste of ice cream and are indulging in Rocky Road, our favorite flavor by far. Hence the reinforcer delivered by our parents is even more reinforcing, or an establishing operation, because we love the taste of this flavor. We will work hard to get an A on the next test and more Rocky Road.

10.2.5. Smell

The sense of smell is also referred to as **olfaction**. Receptor cells for smell are specialized neurons embedded in a tiny patch of mucous membranes in the upper part of the nasal passage, just beneath the eye. Signals from the receptors are carried to the brain's olfactory bulb by the olfactory nerve which is made up of the receptor's axons. From the olfactory bulb, they travel up to a higher region of the brain.

Do smells affect us? The answer is yes, and they have a definite psychological effect on us. Consider the purchase of perfumes and colognes and that we like to sniff flowers. Also, olfactory centers in the brain are linked with areas that process memories and emotion. This is why we might not just remember the song that was playing when we kissed that special someone for the first time, but also remember the way he or she smelled.

What are some other ways smells affect us? The smell of food induces us to eat even if not physically hungry. As the dogs in Pavlov's study showed, we salivate at the sight (vision) or smell (olfaction) of food (both US). And this unlearned response to a stimulus can even be linked with something neutral in our environment like a bell or metronome.

10.2.6. Touch

The skin is our largest sense organ. It protects us from the environment, holds in body fluids, regulates our internal temperature, and contains receptors for our sense of touch. You might say it acts as a boundary between ourselves and everything else and gives a sense that we are distinct from our environment. The notions that skin is a *boundary* and makes us *distinct* are interesting concepts and likely facts we do not give much thought to on a regular basis. Basic senses include touch, warmth, cold, and pain.

Mechanoreceptors are the receptor cells in the skin that are sensitive to different tactile qualities such as shape, vibration, grooves, and movement. Our skin helps us detect temperature, hot or cold, through *thermoreceptors* and we detect pain through *nociceptors*. Pain differs from other senses in one important way. When the stimulus that produces it is removed, the sensation may continue — sometimes for years. The skin is remarkably sensitive with the face and fingertips being the most sensitive body parts and our legs, feet, and back being much less so.

Our skin senses are influenced by our expectations such that when tickled by another person, we respond with excitement. The idea of expectations is an interesting one and links to respondent conditioning. How so? The act of being tickled and it making us laugh is a US-UR relationship, or one that does not need to be learned. We come into the world pre-wired to respond in this way. Consider the Tickle Monster. Do kids enter the world knowing what it is? No, so it represents an NS which causes no response. If every time the father or mother says Tickle Monster (NS) when he/she tickles their child (US) making her laugh (UR), eventually the parent merely saying “Here comes the Tickle Monster” will make the child laugh. Therefore, Tickle Monster has become a CS for which a CR occurs, or the relationship has been learned. What is the essence of respondent conditioning? An expectation that every time an NS occurs the US follows which leads to the response. Hence the relationship is learned.

In terms of operant conditioning, a swift crack on the behind is a punishment (PP) for misbehaving and so a child will be less likely to act out again. If we bring our wife flowers for no other reason than we think she is wonderful, and she gives us a kiss, we will be more likely to bring home flowers again. The kiss is a tactile stimulus, detected via mechanoreceptors, and reinforcement (PR) for a desirable behavior.

10.3. The Neural Impulse

Section Learning Objectives

- Outline how neural transmission occurs, outlining the three "parts."
- Identify and define important neurotransmitters.

Recall that the cells that do the detecting in the sensory organs are called *receptor cells* and the physical energy from objects outside of us is converted to neural information in the form of electrochemical codes in the process called *transduction*. This is then sent to the brain. How so? We will cover this process in three parts.

10.3.1. Part 1: The Axon and Neural Impulse

The neural impulse occurs as follows:

- Step 1 – Neurons waiting to fire are said to be in **resting potential** and **polarized**, or having a negative charge inside the neuron and a positive charge outside.
- Step 2 – If adequately stimulated, the neuron experiences an **action potential** and becomes **depolarized**. When this occurs, voltage-gated ion channels open, allowing positively charged sodium ions (Na+) to enter. This shifts the polarity to positive on the inside and negative outside. Note that **ions** are charged particles found both inside and outside the neuron.
- Step 3 – Once the action potential passes from one segment of the axon to the next, the previous segment begins to **repolarize**. This occurs because the Na

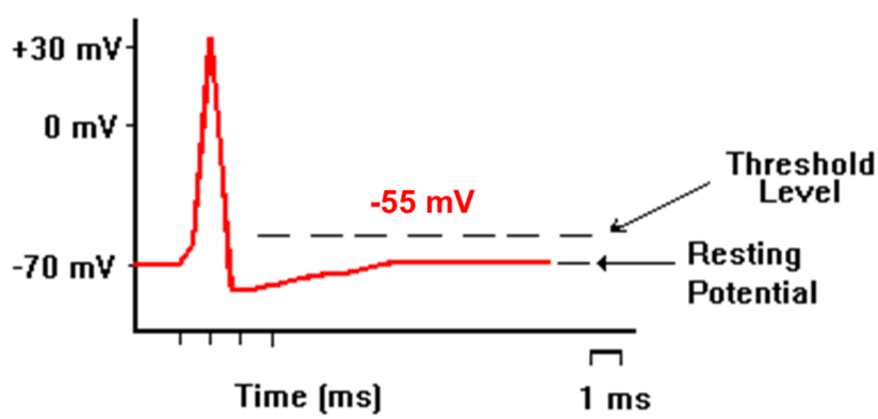
channels close and potassium (K) channels open. K+ has a positive charge, so the neuron becomes negative again on the inside and positive on the outside.

- Step 4 – After the neuron fires, it will not fire again no matter how much stimulation it receives. This is called the **absolute refractory period**. Think of it as the neuron ABSOLUTELY will not fire, no matter what.
- Step 5 – After a short time, the neuron can fire again, but needs greater than normal levels of stimulation to do so. This is called the **relative refractory period**.
- Step 6 - Please note that this process is cyclical. We started at resting potential in Step 1 and end at resting potential in Step 6.

10.3.2. Part 2: The Action Potential

Let's look at the electrical portion of the process in another way and add some detail.

Figure 10.4. The Action Potential



- Recall that a neuron is normally at resting potential and polarized. The charge inside is -70mV at rest.

- If it receives sufficient stimulation meaning that the polarity inside the neuron rises from -70 mV to -55mV defined as the *threshold of excitation*, the neuron will *fire* or send an electrical impulse down the length of the axon (the action potential or depolarization). It should be noted that it either hits -55mV and fires or it does not. This is the *all-or-nothing principle*. The threshold must be reached just like in our earlier discussion of absolute and difference thresholds.
- Once the electrical impulse has passed from one segment of the axon to the next, the neuron begins the process of resetting called repolarization.
- During repolarization, the neuron will not fire no matter how much stimulation it receives. This is called the absolute refractory period.
- The neuron next moves into the relative refractory period, meaning it can fire but needs greater than normal levels of stimulation. Notice how the line has dropped below -70mV. Hence, to reach -55mV and fire, it will need more than the normal gain of +15mV (-70 to -55 mV).
- And then we return to resting potential.

Ions are charged particles found both inside and outside the neuron. It is positively charged sodium (Na) ions that cause the neuron to depolarize and fire and positively charged potassium (K) ions that exit and return the neuron to a polarized state.

10.3.3. Part 3: The Synapse

The electrical portion of the neural impulse is just the start. The actual code passes from one neuron to another in a chemical form called a **neurotransmitter**. The point where this occurs is called the **synapse**. The synapse consists of three parts — the *axon* of the sending neuron; the *space* in between called the *synaptic space, gap, or cleft*; and the *dendrite* of the receiving neuron. Once the electrical impulse reaches the end of the axon, called the *axon terminal*, it stimulates synaptic vesicles or neurotransmitter sacs to release the neurotransmitter. Neurotransmitters will only bind to their specific *receptor sites*, much like a key will only fit into the lock it was designed for. You might say neurotransmitters are part of a lock-and-key system.

What happens to the neurotransmitters that do not bind to a receptor site? They might go through *reuptake* which is the process of the presynaptic neuron taking up excess neurotransmitters in the synaptic space for future use or *enzymatic degradation* when enzymes are used to destroy excess neurotransmitters in the synaptic space.

What exactly are some of the neurotransmitters which are so critical for neural transmission? See Table 10.1 for details.

Table 10.1. Neurotransmitters and Their Function

Neurotransmitter	Function
Dopamine	Controls voluntary movements and is associated with the reward mechanism in the brain
Serotonin	Controls pain, sleep cycle, and digestion; leads to a stable mood and so low levels leads to depression
Endorphins	Involved in reducing pain and making the person calm and happy
Norepinephrine	Increases the heart rate and blood pressure and regulates mood
GABA	Responsible for blocking the signals of excitatory neurotransmitters responsible for anxiety and panic
Glutamate	Associated with learning and memory

10.4. Perception: Adding Meaning to Raw Sensory Data

Section Learning Objectives

- List the major structures of the brain.
- Define perception and perceptual set.
- Outline Gestalt principles of perceptual organization.

Information has been gathered from the world around us by receptor cells/transducers in our sensory organs and sent to the brain via afferent neurons in the Somatic Nervous System in the form of a neural impulse. Now the brain needs to interpret this information. We will first discuss the brain and some of its parts. Then we will discuss the process of perception briefly.

10.4.1. The Brain

The central nervous system consists of the brain and spinal cord. The former we will discuss briefly and in terms of key structures which include:

- *Medulla* — Regulates breathing, heart rate, and blood pressure.
- *Pons* — Acts as a bridge connecting the cerebellum and medulla and helps to transfer messages between different parts of the brain and spinal cord.
- *Reticular formation* — Responsible for alertness and attention.
- *Cerebellum* — Involved in our sense of balance and for coordinating the body's muscles so that movement is smooth and precise. It is involved in the learning of certain kinds of simple responses and acquired reflexes.
- *Thalamus* — The major sensory relay center for all senses but smell.
- *Hypothalamus* — Involved in drives associated with the survival of both the individual and the species. It regulates temperature by triggering sweating or shivering and controls the complex operations of the autonomic nervous system.
- *Amygdala* — Responsible for evaluating sensory information and quickly determining its emotional importance.
- *Hippocampus* — Our "gateway" to memory. It allows us to form spatial memories so that we can accurately navigate through our environment and helps us to form new memories about facts and events. The spatial memories will help a rat learn a maze and run it quicker with each trial and make fewer errors.

- The *cerebrum* has four distinct regions in each cerebral hemisphere. First, the *frontal lobe* contains the motor cortex which issues orders to the muscles of the body that produce voluntary movement. The frontal lobe is also involved in emotion and in the ability to make plans, think creatively, and take initiative. The *parietal lobe* contains the somatosensory cortex and receives information about pressure, pain, touch, and temperature from sense receptors in the skin, muscles, joints, internal organs, and taste buds. The occipital lobe contains the *visual cortex* and receives and processes visual information. Finally, the temporal lobe is involved in memory, perception, and emotion. It contains the *auditory cortex* which processes sound.

Of course, this is not an exhaustive list of structures found in the brain but gives you a pretty good idea of function and which structure is responsible for it. This will better help us understand perception and how we learn.

10.4.2. Perception: An Overview

As we have seen in the preceding sections, there is a great deal of sensory information going to the brain via the neural impulse at any given moment. What do we do about it? That is where **perception** comes in, or the process of adding meaning to raw sensory data. An analogy is appropriate here. When we collect data in a research study we obtain a ton of numbers. This raw data really does not mean much by itself. Statistics are applied to make sense of the numbers. Sorry. I did not mean to use the s-word in this book. Anyway, sensation is the same as the raw data from our study and perception is the use of statistics to add meaning. You might say we are motivated to engage in the process of perception so that we can make sense of things.

Our perception of a stimulus can vary though…. even on the same day. How so? **Perceptual set** accounts for how our prejudices, beliefs, biases, experiences, and even our mood affect how we interpret sensory events called stimuli. Let's say we wake up one morning feeling good but by afternoon are coming down with a cold and by the evening feel crappy. Consider how you might deal with your kids differently as the day goes on.

There is quite a lot that can be discussed in relation to perception but I will focus our attention on Gestalt principles of perceptual organization. Gestalt psychology arose in the early 1900s in response to ideas proposed by Wilhelm Wundt in German and Titchener and his system called Structuralism in the United States. They were against the notion that perception occurred simply by adding sensations. They instead asserted that the whole is different than the sum of its parts. Their principles include:

- *Figure-ground* — States that figure stands out from the rest of the environment such that if you are looking at a field and see a horse run across, the horse would be the figure and the field would be ground.
- *Proximity* — States that objects that are close together will be perceived together.
- *Similarity* — States that objects that have the same size, shape, or color will be perceived as part of a pattern.
- *Closure* — This is our tendency to complete an incomplete object.
- *Good continuation* — States that items which appear to continue a pattern will be seen as part of a pattern.
- *Pragnanz* — Also called the law of good figure or simplicity, this is when we see an object as simple as possible.

These principles help us to make sense of a world full of raw sensations. Other ways we make sense of our world, though not covered here, include monocular and binocular cues, which aid with depth perception, perceptual constancy, apparent motion, and optical illusions. Give some thought as to how these principles of perceptual organization affect which stimuli we attend to from our environment. Maybe for the dog in Pavlov's study, the bell is the figure against all other background noises in the environment, which is ground.

10.5. Sending Commands Out

Section Learning Objectives

- Contrast primary and secondary appraisal.
- Define afferent and efferent neurons.
- Clarify the importance of sending commands back out for learning.

Now that a stimulus has been sensed, information sent to the brain via the neural impulse, and it has been perceived by the brain, what is next? You need to decide on a course of action. This is where primary and secondary appraisal come in. *Primary appraisal* (PA) is when we assess the emotional importance of an event. If deemed important, we then need to figure out a course of action to deal with it, which is *secondary appraisal* (SA). Think about this. We sense the world and send that information to the thalamus. We determine its emotional importance (PA) in the amygdala. If deemed emotionally significant, we decide what to do (SA) in the prefrontal cortex of the cerebrum. Once a course of action is decided upon, we need to send commands/messages out to the rest of the body.

Recall that the peripheral nervous system includes all parts of the nervous system outside the brain and spinal cord. It divides into the somatic and autonomic nervous systems. It is the *somatic* nervous system that handles sensory information. This is accomplished through sensory, or *afferent neurons*, which carry messages to the brain. It is also the somatic nervous system that controls voluntary movement via **efferent** or **motor neurons,** which send commands out of or away from, the nervous system.

Remember that if we deem an event in our world to be emotionally important, via the action of the amygdala in the CNS we need to activate our fight-or-flight instinct. This is where the sympathetic nervous system comes in. Once the event has passed, we return to normal via activation of the parasympathetic nervous system. Both are part of the autonomic nervous system and have tremendous implications for learning.

How is this process important for learning? As we gain experience with our environment and the stimuli present in it, we update our understanding or knowledge of the world. This represents learning. If say, we know that a neighbor's dog is quite aggressive because in the past we went up to pet it and were bitten, in the future we will not approach the dog. In the case of our first interaction with the mangy mutt, we pulled our hand back when bitten because the pain information was detected by nociceptors, sent to the brain via the neural impulse. Interneurons in the spinal cord then quickly told our hand to move away from the dog to prevent further damage and through motor neurons, our brain then processed and added meaning to the raw sensory data, and finally determined that we were in danger and to move away from the dog and get help for the bite, all controlled by efferent neurons. Primary and secondary appraisal were at work. We determined that the bite was a positive punisher which affected our future behavior of touching the dog. Withdrawing our hand was escape behavior and not going near the dog in the future is avoidance behavior, both types of negative reinforcement. You might also say that the dog was initially an NS but quickly became a CS with a CR of fear (being bitten is a US). We could also have stimulus generalization occur and become fearful of all dogs (and similar animals like cats) which will necessitate discrimination training to realize that most dogs are nice. Other children may have observed the attack and were vicariously punished and will also avoid the dog in the future. If we are sent into therapy to deal with our new phobia to dogs, the therapist may choose to treat the problem using modeling (observational learning) or flooding (respondent conditioning).

Module Recap

Module 10 presented the first complementary cognitive process of sensation (and perception). A model for communication in the nervous system was presented and then each step in the process was outlined and linked to learning. This included sensation, the neural impulse, perception and the brain, and sending commands back out. Not only is the whole process important to learning, but each step adds its own unique contribution.

We will now turn to the cognitive process possibly most directly related to learning — memory; much in the same way that sensation and perception and intertwined. I hope you enjoyed the discussion we just undertook.

Part VI. Complimentary Cognitive Processes

Module 11:

Complementary Cognitive Processes - Attention and Memory

Module 11: Complementary Cognitive Processes - Attention and Memory

Module Overview

Module 11 covers the second of the four complementary cognitive process — memory. Before we even get to this, we discuss another important cognitive processes — attention. Simply, if we are not paying attention no amount of learning will occur. But if we are and learning occurs, we can demonstrate our newfound knowledge after some time has passed showing that it made its way into long term memory. If we struggle with this task, then forgetting has occurred.

Module Outline

11.1. Attention: Deciding What to Dedicate Cognitive Resources To

11.2. Memory: Demonstrating That We Have Learned

11.3. Memory Errors and Forgetting

Module Learning Outcomes

- Describe attention and clarify why it is important to the cognitive process of learning.
- Define memory and outline its three types.
- Clarify the types of errors we make in relation to memory.
- Hypothesize reasons why we forget.

11.1. Attention: Deciding What to Dedicate Cognitive Resources To

Section Learning Objectives

- Define attention.
- Clarify what it means to be distracted.
- Clarify the role of the central executive.
- Define selective attention.
- Explain how the concepts of processing capacity and perceptual load explain how attention can be focused and not distracted.
- Describe inattentional blindness.
- Differentiate repetition and change blindness.
- Hypothesize whether attention can be divided.
- Explain the importance of attention for learning.

11.1.1. What We Attend To

Attention is our ability to focus on certain aspects of our environment at the exclusion of others. Despite this, we can be **distracted**, or when one stimulus interferes with our attending to another. So how do we choose what to attend to? Baddeley (1996) proposed that attention is controlled by what he called the **central executive.** It tells us where to focus our attention and can even home in on specific aspects of a stimulus such as the tone in a speaker's voice, color in someone's face, a noxious smell, or peculiar taste.

We can even use **selective attention** to voluntarily focus on specific sensory input from our environment (Freiwald & Kanwisher, 2004). As such, we might choose to focus on an aspect of a professor's lecture when it is interesting but begin paying attention more to people walking by in the hallway if it becomes boring and dry.

Our ability to focus our attention and not become distracted by outside stimuli is a function of our **processing capacity** — how much information we can handle, and **perceptual load** — how difficult a task is. *Low-load tasks* use up only a small amount of our processing capacity while *high-load tasks* use up much more. Lavie's **load theory of attention** (Lavie et al., 2004) posits that we can attend to task-irrelevant stimuli since only some of our cognitive resources have been used when engaged in low-load tasks, but high load tasks do not leave us any resources to process other stimuli.

Before moving on, check the following out:

https://www.youtube.com/watch?v=vJG698U2Mvo

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Note: If you did not actually watch the short video, the next section will not make sense.

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11.1.2. Issues with Attention

Did you count the number of passes correctly? Likely not, and if this is true, it is due to the phenomena of **inattentional blindness** or when we miss a stimulus clearly present in our visual field when our attention is focused on a task (Simons & Chabris, 1999). In the video, you were presented with 2, three-person basketball teams who were passing the ball to other members of their team. One team wore white shirts and the other black. The participant had to count the number of times members of one of the two teams passed the ball to other team members, all while ignoring the other team. During this, a person wearing a gorilla suit walks through the basketball game, stopping to turn in the direction of the camera and thump its chest. Only half of the participants see the gorilla walk through. Did you?

Visit the Invisible Gorilla website to learn more about this study:

http://theinvisiblegorilla.com/

Two other types of blindness are worth mentioning too, and not in relation to problems in the visual sensory system. First, **repetition blindness** is when we experience a reduction in the ability to perceive repeated stimuli if flashed rapidly before our eyes. Say for example a series of numbers are flashed in rapid succession and during this string, the number 3 is flashed four times in a row. You may recall only seeing 3 one time, not four. Is it because we cannot visually separate the numbers? No. If the same experiment was repeated with letters, and in the midst of a string of letters you saw R r, you would believe only one R/r was presented to you.

Second, **change blindness** occurs when two pictures are flashed before our eyes in rapid succession. If the second picture differs slightly from the first, you will not see the difference as well as you could if presented side-by-side. The effect is stronger when the change is not in the central portion of the picture but in a peripheral area.

11.1.3. Can We Divide Our Attention?

So, can we successfully *divide our attention* or focus on more than one stimulus at a time? Results of several experiments show that it is possible to successfully divide our attention for tasks that we have practiced numerous times, but as the task becomes more difficult this ability quickly declines (Schneider & Shiffrin, 1977). Of course, dividing our attention comes with risks, especially where driving and texting are concerned. Finley, Benjamin, & McCarley (2014) found that people can anticipate the costs of multitasking, but do not believe they are personally vulnerable to the risks compared to other people.

11.1.4. The Importance of Attention for Learning

Before moving on I hope you can see why attention is important to learning. Consider that a dog must hear the bell which leads to salivation (recall that the bell has become a CS because it was associated with the US of food). For the animal to ever learn the association (CS-NS), it must be paying attention. One of the limits of observational learning is that the organism needs to attend to the model. If it is not, then the model's behavior will never be imitated later. Observational learning is important to respondent and operant conditioning as well. If we do well on our test and our parents say, 'Great job,' though the comment is a PR, if we do not pay attention to it from the start, we will not yield its reinforcing effect.

Attention is relevant to all three learning models discussed in this class. Think of it another way. If your boss is showing you how to use the new cash register and your mind is wandering and thinking about your big date that night, you will not learn how to use the machine, and likely frustrate your boss. This does not imply you are intellectually unable to learn how to use the cash register, only that in this moment, you are not paying him or her any attention.

11.2. Memory: Demonstrating That We Have Learned

Section Learning Objectives

- Define memory.
- Describe the three stages of memory.
- Review the web resources on ways to improve your memory, and subsequently your learning of the material.
- Describe for yourself, based on the information in this section, the relevance of memory as a complementary cognitive process to learning.

11.2.1. What is Memory?

In this class, you have likely already taken a few quizzes or exams. As you completed each, you had to draw the information it asked about from your storehouse of information that we typically refer to as memory, whether you were trying to recall dates, names, ideas, or a procedure. Simply, **memory** is the cognitive process we use to retain and retrieve information for later use. Two subprocesses are listed in this definition — **retain** and **retrieve**. The former is when we encode, consolidate, and store information. The latter is when we extract this information and use it in some way.

You might think of memory as a file cabinet. If you have one at home you use it to store information, or pieces of paper, away for use at a later time. Hopefully, your system of filing this information is good and you can easily find a document when you need it again. Our memory operates in the same general way. We take pieces of information and place them in this file cabinet. We should know in what drawer, in which hanging folder, and then where in the folder our information is. If we do, we find the information and use it when we need it again, such as during an exam. If we do not, well, we hit a stumbling block and may spend minutes staring at the wall or ceiling trying to figure out where the information is. As you will soon come to see, the cabinet represents long-term memory (LTM) and when we pull information from it, we move it into a special type of short-term memory (STM) called *working memory.*

11.2.2. Stages of Memory

Atkinson and Shiffrin (1968) proposed a three-stage model of memory which said that memory proceeds from sensory, to short-term, and finally to long-term memory. First, **sensory memory** holds all incoming sensory information detected from our environment for a very short period of time (i.e. a few seconds or even a fraction of a second). Second, **short-term memory (STM)** holds a limited amount of information for a slightly longer period (about 15 to 20 seconds). Third, **long-term memory (LTM)** holds a great deal of information for an indefinite period, possibly for decades (consider that the elderly can recall events from childhood if properly motivated). When we say we have learned, this is what we are talking about. We are saying that it has been stored in LTM for later use. Let's tackle each briefly.

11.2.2.1. Sensory memory. Information obtained from our five sensory organs moves to sensory memory, also called the sensory register. This memory system has a near unlimited capacity but information fades from it very quickly. For instance, visual stimuli are stored in what is called the *iconic register* but only lasts here for a fraction of a second (Sperling, 1960) while auditory information is stored in the *echoic register* for a few seconds (Darwin et al., 1972).

11.2.2.2. Short-term memory (STM). Our second memory system holds information for about 15-20 seconds (Peterson & Peterson, 1959; Brown, 1958) meaning that what you just read in the sensory memory section is still in your STM. Likely what you read in Section 11.1 is no longer present. Also, the capacity of STM has been found to be 5 to 9 items (Miller, 1956) with the average being 7. Miller (1956) also proposed that we can take larger lists of unrelated and meaningless material and group them into smaller, meaningful units in a process called **chunking**. For example, if you were given a list of states to include Rhode Island, Pennsylvania, Washington, Maine, Oregon, California, Maryland, South Dakota, Florida, Nebraska, and Arizona, you could group them as follows:

- Rhode Island, Maine, Maryland, Kansas, Pennsylvania, and Florida falling on the east coast
- Washington, Oregon, California, and Arizona falling on the west coast
- Kansas, South Dakota, and Nebraska falling in the middle of the country

Alone, the list of 11 items exceeds our capacity for STM but making three smaller lists falls on the short side of our capacity and no list itself has more than 6 items, still within the limits.

Our STM also holds information retrieved from long term memory to be used temporarily, sort of like taking the information from the file cabinet and placing it on a table. We call this **working memory** (Baddeley & Hitch, 1974). Once finished with the information, it is returned to the file cabinet for future use. It is important to point out the word *use* in the definition. By use, it is implied that the information is manipulated in some way which makes it distinct from STM which just involves a mechanism of temporary storage.

11.2.2.3. Long-term memory (LTM). As the name indicates, information stored in this memory system is retained for a long period of time with the ability to be retrieved when needed. There seems to be no time limit for LTM and when people use the word memory, it is LTM they are referring to. There are two specific types of LTM — implicit and explicit. First, **implicit**

memory includes knowledge based on prior experience and is called nondeclarative. An example is a **procedural memory** or memory of how to complete a task such as make a grilled cheese sandwich, ride a bike, or ring up a customer on a cash register. Second, **explicit memory** includes the knowledge of facts and events. This type is said to be declarative as it can be deliberately accessed. It includes **semantic memory** or memory of facts such as what the definition of semantic memory is, and **episodic memory** or the memory of a personally experienced event. Again, in the case of either semantic or episodic memory, you must declare it. The knowledge is not automatic.

The **serial position effect** states that we recall information falling at the beginning (called *primary*) and end (called *recency*) of a list better than the information in the middle. Think about the most recent lecture you attended. What do you remember best? Likely, you remember what the professor said when class started such as if he/she made a few quick announcements or did a review of previously covered material and at the end in terms of final comments or a summary of new material. We remember the information presented first likely since it has had time to make its way into LTM because we could rehearse it (Rundus, 1971). As for the end of a list, we likely recall it because it is still in STM and accessible to us (Glanzer & Cunitz, 1966).

LTM includes four main steps — encoding, consolidation, storage, and retrieval. First, **encoding** is when we pay attention to and take in information that can then be processed or moved to LTM. This processing is either *automatic* or done with little effort such as remembering what we had for lunch today or is *effortful* and requires us to commit cognitive resources such as remembering the vocabulary (bolded terms) in this module.

According to the **levels of processing theory** (Craik & Lockhart, 1972), our memory is dependent on the depth of processing that information receives. It can be *shallow* or not involving any real attention to meaning, such as saying the phone number of a person you just met at a party repeatedly, or is *deep,* indicating you pay close attention to the information and apply some type of meaning to it.

The next step in the process is **consolidation** or when we stabilize and solidify a memory (Muller & Pilzecker, 1900). Sleep is important for consolidation and is the reason why studying all night before a test the next day really does not help much (Gais, Lucas, & Born, 2006). The third step is **storage** and involves creating a permanent record of the information. This record has to be logically created so that we can find the information later and in the final part of the process called **retrieval.**

Improving Your Learning – Memory Techniques

All students struggle with test-taking from time to time and this usually centers on how they go about studying for exams. Below are some websites with useful tips for studying, and some of the strategies have been mentioned already in Section 11.2. Enjoy.

- https://academictips.org/study-skills/20-ways-to-improve-your-memory/
- https://www.oxford-royale.co.uk/articles/memory-tricks-exam-success.html
- https://www.collegeraptor.com/find-colleges/articles/tips-tools-advice/9-simple-brain-hacks-to-improve-your-memory/

11.3. Memory Errors and Forgetting

Section Learning Objectives

- Outline the seven sins of memory.
- Define forgetting.
- Define retention interval.
- List ways to measure forgetting.
- Clarify how amnesia and interference lead to forgetting.

11.3.1. Memory Errors

In his book, "The Seven Sins of Memory: How the Mind Forgets and Remembers," Schacter (2002) outlines seven major categories of memory errors broken down into three sins of *omission* or forgetting and four sins of *commission* or distortions in our memories.

The sins of omission include:

- **Transience** or when our memories decrease in accessibility over time.
- **Absent-mindedness** or when we forget to do things or have a lapse of attention such as not remembering where we put our keys.
- **Blocking** or when we experience the tip-of-the-tongue phenomena and just cannot remember something. The stored information is temporarily inaccessible.

The sins of commission include:

- **Suggestibility** or when false memories are created due to deception or leading questions.

- **Bias** or when current knowledge, beliefs, and feelings skew our memory of past events such as only remembering the bad times and not the good ones after a relationship has come to a tragic end.
- **Persistence** or when unwanted memories continue and are not forgotten such as in the case of PTSD.
- **Misattribution** or when we believe a memory comes from one source when it really came from another source.

For more on these sins, please visit: https://www.apa.org/monitor/oct03/sins.aspx

11.3.2. Forgetting

11.3.2.1. Defining forgetting. Forgetting can be defined as a reduction in how well we perform learned behaviors. In the spirit of this definition, you are trained one day on the new register and do well, but after a two-day weekend, you return to work and cannot remember how to execute some of the procedures that you previously learned. The two-day weekend represents what is called a **retention interval** or a period during which you are not practicing what you previously learned.

You might also think of it as an inability to recall or remember something that should be remembered, such as forgetting who the founder of Behaviorism was when taking your principles of learning exam. Or maybe you cannot remember what you ate for breakfast this very morning when asked by a friend or your mother (calling to check on you).

11.3.2.2. Measuring forgetting. Forgetting can be measured in a few different ways. First, we can use what is called **free recall** or asking the person to demonstrate what they previously learned. Your boss might ask you to ring up a few customers when you first get to work after your weekend to demonstrate that you remember how to do it. Or you might test your understanding of the neural impulse which was covered in Module 10 by describing what happens across its three "parts." Failing to solve the problem or recite the steps in the neural impulse represents that forgetting occurred and additional training/learning is needed.

Recall from our discussion of operant conditioning that prompts are often used to help someone learn and a *prompt delay* could be used in which the person is asked to perform a task and *prompts* are only delivered if he or she has trouble doing so, such as asking your son or daughter to solve the first math problem assigned for homework. If he cannot you might verbally tell him what to do or model it by doing the first problem. This is a procedure for measuring forgetting called **prompted** or **cued recall.**

Another way to measure forgetting, or what we know, is the most common way to test material in both grade school and college courses — the multiple-choice test. Students are presented with a definition, say, and then a list of four choices. One of the four is the word the definition is of and three are distractors. Students demonstrate that they remember the information if they can correctly pick out the word, or recognize it, from the list of distractors. If they do not, then we can say they forgot the material. Of course, a problem with multiple-choice style exams is that a student can guess and get the question right. This suggests that they did not forget when they actually did.

11.3.2.3. Why we forget? Forgetting can occur for several reasons. In the memory errors section, we mentioned *transience* or memory fading due to the passage of time. Forgetting can also occur due to **amnesia** or a condition in which an individual is unable to remember what happened either shortly before (retrograde) or after (anterograde) a head injury.

Forgetting could occur due to **interference** or when information that is similar to other information interferes in either storage or retrieval. Interference can be *proactive* as when old information interferes with new or *retroactive* in which new information interferes with old. Proactive interference explains why students have trouble understanding the concepts of positive and negative correlations and positive and negative reinforcement/punishment. Our previous education taught us that positive implies something good and negative something bad. Our new learning shows that positive can mean moving in the same direction and negative means moving in opposite directions as in the case of correlations, or that positive means giving and negative means taking away in respect to reinforcement and punishment. Again, our previous learning interferes with new learning. When you take an abnormal psychology class you will see a third use of positive and negative in relation to the symptoms of schizophrenia. No symptom of this disease is good, so the words positive and negative have no affective connotation yet again, but this previous learning will make our new understanding a bit more challenging to gain.

Module Recap

We are now through with our second of the four major cognitive processes that are related to learning. In this module, we discussed memory, as well as the process of attention. Reasons why these two cognitive processes are important were outlined, and memory is really the most complementary process to learning, in the same way sensation and perception are linked. In a way, attention is important to these two cognitive processes also as if we are not paying attention, we will not perceive anything. Sensation may still occur as sensory memory shows.

We now move to a discussion of language and then learning concepts to round out Part VI. Enjoy.

Part VI. Complimentary Cognitive Processes

Module 12: Complementary Cognitive Processes - Language

Module 12: Complementary Cognitive Processes - Language

Module Overview

Our third module on complementary cognitive processes will involve a brief investigation of language and how it relates to learning (or is learned). We will first set a foundation for what language is and its structure. Then we will discuss how language is learned over childhood. Our discussion will end with learning another language, whether spoken or visual.

Module Outline

Module Learning Outcomes

- Describe language and its structure.
- Clarify how we learn language focusing on developments across childhood.

12.1. Language and Its Structure

Section Learning Objectives

- Define language.
- Define linguistics and the four aspects of language it is concerned with.
- List and define the two elements of speech.
- Describe factors on how we interpret the meaning of words and sentences.

12.1.1. What is Language?

Language can be defined as all the socially shared rules for what words mean, how to make new words, how to put them together, and what combinations work best in specific situations. This leads to a systematic and meaningful arrangement of symbols that allow us to convey our thoughts to others. *Speech*, in contrast, is the verbal means of communicating and includes our voice, how we articulate words, and fluency.

The scientific study of language is called *linguistics***.** Linguists are concerned with four main aspects of language. First, *phonology* is the study of how sounds are used to construct meaning in a language. *Semantics* is the study of the meaning of language. *Syntax* is the study of the structure of language and includes grammar. Finally, *pragmatics* is the study of how language is used.

12.1.2. Elements of Speech

Phonemes are the smallest unit of sound that affects the meaning of speech. For instance, the word, “bad,” contains three phonemes – /b/, /a/, and /d/. If we change the first phoneme from a /b/ to a /s/ we get the word “sad.” We could also replace the /b/ with a /m/ to make “mad,” a /f/ to make “fad,” a /d/ to make “dad,” a /h/ to make “had,” and a /l/ to make “lad.” Alternatively, we could change the /d/ at the end to a /y/ to make “bay,” a /t/ to make “bat,” a /r/ to make “bar,” a /g/ to make “bag,” or a /n/ to make “ban.”

Morphemes are the combination of phonemes in meaningful ways to form words. They have clear meaning and grammatical functions. For instance, “mother” has five phonemes, one morpheme, and two syllables. If the morpheme was the word “mom” it would still contain one morpheme but three phonemes and one syllable now. What if the woman has a son and he and his wife have a baby? The mother is now called a “grandmother” which has several phonemes, three syllables, and two morphemes (grand and mother). If we were talking about a whole lot of women whose children had babies, we would call them “grandmothers” which consists of three morphemes. Why? “Grand” and “mother” are the first two but the ‘s’ on mother has the grammatical function to indicate more than one and so is a morpheme as well.

12.1.3. Words and Sentences

Several peculiarities of language are worth mentioning here. The *word frequency effect* states that people respond quicker to words that occur more often in everyday language than they do to words that occur less often**.** For instance, saying, ‘The door is open’ will yield a quicker response than saying ‘The door is ajar.’ The less frequently used word is ajar.

Lexical ambiguity is when words have more than one meaning. For instance, consider the meaning of the word ‘grade.’ We might think of a grade that we earn in a class. But grade can also mean to evaluate work (i.e. I have to grade papers today), to slant or incline (i.e. The road grades steeply for the next 3 miles), it can be a class of objects with about the same rank or quality (i.e. Having all soldiers of grade E-3 or lower pull kitchen duty), or to arrange or sort (i.e. The machine grades 1,000 eggs every hour).

Language involves more than just understanding the meaning of words arranged in sentences, but also includes understanding the meaning of sentences arranged in stories and how sentences in different parts of stories relate to one another. We must go beyond the information stated in the text using a process called *inference* so that we can determine what the text means. We make several different types of inferences. *Instrument inferences* are inferences about tools or methods. For example, I sent an email to my boss. The fact that a computer was used is inferred. You cannot send an email on paper.

Causal interferences are inferences in which events in one sentence are caused by events in another sentence. John studied hard. He earned an A on the exam. This infers that through studying, John earned a good grade. What if we said, “John walked to school that morning instead of taking the bus. He earned an A on the exam.” This inference is much more difficult to make as walking to school does not directly lead to higher grades. It could be he used the time to quiz himself or it could mean nothing at all. This is sort of like the idea that correlation does not infer causation. Any two variables can be related to one another but it does not necessarily mean that one caused the other.

Anaphoric inferences are inferences connecting an object or person in one sentence to an object or person in another sentence. Doug is trying to save some money. He took the bus to work this morning. The 'He' mentioned in the second sentence refers back to Doug in the first sentence.

12.2. Learning a Language

Section Learning Objectives

- Describe progress made in the learning of language in infancy.
- Describe progress made in the learning of language in the preschool years.
- Describe progress made in the learning of language in middle childhood.
- Clarify how learning theory explains the acquisition of language.
- Describe the language acquisition device and universal grammar.

12.2.1. Infancy

In very early childhood, language development reflects an infant's desire to communicate with the world. Unfortunately, communicating in a more adult manner takes some time to occur, and infants first display what is called **prelinguistic communication,** or the type of communication that occurs before language is possible. This includes sounds, facial expressions, gestures, and imitation. Children are also able to understand language before they can produce it. For example, they can follow a parent's command before they can hold a meaningful conversation or ask 'why' the million times they will do so in childhood. The earliest form of language they demonstrate is called *babbling,* or speechlike but meaningless sounds. Starting around 2-3 months of age and continuing to around one year of age, it proceeds from simple, or saying ba ba ba ba, to complex, or saying ba da ma fa.

Babbling ends as first words are spoken around 10-14 months of age, though early vocabulary is quite small and reaching up to about 400 words at 16-24 months. Children use *holophrases* or one word meant to represent a whole phrase such as saying 'Up' instead of 'Pick me up.' The word is often accompanied by a gesture such as lifting the arms up. First sentences are spoken around 18 months of age as vocabulary expands and children move from holophrases to *telegraphic speech* or when a sentence is created with the fewest number of words necessary to convey the same meaning, such as if the child says, 'I read book' and not 'I read the book' (Brown & Bellugi, 1964).

Parents are motivated to communicate with their infants in a unique way too. Using simple sentences and repetition the parent may say to the child, "You are so cute. Yes you are. Yes you are pretty baby." This is called *motherese* or can be defined as infant-directed speech.

12.2.2. Preschool Years

Children continue to make great gains in language during the preschool years and by age 3 can use plurals, possessive forms of nouns, past tense, and can ask and answer complex questions. In terms of vocabulary, by the age of 6 or about first grade they have a vocabulary of about 15,000 words (Anglin, Miller, & Wakefield, 1995). This rapid increase in vocabulary occurs courtesy of what is called **fast mapping** or when children ascertain the meaning of a word from how it is used in a sentence (its context), what word it is contrasted with, and previous knowledge of words and word categories. Thus, the child can hypothesize the meaning of the word and then tests the hypothesis by immediately using it and seeing what response he/she gets for doing so. This feedback helps them determine if their hypothesis was accurate or not. How does fast mapping demonstrate learning? Do you see any of the learning models referenced in its description?

12.2.3. Middle Childhood

A child's vocabulary grows to almost 60,000 words by the end of fifth grade. They also begin to use passive voice and conditional sentences with greater frequency. Children can tell stories, give directions, and stick to a topic when involved in a conversation.

12.2.4. Acquiring Language

Consider the learning models we have discussed so far in this book and which might be useful for learning language. First, we can learn a language quite simply but observing a model such as our parents. Though through this method we would expect a child's grammar to be generally good, they do make many mistakes still. Though they hear their parents say that they went to the store, the child may still say, 'I goed to the store,' using the past tense of 'go' in much the same fashion as they might with the word 'play' (i.e. saying I played with my toys today). They could also mistakenly say 'I eated' my food instead of ate. I will explain why this might happen in the next section.

When the child makes a mistake, the parent can correct them using prompts and offer reinforcers such as verbal praise (PR) when they use the correct form of the past tense. Teachers will do much the same in the classroom. Such strategies are in keeping with the principles of operant conditioning.

12.2.5. Universal Grammar and the Language Acquisition Device

Language is *universal*, such that all cultures have some form of language and it develops the same way no matter what the culture. The similarity in how language develops across cultures was of special interest to Noam Chomsky (1928-). He proposed an innate mechanism in the brain called the **language acquisition device** (LAD). To Chomsky, language development is the same as learning to walk. In both cases, we have an innate inclination to develop it as shown by the fact that children learn to place a subject in front of a verb before ever stepping into school. This occurs because the brain has the neural circuitry already in place, or prewired, to learn grammatical structures. In the case of walking, children exhibit the stepping reflex before their leg muscles are strong enough to support walking (see Module 3 for a discussion of reflexes).

This neural circuitry ties in with what he called a **universal grammar**, or a mechanism that allows children to identify many of the basic features of language. This is true of all languages and helps a child to determine the correct sequence of words to make a sentence meaningful. For instance, the child will understand that saying, "John hit Mikey," has a different meaning than saying, "Mikey hit John." The statement has important ramifications for one of the two individuals and potential punishment.

In fact, Chomsky (1986) proposed the concept of **transformation rules** which helps us explain the example at the end of Section 12.2.4. These transformation rules help us to convert a simple sentence into other voices such as past, future, conditional, or passive tenses. So, though the child says, 'I am going to the store,' he can also say, 'I will go to the store' (future tense), 'I went to the store' (past tense), 'I will go to the store if you ask me to' (conditional tense), or 'I will not go the store (negative). It explains the child saying 'I goed' instead of 'I went' as the normal rule for converting present into past tense was applied, but ‘go’ is an irregular verb, much like ‘eat.’

12.3. Learning Another Language

Section Learning Objectives

- Discuss why learning a second language may be important.
- Discuss how you can go about learning ASL.

12.3.1. Spoken Languages

According to the American Speech-Language-Hearing Association (ASHA) learning a second language is called **second language acquisition** and can occur at any time during life. They suggest that when thinking about learning a second language, you consider what language is spoken at home, how often you can practice the second language, how motivated you are to do so, and why you need to know this second language. Maybe you are planning a trip overseas or have an exchange student coming to live with you. Or your job has required you to learn a second language, such as Spanish, so that you can interact with your Hispanic clients more effectively. To learn a language, they suggest you have a good model, or someone who speaks the language reasonably well. For more on ASHA, visit: https://www.asha.org/.

12.3.2. Visual Languages

Note that sign language is a language, though visual in nature, with its own set of rules of grammar and syntax. According to the National Association of the Deaf (NAD), “The shape, placement, and movement of the hands, as well as facial expressions and body movements, all play important parts in conveying information." Signing involves the processing of linguistic information not through the ears, but the eyes. Sign language varies across countries and the version practiced in the U.S. is called American Sign Language or ASL. In terms of learning ASL, NAD says, "To learn enough signs for basic communication and to sign them comfortably, can take a year or more. Some people pick up signs more slowly than others, and if that is the case with you, don't be discouraged. Everyone learns sign language at their own speed. Be patient and you will succeed in learning the language. The rewards will be well worth the effort!" Learning ASL can be done through classes, practicing signs with people who are deaf or hard of hearing, and through apps (yeah, there is an app for that too). For more on learning ASL, please visit:

https://www.nad.org/resources/american-sign-language/learning-american-sign-language/

Module Recap

Module 12 covered how human beings go about learning a language and dealt with language and its structure, the acquisition of language from infancy to middle childhood, and learning a second language, whether another spoken language like Spanish or French, or sign language used by the deaf and hard of hearing. Our coverage of complementary cognitive processes has so far covered sensation and perception, attention and memory, and now language.

We will conclude Part VI, and this book, by examining cognition (reasoning, problem-solving, and intelligence) and its link to learning. We will also discuss challenges to learning, in the form of intellectual and learning disabilities.

Part VI. Complimentary Cognitive Processes

Module 13:

Complimentary Cognitive Processes - Learning Concepts

Module 13: Complementary Cognitive Processes - Learning Concepts

Module Overview

In our final module in the book, we will tackle what seems like a simple topic but is quite complex. Though the module is entitled Learning Concepts, we will discuss several cognitive processes related to the learning of concepts (and other elements of cognitions) and what we do with them to include problem-solving and reasoning and end with a discussion of intelligence. Consider that intelligence reflects what we have learned, whether book knowledge, how to build a kitchen table, a dance routine, language (discussed in Module 12), how to be a better spouse, how to play the guitar, or how we learn best (self-awareness). To get us going though, we will focus on one theory of how cognition develops throughout the life span. We will end with the topic of impediments to learning in the form of intellectual and learning disabilities.

Module Outline

13.1. Piaget's Theory of Cognitive Development

13.2. The Elements of Cognition

13.3. Problem-Solving: When We Seek Solutions

13.4. Reasoning: Making Good Decisions, And Learning from Them

13.5. Intelligence — Putting Our Learning to Good Use

13.6. Learning Disabilities

Module Learning Outcomes

- Describe the contributions of Jean Piaget to our understanding of cognitive development across the life span.
- List and describe the elements of cognition and clarify their relationship to learning.
- Describe how the complimentary cognitive process of problem-solving relates to learning.
- Describe how the complimentary cognitive process of reasoning relates to learning.
- Describe how intelligence relates to learning.
- Outline intellectual and learning disabilities that serve as an impediment to learning.

13.1. Piaget's Theory of Cognitive Development

Section Learning Objectives

- Define schemas.
- Describe how our schemas change due to direct experience with the environment.
- Describe Piaget's four stages of cognitive development.

13.1.1. General Concepts

Swiss psychologist, Jean Piaget (1896-1980), proposed a stage theory of how cognitive development proceeds. Before we get into it, it is important to explain a few key concepts he proposed. First, **schemas** are organized ways of making sense of experience. We have a schema for 'dog' which includes the ideas of four legs, a tail, and being furry. Piaget said that these schemas change due to direct experience with our environment; a process he called **adaptation.** This change occurs in one of two ways. First, **assimilation** is when new information is made to fit into existing schemas. Notice the word similar within assimilation. We interpret the world in terms of our current schemas and understand anything novel similar to this existing way of understanding experience. Second, we could use the process of **accommodation**. Simply, when novel information is obtained, we could update an existing schema or create a brand new one. Let's say a child meets a cat for the first time. We would expect them to call the animal a dog. Why is that? The cat has four legs, a tail, and is furry. But cats and dogs are not the same and have one major difference — cats say 'meow' and dogs say 'woof.' So the child will update his/her schema for 'dog' to now include woof and creates a new schema for 'cat' which includes four legs, tail, furry, and meow.

Piaget's theory consists of four main stages — sensorimotor, preoperational, concrete operations, and formal operations. We will cover each as they relate to how we learn, and update what we learn about our world.

13.1.2. Sensorimotor Stage

The **sensorimotor stage** is when infants focus on developing sensory abilities and learn to get around in their environment. You might say they think with their bodies and this stage lasts from birth to age 2. Have you ever noticed how young babies take genuine delight in putting everything in their mouths, but to the horror of their parents? This is evidence of the sensorimotor stage and thinking consists of coordinating sensory information with the movement of the body.

The sensorimotor stage has six substages. Occurring during the first month, the first substage focuses on schemas the infant is born with or as we called them in Module 3, *reflexes*.

These schemas are beginning to be changed via accommodation. The second stage is called *primary circular reactions* by Piaget and lasts to about 4 months of age. The child practices these basic schemas constantly and even shows the first signs of coordinating schemas from different sensory systems. The third stage is called *secondary circular reactions* and involves trial-and-error learning and attempts to make events happening outside their body occur again. It occurs from 4-8 months.

Substage four, occurring from 8-12 months, is called *coordination of secondary schemas* and involves the child trying to get what they want and involves the combination of schemas to do so. This leads to *tertiary circular reactions* lasting from 12-18 months and is when the child begins experimenting or finding new ways of exploring their world and manipulating objects. Finally, *mental representation* lasts up to 24 months and involves the use of symbols to represent objects. The child may use a block to represent a cell phone and have a conversation much like their father does. This involves imitation, though the behavior does not have to occur in the presence of the model which recall is *deferred imitation*. The child may use the block as a cell phone in the middle of the day when the father is at work, remembering what they saw the night before.

Piaget also said that during the sensorimotor stage infants acquire *object permanence* or knowing that an object continues to exist even though we cannot see it. During the first few months it is basically “out of sight, out of mind” and around 2 months of age or substage 2, infants demonstrate a rudimentary understanding of an object’s permanency. The skill really shows signs of developing by 6 months of age or substage 3 and continues to grow after this, particularly up to about 12 months or substage 4.

13.1.3. Preoperational Stage

Piaget's stage of cognitive development prevalent from about age 2-7 is called the **preoperational stage** and is characterized by acquisition of the symbolic function. There is less dependence on sensorimotor activity to learn about the world and mental reasoning emerges. Piaget said children at this stage show *centration* or the tendency to focus only on one aspect of a situation at the exclusion of others. Related to this, Piaget believed that children could not take another person's point of view because they see the world only from their frame of reference, which he called *egocentrism* (Piaget, 1954). Children also show *animistic thinking* or assigning lifelike qualities to inanimate objects and have trouble with *reversibility* or reversing the order of operations such as they understand that 3 times 5 equals 15 but do not realize that 15 divided by 5 equals 3.

Preoperational children have also not developed *conservation* or understanding that an object is fundamentally the same despite changing its properties. For instance, if two glasses are filled with the same amount of liquid and children confirm they are the same, and we take one glass and pour it into a flat container which stands much lower than the glass, children will choose the glass if asked which one they want. When asked why they say that the glass has more liquid than the container.

13.1.4. Concrete Operations Stage

Piaget's third stage of cognitive development is **concrete operations.** Children now understand conservation, reversibility, and cause and effect but their thinking is still grounded in concrete experiences and concepts. They can now *decenter* or take multiple aspects of a situation into account due to them being less egocentric.

13.1.5. Formal Operations Stage

Piaget's fourth and final stage of cognitive development is **formal operations** which begins in adolescence and lasts into adulthood. Teens become capable of abstract thinking and understand that ideas can be compared and classified, just as objects can. They search systematically for answers to questions/problems that they experience. Piaget said there are two major developments at this time. First, *propositional thought* is when teens gain the ability to examine the logic of verbal statements without referring to real-world situations. This leads to many debates with their parents over the morality of rules and curfews. Second, *hypothetico-deductive reasoning* is the use of the scientific method to test theories with hypotheses. It begins with a general theory of all possible factors that could affect the outcome and from them, deduces specific hypotheses about what may happen. These hypotheses are then tested in an orderly fashion to see which ones hold up in the real world.

13.2. The Elements of Cognition

Section Learning Objectives

- Define cognition.
- Describe the four main elements of cognition.

13.2.1. What is Cognition?

Cognition concerns thinking and includes such processes as attention, learning, memory, language, reasoning, decision making, problem-solving, and learning. It consists of four main elements — concepts, schemas, propositions, and images.

13.2.2. Concepts

Concepts are mental categories of objects, ideas, abstractions, events, relations, or activities that have common properties and are shared by all members of the category.
The concept of "textbook" includes having a table of contents, preface, chapters with summaries at the end of each, a glossary, index, and references. Concepts summarize information making it manageable and allow us to make comparisons. If we were asked which was heavier, a feather or a brick, we would be able to decide easily based on our concept of each object. Concepts can take two forms — formal and natural.

Formal concepts are more rigid and defined for us as in the case of a square. All squares have four equal sides and four right angles. **Natural concepts** have only a typical set of characteristics. An example is the natural concept of *bird* and the characteristic of being able to fly. An exception to this is the penguin which has wings but cannot fly as we typically think of flying. They instead "fly" underwater at speeds of up to 15 to 25 miles per hour but like other birds, lay eggs and raise their chicks on land.

When trying to determine if something belongs in a natural concept, we need to compare it against a member that shares most of the characteristic features. This member is called a **prototype.** In our example, a penguin was found to be a bird, but maybe not the best example since it does not fly in the typical sense. Instead, a prototypical bird would be a pigeon or a woodpecker and a person would not have trouble deciding quickly if it was one.

13.2.3. Propositions

Propositions are units of meaning that are composed of concepts and express a relationship between the concepts. They express a unitary or single idea and can express nearly any type of knowledge. Let's say we consider our friend, John, to be a good friend. This would be an example of a proposition. What if he spoke some gossip about another friend and so we had to resolve the cognitive dissonance this event created in relation to our previously held belief or proposition. We want to believe it is true and Chris is a good friend, but we have evidence to the contrary which creates tension.

13.2.4. Schemas

Propositions are linked together in a network of associations, knowledge, beliefs, and expectations called schemas. A **schema** is an organized way of making sense of experience.

13.2.4.1. Types of schemas. We have several types of schemas that we use to assign meaning to our world. First, there are **role schemas**, which relate to how people carrying out certain roles or jobs are to act. For instance, what it the role schema you have for someone working in your Human Resources office at work? What about the cashier at your local grocery store?

Another schema we have is called the **person schema** and relates to certain types of people such as firefighters, geeks, or jocks. For each of these people, we have specific beliefs and expectations about what their personality is like and how they are to behave in various situations. What traits do you believe cheerleaders hold?

The final schema is called an **event schema** or **script**. This type of schema tells us what is to occur in certain situations such as at a party or in a chemistry lab. The parking garage I use daily requires me to swipe my card as I enter. Now the garage houses more than just those with my special permit. It is used as a public parking lot too. Recently, the gate as you exit has been broken and so left up. Usually, when I leave I would swipe my card again, thereby causing the gate to go up. What I have to do when entering and exiting the lot is usually pretty clear. Since the gate is just up now, I have been confused about what to do when I get to the pay station. I have been trying to swipe my card again but really, it is not needed. The gate is up already. I finally asked what to do and the parking attendant told me that those with parking permits can just pass through. Until this point, I was afraid to just go through, even though I have an orange permit sticker on the bottom left of my windshield. I was not sure if the university would consider my behavior to be trying to skip payment and send the police after me. The broken gate has left my event schema in turmoil. Hopefully, it is fixed soon. That is the gate, not my event schema. I guess you could say by fixing the gate they restore my event schema too.

Let's put them all three schemas together. Imagine you are at a football game for your favorite team, whether high school, college, or professional. Who are some of the people there? Fans, coaches, players, referees, announcers, cheerleaders, and medical staff are all present. We expect the fans to be rowdy and supportive of the team by doing the wave or cheering. We expect the head coach to make good decisions and to challenge poor decisions by the referees. To that end, we expect the referees to be fair, impartial, and accurate in the judgments they make. We would not be surprised if they threw a flag or blew a whistle. Cheerleaders should be peppy, cheerful, and do all types of gymnastics on the field and wave pom poms, etc… These are the main people involved in the football game. In terms of roles, the head coach fulfills the role of leader of the team along with the Quarterback. The role of promoting team spirit and energizing the crowd goes to the cheerleaders and maybe some key players on the field. The medical staff is there to diagnose and treat injuries as they occur and so their role is to keep everyone safe. Finally, what do we do as a fan when we attend a football game? We have to enter the stadium and likely go through a search of our bags and present our ticket. We walk to our assigned seat. Though we cheer our team on, we need to be respectful of those around us such as not yelling obscenities if children are nearby. We also are expected to participate in the wave and sing the team's fight song, etc…. This is the event schema that dictates our behavior.

13.2.4.2. Benefits of schemas. It should not be surprising to learn that schemas *make cognitive processing move quicker*. But they *also complete incomplete pictures* in terms of what we know about someone. Though we may not know Johnny personally, placing him in the schema football player helps us to fill in these blanks about what his personality is like and how he might behave. Using our schema for football player we can now *predict* what a *future interaction* with Johnny might involve. Let's say he is assigned to be our lab partner in chemistry. We use our schema to make a quick assessment if the experience of working with him might be pleasant or unpleasant and we might be able to predict what his level of involvement in the project will be as well as the potential quality of his work.

13.2.5. Mental Images

Mental images are like pictures in the mind's eye. If you are asked to picture an apple in your mind, can you do it? Maybe we recall previous times when we saw, touched, smelled, or tasted an apple. As we recall more and more memories, we can form a more complete mental image. Or maybe we have had limited experience with an apple, or maybe some exotic fruit, and so seek them out to gain additional sensory information? These images become more complete as we gain additional information either from existing memories or new information from our world. In the case of the latter, we learn about the object in question.

13.3. Problem-Solving: When We Seek Solutions

Section Learning Objectives

- Define problems.
- Describe insight learning.
- Define and exemplify functional fixedness.

Let's face it. Hardly anything in life runs smoothly. Even with the best-laid plan, and clearest goals we can formulate, success can be elusive. We might even be unsure how to proceed or to solve what are called **problems** or when we cannot achieve a goal due to an obstacle that we are unsure how to overcome. In Section 10.4.2 we discussed Gestalt principles of perceptual organization but in this section, we focus on what they said about problem-solving. Simply, when it comes to problem-solving, the Gestalt psychologists said that we had to proceed from the whole problem down to its parts. How so? Kohler studied the problem-solving abilities of chimpanzees and used simple props such as the bars of the cages, bananas, sticks, and a box. Chimps were placed in a cage with bananas hanging overhead. They could use any prop they needed to get them, but no one prop alone would suffice. The chimps had to figure out what combination of props would aid them in getting the bananas. At first, they did not do well but then out of nowhere saw the solution to the problem. He called this *insight learning* or the spontaneous understanding of relationships. The chimps had to look at the whole situation and the relationships among stimuli, or to restructure their perceptual field, before the solution to the problem could be seen.

One obstacle to problem-solving is what is called **functional fixedness** or when we focus on a typical use or familiar function of an object. Duncker (1945) demonstrated this phenomenon using what he called the candle problem. Essentially, participants were given candles, tacks, and matches in a matchbox and were asked to mount a candle on a vertical corkboard attached to the wall such that it would not drip wax on the floor. To successfully complete the task, the participant must realize that the matchbox can be used as a support and not just a container. In his study, Duncker presented one group with small cardboard boxes containing the materials and another group with all the same materials but not in the boxes (they were sitting beside the boxes). The group for which the materials were in the boxes found the task more difficult than the group for which the materials were outside. In the case of the latter, these participants were able to see the box as not just a container, but as another tool to use to solve the problem.

As you can see from the candle problem, and other related problem-solving tasks, we sometimes have to think outside of the box or to demonstrate *creativity*. This is called **divergent thinking** or thinking that involves more than one possible solution and that is open-ended. Part of the open-endedness is coming up with ideas on how to solve the problem, which we call *brainstorming*. Really, any idea could have merit so just saying whatever comes to mind is important.

13.4. Reasoning: Making Good Decisions, And Learning from Them

Section Learning Objectives

- Differentiate deductive from inductive reasoning.
- Define heuristics and describe types.
- Outline errors we make when reasoning.

13.4.1. Types of Reasoning

Though you are sitting in a college classroom now, how did you get there? Did you have to choose between two or more universities? Did you have to debate which area to major in? Did you have to decide which classes to take this semester to fit your schedule? Did you have to decide whether you were walking, riding a bike, or taking the bus to school? To answer any of these questions, you engaged in reasoning centered on making a good decision or judgment. There are two types of reasoning we will briefly discuss — formal or deductive and informal or inductive.

First, we use **formal** or **deductive reasoning** when the procedure needed to draw a conclusion is clear and only one answer is possible. This approach makes use of *algorithms* or a logical sequence of steps that always produces a correct solution to the problem. For instance, solve the following problem:

$3x + 20 = 41$

- Step 1 — Subtract 20 from both sides resulting in: $3x = 21$
- Step 2 — Divide each side by 3 resulting in $x = 7$
- Check your answer by substituting 7 for x in the original problem resulting in $21+20=41$ which is correct.

Deductive reasoning also uses the *syllogism* which is a logical argument consisting of premises and a conclusion. For example:

- Premise 1 — All people die eventually.
- Premise 2 — I am a person.
- Conclusion — Therefore, I will die eventually.

Second, **informal** or **inductive reasoning** is used when there is no single correct solution to a problem. A conclusion may or may not follow from premises or facts. Consider the following:

- Observation — It has snowed in my town for the past five years during winter.
- Conclusion — It will snow this winter.

Though it has snowed for the past five years it may not this year. The conclusion does not necessarily follow from the observation. What might affect the strength of an inductive argument then? First, the number of observations is important. In our example, we are basing our conclusion on just five years of data. If the first statement said that it snowed for the past 50 years during winter, then our conclusion would be much stronger. Second, we need to consider how representative our observations are. Since they are only about our town and our conclusion only concerns it, the observations are representative. Finally, we need to examine the quality of the evidence. We could include meteorological data from those five years showing exactly how much snow we obtained. If by saying it snowed, we are talking only about a trace amount each year, though technically it did snow, this is not as strong as saying we had over a foot of snow during each year of the observation period.

13.4.2. Heuristics and Cognitive Errors

We use our past experiences as a guide or shortcut to make decisions quickly. These mental shortcuts are called **heuristics.** Though they work well, they are not fool proof. First, the *availability heuristic* is used when we make estimates about how often an event occurs based on how easily we can remember examples (Tversky & Kahneman, 1974). The easier we can remember examples, the more often we think the event occurs. This sounds like a correlation between events and is. The problem is that the correlation may not actually exist, called an *illusory correlation*.

Another commonly used heuristic is the *representative heuristic* or believing something comes from a larger category based on how well it represents the properties of the category. It can lead to the *base rate fallacy* or when we overestimate the chances that some object or event has a rare property, or we underestimate that something has a common property.

A third heuristic is the *affect heuristic* or thinking with our heart and not our head. As such, we are driven by emotion and not reason. Fear appeals are an example. Being reminded that we can die from lung cancer if we smoke may fill us with dread.

In terms of errors in reasoning, we sometimes tend to look back over past events and claim that we knew it all along. This is called the *hindsight bias* and is exemplified by knowing that a relationship would not last after a breakup. *Confirmation bias* occurs when we seek information and arrive at conclusions that confirm our existing beliefs. If we are in love with someone, we will only see their good qualities but after a breakup, we only see their negative qualities. Finally, *mental set* is when we attempt to solve a problem using what worked well in the past. Of course, what worked well then may not now and so we could miss out on a solution to the problem.

13.5. Intelligence – Putting Our Learning to Good Use

Section Learning Objectives

- Define intelligence.
- Contrast the two main types.
- Describe the development of intelligence tests over time.
- Propose whether intelligence is more complex than we first thought.
- Define emotional intelligence (EI).
- List and discuss EI's four core skills and two primary competencies.
- Clarify what research says about EI and its benefit.

13.5.1. What is Intelligence?

Intelligence includes the ability to solve problems, acquire language and knowledge, think abstractly, adapt to one's environment, and engage in the manipulation of one's environment. It consists of two types – crystalized and fluid. **Crystalized intelligence** is our accumulated knowledge acquired across life. **Fluid intelligence** is used when we solve problems, remember information, and reason abstractly.

13.5.2. The Development of Intelligence Tests

In 1890, while at the University of Pennsylvania, James McKeen Cattell (1860-1944) coined the term mental tests or tests of motor skills and sensory functioning. They included rate of movement, just noticeable differences in judging weights, time to name colors, reaction time for sound, and dynamometer pressure. Though Cattell coined the term, Francis Galton (1822 – 1911 and mentor of Cattell) originated the idea and believed intelligence was linked to a person's sensory capabilities such that individuals with greater intelligence would have more advanced sensory functioning. Were Galton and Cattell correct? In 1901 Cattell obtained enough data to be able to correlate test scores with academic performance. The results produced extremely low correlations leading Cattell to conclude that the tests were not adequate predictors of college performance or intellectual ability.

Unlike Galton and Cattell who focused on sensorimotor functioning, Alfred Binet (1857-1911) believed intelligence should be measured through cognitive processes such as learning, memory, attention, and comprehension. He had a chance to develop a test when the French Ministry of Education appointed Theodore Simon and himself to identify children who were having difficulties in school so that remedial work could be assigned to them. The ministry was reluctant to ask teachers to undertake the task as they feared bias would creep into the decision. A more objective approach was needed. Binet and Simon's work yielded a test consisting of 30 problems assessing comprehension, reasoning, and judgment. It was revised three years later to include the concept of *mental age* or a child's level of intellectual development compared to other children. Let's say a six-year-old child is given the test and performances as well as seven-year-old children given the same test, then he would be assigned a mental age of seven.

After Binet's death in 1911, the development of intelligence tests shifted to the United States. Henry Goddard translated Binet's test and presented it to American psychologists in 1908. He called his translation the *Binet-Simon Measuring Scale for Intelligence*. In 1916 Lewis Terman developed the *Stanford-Binet Test*, named after the university he was affiliated with, and introduced the concept of **intelligence quotient (IQ)**, or a measure of intelligence calculated by dividing the child's mental age by his/her chronological age and multiplying by 100. If a child's mental age and chronological age were the same, he/she would have an IQ of 100, considered to be “average” intelligence. If a child had a mental age of 7 and a chronological age of 5, his/her IQ score would be 140 and above average. Finally, a mental age of 8 and chronological age of 10 yields an IQ of 80 or below average.

Today, the Stanford-Binet test is still used though other scales have been created too. David Wechsler designed a test only for adults, the Wechsler Adult Intelligence Scale (WAIS). Later, the Wechsler Intelligence Scale for Children (WISC) was created. The two Wechsler tests include a general IQ score as well as scores for different types of abilities to include perceptual reasoning, working memory, verbal comprehension, and processing speed.

13.5.3. Types of Intelligence

The discussion of the development of IQ tests leads us to one important question — is there more than one type of intelligence? To examine this question, the work of Robert Sternberg and Howard Gardner will be examined briefly.

13.5.3.1. Sternberg’s triarchic theory of intelligence. Sternberg proposed his **triarchic theory of intelligence** which says there are three different types (Sternberg, 1988). **Componential (analytic) intelligence** is the first. This type of intelligence is measured by traditional intelligence tests and aids you in solving problems by first identifying a problem, deciding on a strategy to solve it, learning and then executing the strategy, and finally evaluating the result of your strategy. **Creative (experiential) intelligence** is the type of intelligence used to compose music. People with this ability cope with new situations well and learn quickly. **Practical (contextual) intelligence** reflects your ability to adapt to your environment or to consider the different contexts you may find yourself in. This type of intelligence would help you figure out what to do if stranded in the forest.

13.5.3.2. Gardner's multiple intelligences. Howard Gardner (Gardner, 1999) proposed the existence of several intelligences, each which involve a different set of skills and which can function independently of one another. They include linguistic (verbal skills), logical-mathematical (math and reasoning skills), and spatial (relationships between objects) intelligences which are the only three of the eight assessed by standard IQ tests, as well as musical (shown through skills in tempo and rhythm), body-kinesthetic (having skill in dancing and athletics), intrapersonal (self-understanding), interpersonal (how well you interact with others), and naturalistic (seeing patterns in nature).

We may also develop some of these intelligences more than others. To assess these other intelligences, Gardner suggests assessing a child's music ability, sampling writing, and asking teachers what strengths and weaknesses students have in terms of athletic ability and social skills.

13.5.4. Emotional Intelligence

Emotional intelligence or **EI** is our ability to manage the emotions of others as well as ourselves and includes skills such as empathy, emotional awareness, managing emotions, and self-control. According to a 2014 Forbes article by Travis Bradberry, EI consists of four core skills falling under two primary competencies: personal and social.

First, *personal competence* focuses on us individually and not on our social interactions. Through personal competence, we are *self-aware* or can accurately perceive our emotions and remain aware of them as they occur. We also can engage in *self-management* or using this awareness of our emotions to stay flexible and direct our behavior to positive ends.

Second, *social competence* focuses on social awareness and how we manage our relationships with others. Through it, we can understand the behaviors, moods, and motives of others. This allows us to improve the quality of our relationships. In terms of *social awareness*, we pick up on the emotions of others to understand what is going on. *Relationship management* allows us to be aware of the emotions of others and ourselves so that we can manage interactions successfully.

EI is not the same as IQ or intelligence quotient as EI can be improved upon over time while IQ cannot. This is not to say that some people are not naturally more emotionally intelligent than others, but that all can develop higher levels of it with time.

How do we effectively use emotional intelligence? Mayer and Salovey (1997) offer four uses. First, *flexible planning* involves mood swings which cause us to break our mindset and consider other alternatives or possible outcomes. Second, EI fosters *creative thinking* during problem-solving tasks. Third, the authors write that "*attention* is directed to new problems when powerful emotions occur." Attending to our feelings allows us to shift from one problem to a new, more immediate one (consider that this can be adaptive too). Finally, moods can be used to motivate *persistence* when a task is challenging. Anxiety about an impending test may motivate better preparation or concern about passing preliminary examinations or may motivate a graduate student to pay extra careful attention to details in the research articles he/she has been assigned.

Utilizing a sample of 330 college students, Brackett, Mayer, and Warner (2004) found that women scored higher than men on EI and that lower EI in males was associated with maladjustment and negative behaviors such as illegal drug and alcohol use, poor relationships with friends, and deviant behavior. Individuals scoring higher in the ability to manage emotions were found by Lopes, Salovey, and Staus (2003) to report positive relations with others, report fewer negative interactions with their close friends, and to perceive greater levels of parental support. They also found that global satisfaction with relationships was linked to effectively managing one's emotions, the personality trait of extraversion (positive correlation), and was negatively associated with neuroticism. In terms of the academic performance of students in British secondary education, those high in EI were less likely to have unauthorized absences or be excluded from school and demonstrated greater levels of scholastic achievement (Petrides, Frederickson, & Furham, 2004) while EI is also shown to be related positively to academic success in college (Parker, Summerfeldt, Hogan, & Majeski, 2004).

Finally, Ciarrochi, Deane, and Anderson (2002) investigated the relationship of stress with the mental health variables of depression, hopelessness, and suicidal ideation. They found that stress was related to greater reported levels of the three mental health variables for those high in emotional perception and suicidal ideation was higher in those low in managing other's emotions.

13.6. Learning Disabilities

Section Learning Objectives

- Describe the presentation and associated features of ID.
- Describe the presentation and associated features of LDs.
- Clarify the differences and similarities between ID and LD.
- Describe treatment options for ID and LDs.

In the final section of Module 13, we will discuss matters related to intellectual disability and learning disorders. Be advised a more thorough description of these disorders is beyond the scope of this book, but you can read more in the *Behavioral Disorders of Childhood* OER by Kristy McRaney, Alexis Bridley, and Lee Daffin (2021) by visiting:

https://opentext.wsu.edu/behavioral-disorders-childhood/chapter/module-7-intellectual-disability-intellectual-developmental-disorder-ididd-learning-disorders/

13.6.1. What is Intellectual Disability?

At the core of an Intellectual Disability is a deficit in cognitive or intellectual functioning. Historically, we labeled individuals with this presentation of deficits as having Mental Retardation. Due to significant stigma and social misuse of the term, when the DSM 5 was published, the term changed from Mental Retardation to Intellectual Disability (also described as an Intellectual Developmental Disorder). While the terms Intellectual Disability and Intellectual Developmental Disorder are considered interchangeable, we will use the term Intellectual Disability (ID) for the purposes of this book. This disorder leads to two primary areas of major deficits – cognitive functioning and adaptive functioning (APA, 2013).

13.6.1.1. Cognitive functioning. Cognition or intellectual functioning refers, in a general sense, to our ability to problem solve, understand and analyze complex material, absorb information from our environment, and reason. An individual with ID has a significant deficit in this area. Cognitive functioning is most often measured using an intelligence test (more on this later in this chapter). An IQ score under 70 – 75 indicates a severe deficit in cognitive functioning, although there is some flexibility within this criterion.

13.6.1.2. Adaptive functioning. Adaptive skills are skills that help us navigate our daily lives successfully such as understanding safety signs in our environment, making appointments, interacting with others, completing hygiene routines, etc. Essentially, these are the skills that one would ultimately need to live independently. Individuals with ID typically have adaptive skills that are far below what would be expected given their chronological age. This is typically measured by a standardized scale (more on this later, as well).

When both cognitive and adaptive functioning is delayed, the likelihood of ID is high. ID is also categorized into different severities based on the level of delays related to adaptive functioning. The more support someone needs, the more severe the ID diagnosis. Severity ranges from mild (least severe), moderate, severe, and profound (most severe; APA, 2013).

ID is present in the early neurodevelopmental period. As such, it is most frequently diagnosed in children. ID is not something one would "acquire" in adulthood. If an individual experiences cognitive and adaptive function decline in later years, this is not considered ID (which is a neurodevelopmental disorder) but is more likely a neurocognitive disorder that may be due to several things (e.g., traumatic brain injury, dementia). As such, although an individual can go undiagnosed until adulthood, and then as an adult be diagnosed with ID, there must be significant and indisputable evidence of cognitive delay and adaptive functioning delay in the early developmental time period. Otherwise, an adult would not be diagnosed with ID.

13.6.2. What Are Specific Learning Disabilities?

A learning disorder is characterized by the inability or difficulty processing academic or functional information in our environment (APA, 2013). Despite an ability to cognitively achieve similar to peers, an individual is delayed in learning in a particular area. More specifically, academic tasks are challenging within one or more areas, which results in significant academic impairment (APA, 2013). Historically, we diagnosed LDs when there was a significant discrepancy between an individual's cognitive/intellectual ability (as measured by an intelligence test) and their academic achievement (as measured by a standardized achievement test) as this was required by the DSM-IV-TR criteria. This method is referred to as the *discrepancy model.* While many still do this, and there is nothing in the DSM 5 that disallows this practice, the DSM 5 criteria were rewritten to allow for more flexibility. Ultimately, a discrepancy between one's IQ and academic achievement is no longer required; however, there must be specific data that indicates an individual is performing significantly below what would be expected given their age.

In addition to significant academic deficits, there must be evidence that efforts (e.g., tutoring, increased and specialized instruction) to improve one's abilities within the specific area have been made, before assigning a diagnosis of an LD. This is to ensure that an individual has had full access to educational material and support before a professional assigns a diagnosis to them. In school systems, tiered interventions have come into play (more on this in the Interventions section).

When considering LDs, there are three specific areas that are considered: reading, mathematics, and written expression. For example, a professional would diagnose an individual with a *specific learning disorder with impairment in reading*. An individual may have a diagnosis of only one LD, or multiple LDs.

Reading — This relates to an individual having difficulty in reading, may that be in comprehending material, reading fluently and quickly, or reading words accurately.

Mathematics — This may be related to simple calculation abilities such as math facts or more complex problem-solving and reasoning abilities.

Written expression — This may refer to the ability to accurately spell words or punctuate and use correct grammar, or it may include one's ability or create written work that is well-organized and comprehendible.

13.6.2.1. Matters of dyslexia and dyscalculia. Technically, dyslexia and dyscalculia are not actual diagnoses in the DSM 5; rather they are alternative terms used to describe learning disorders in reading (dyslexia) and math (dyscalculia). *Dyslexia* is the presence of a significant deficit related to fluent word recognition, decoding, and spelling (APA, 2013). *Dyscalculia* is the presence of significant deficits related to "problems processing numerical information, learning arithmetic facts, and performing accurate or fluent calculations" (APA, 2013). Although these two terms are used very frequently in school systems and by other professionals such as speech/language pathologists they are considered alternative terms in the DSM 5, not diagnoses, and as such psychologists cannot use these terms when diagnosing a patient. Instead, they assign a diagnosis of s*pecific learning disorder with impairment in reading* (for dyslexia) and a *specific learning disorder with impairment in mathematics (*for dyscalculia). They can provide an explanation and rationale that the individual's deficits are characteristic of the pattern of deficits seen in individuals with dyslexia or dyscalculia. This is an excellent example of how professionals sometimes will discuss the same phenomenon but use different terminology.

13.6.3. Differences and Similarities between ID and LD.

Although ID and LDs may seem very similar, it is important to not confuse the two as they are different. When thinking about both disorders, we have three different core areas to consider: adaptive functioning, cognitive/intellectual ability (IQ), and academic achievement. A rudimentarily way to think about this is — with ID we are concerned with adaptive functioning and IQ and with LD we are concerned with IQ (sort of) and academic achievement. Although IQ matters (sort of) in both disorders, the reason they are important vary slightly. However, because IQ is considered in both disorders, people often intertwine and confuse the two disorders.

Think about it like this: IQ essentially is what we are cognitively able to do — what we *can* do. Adaptive skills and academic achievement is what we *are* doing.

13.6.3.1 Intellectual disability. If we *cannot* perform in the average range on an IQ test **and** we *are not* performing daily living tasks appropriately (for our particular age — let's not forget that we would not expect a 7-year-old to make their own doctor's appointment. We would, however, expect a 7-year-old to know to dial 911 in an emergency), then this is indicative of an ID.

13.6.3.2. Learning disorders. If we *can* achieve an average level of skill (meaning our IQ is average), but we *are not* achieving an average level of academic achievement in an area, that leads us to be puzzled, right? If we *can* do something, but we *are not*, that does not make sense. But what if we *cannot* perform average (meaning our IQ is not average, but substantially below average)? Would we expect the individual to perform averagely on academic tasks? For example, if someone's IQ is 65 (*cannot* function typically on a cognitive task*)* would we expect them to have an academic achievement score of 100 (remember, this is their "*is* or *is not* doing/performing)? That is a 30-point jump from their '*can'* to their '*are doing'.* We would not necessarily expect this, right? We would expect that if someone's IQ is a 70 to have an academic score of around a 70. This isn't necessarily an LD; it is reflective of low achievement due to low cognitive abilities resulting from ID. However, if that person's IQ was 100 (*can*) and they scored a 70 (*is* not performing) on an academic achievement task, we would be concerned about an LD because what they *are* doing is not matching and measuring up to what they, theoretically, *can* do.

13.6.3.3. LDs in the cognitively delayed and in the cognitively gifted. Individuals with extreme cognitive functioning abilities often get overlooked. For example, children that are gifted, but have a reading disorder, often go undiagnosed. Think about it, their weaknesses, although areas of deficit for themselves, look like average abilities to others around them. You might be asking yourself what I mean by this. An example should help.

A 2nd-grader with a high cognitive ability gets all As. She excels in math and writing. In fact, she is far past her peers in these areas. She has long learned her multiplication and division facts and is even working on some basic geometry skills. She has a great ability to write and has been drafting paragraphs with ease and has even started learning to write essays. She loves math and writing, but she dislikes reading. When in class, she reads just like her peers, no more advanced, but right on 2^{nd}-grade-level expectations. She finds reading to be more difficult, though, and it does not come nearly as easy as math and writing. However, because she is on track compared to her peers, her teachers and parents do not recognize any issues — her grades are fine and her school standardized testing is not a problem.

What if I told you that her standardized math and writing scores matched her intellectual ability (meaning her *can* and *is/are* matched) but her reading score (*is/are*), although average, was well below what would be expected given her IQ (*can*) and is much lower than her math and writing scores (despite still being an acceptable score). Would you say she may have a reading disorder? If you said yes, you are right. If you said no, you may be right too. Fact is, this is a gray area. The old DSM would have made it easy to diagnose this child with an LD in reading. The new DSM makes it a bit tougher. However, one would be inclined, if this reading deficit (compared to her own abilities) caused impairment (internal distress, preventing her from advancing in math and writing because her reading abilities were lagging behind the other abilities), to diagnose her with an LD in reading. It is easy to see how this child would be missed and go undiagnosed for years.

Now let's reverse the scenario. Let's take a 2^{nd} grade girl who has a diagnosis of an ID. She struggles in all academic areas but her math abilities are even more behind than her reading and writing. Do you think one could make a case for an LD in math? Theoretically, they could. But it takes a lot of careful documentation of intervention attempts (see RTI discussion) and standardized testing that makes it undoubtably clear that this is true (similar to the above example).

Essentially, when individuals have an IQ that falls to the extreme (low or high), their weaknesses are often missed. As such, providers and educators must be careful and mindful to not overlook potential LDs in these individuals.

13.6.4. Treatments for Intellectual Disability

13.6.4.1. Community supports and programs. For individuals with ID, community supports may be critical during childhood, and even more so as the individual transitions to adulthood. Community supports may include organizations devoted to socialization and family support. For example, The Arc is an incredible organization that is devoted to serving individuals with developmental delays, including but not limited to ID. They often engage in advocacy efforts and offer training for the community and professionals. Moreover, they offer employment services for individuals with ID or other developmental delays. Local chapters will often host social gatherings and events for individuals and their families (The Arc, 2018). Typically, there is an Arc chapter in most major cities and areas. Other community supports may involve government-funded programming for living arrangements, supplemental income, etc.

As individuals' transition to adulthood, some programming may need to be considered related to home/living arrangements. Historically, individuals with ID were often institutionalized. However, in recent years, a strong push to deinstitutionalize care, and provide group and community home options has occurred. As such, a more common and inclusive living option for individuals may be a group home in which multiple individuals live in a home-like setting and have constant supervision and medical care as well as transportation. Another option, often referred to as supported independent living, is a situation in which fewer, perhaps four individuals, live in an apartment or similar setting, and are provided constant supervision by one individual. This is a less restrictive environment than a group home, as only one supervising staff member is present, and a nurse and other medical staff are not readily available. Moreover, individuals with ID are often capable of successful employment and these opportunities are provided in group and independent living home arrangements. Individuals with ID, depending on the severity of their intellectual impairment, may work in settings with routine tasks (e.g., assembling plasticware packets, bussing tables) in independent settings (e.g., employed independently within the community) or in 'supervised workshops' (i.e., settings where multiple individuals with disabilities are employed and provided significant help and supervision while working).

13.6.4.2. Education. Individuals with an Intellectual Disability receive an Individualized Education Plan (IEP) at their school which is federally regulated, and implemented at the state level, through the Individuals with Disabilities Education Act (IDEA), established in 2004 (IDEA, n.d.). This was enacted to ensure fair and equal access to public education for all children. An IEP outlines specific accommodations and supports a child is entitled to in the educational setting so that they can access educational material to the fullest degree.

Children with ID may receive typical academic instruction in an inclusion classroom, meaning they are in a general educational class. However, the more severe the disability, the more supports they may require. As such, this may mean the child is pulled out at periods of time to receive specialized instruction. Additionally, if the child's disability is severe, they may be placed in a self-contained classroom which is a class with a small number of kids that all have a severe disability, oftentimes with several teachers/teacher aids. Supports and accommodations may include reduced workloads, extended time to master the material, increased instructional aid, etc. Additionally, supports may also go beyond specific academic areas. For example, social skills may be a focus of an intervention.

Individuals with severe deficits related to ID will eventually have to have a determination of diploma track or not. If an individual is not placed in a diploma track, they will receive a "certificate of completion" from high school, rather than a high school diploma. Non-diploma track supports might focus heavily on functional skills rather than traditional academics. For example, rather than worrying about mastering algebra, the individual's education may focus on learning functional mathematics so that they will be able to successfully manage a grocery shopping trip/purchase.

Some **college programs** have been designed to allow individuals with developmental delays such as ID to access the college experience and receive specialized vocational instruction. For example, Mississippi State University's ACCESS program (which is an acronym for Academics, Campus Life, Community Involvement, Employment Opportunities, Socialization, and Self-Awareness) is 4-year, *non-degree* program designed for individuals that have a developmental delay, including ID. Students receive a "Certification of Completion" within a specific vocational area when they complete the program. They live on campus and are able to access the full college experience (MSU, n.d.).

13.6.4.3. Psychotherapy. Therapy is often underutilized in individuals with ID, despite beneficial impacts that research has shown when both behavioral and cognitive-behavioral therapies are utilized (Harris, 2006). Therapy often focuses on the emotional and behavioral impacts of ID, normalizing the individual's experiences, and treating comorbid depression, anxiety, or other mental health conditions (Harris, 2006). Another area of strong focus may be increasing adaptive functioning skills. For example, helping the individual complete daily hygiene, chores, etc. and learn how to navigate their home and community safely, may be a focus of therapy.

13.6.4.4. Medication. Medications to manage emotional or behavioral concerns that are occurring comorbid with an individual's ID diagnosis may be beneficial. For example, if an individual has ID and depression, an antidepressant may be beneficial to help resolve some symptoms of depression. However, medications are not utilized to "treat" ID.

13.6.5. Treatments for Learning Disorders

13.6.5.1. Education. Individuals with an LD receive an Individualized Education Plan (IEP) as well. Focus is placed on increasing instructional aids for the child. The child will often be pulled out for additional, one-on-one interventions in the academic area(s) of concern. Additionally, the child may receive additional supports such as extended time on tests and assignments, partial credit (when partial credit is not typically given in a particular class), and early access to study guides or access to study guides if a study guide is not regularly given in a particular class. A child may also be allowed to have tests read to them, especially on nonreading-related tests, such as history, when a reading impairment is noted. The reason for doing this is so that the child's performance in the nonreading-subject (e.g., science, history) is not negatively impacted by their reading deficit. The child may also be able to verbally respond to test items and have a teacher write their answers. Moreover, the child may get opportunities to correct errors on tests for additional credit, etc. These are just examples of accommodations and are not an exhaustive list. The specific accommodations and supports that are implemented should be specific to the child, their deficits, and their current needs.

Tutoring, whether occurring in school or privately, is often useful as well. This simply increases exposure to material and provides additional support and intervention. Empirically-based tutoring methods are sometimes used, particularly for children with dyslexia.

13.6.5.2. Medication. Like ID, medicine is not utilized to 'treat' an LD. However, given that ADHD is highly comorbid with LDs, ADHD-related medications may be utilized and beneficial. As chronic underachievement in an academic area may lead to anxiety and depressive states for some children, prescription medication (or psychotherapy) may also be utilized and beneficial.

Module Recap

And that's it. We have now covered the cognitive process of learning across 13 modules. Our final topic was how we learn concepts that involved a multi-faceted discussion of cognitive development across the life span and the elements of cognition, and a few complementary cognitive processes including problem-solving and reasoning, as well as intelligence. I thought it important to at least raise your awareness of issues that can make learning more difficult for some among us. As such, we discussed intellectual and learning disabilities to finish out the module.

I hope you enjoyed our discussion in this module, and across the entire book. This concludes Part 6.

Glossary

A

A-B design – A research design in ABA which includes just one rotation from baseline to treatment phase and then from that we see if the behavior changed in the predicted manner

A-B-A-B Reversal Design - A research design in ABA in which the baseline and treatment phases are implemented twice

Abolishing operation - When an event makes a reinforcer or punisher less potent and so less likely to occur

Absent-mindedness - When we forget to do things or have a lapse of attention such as not remembering where we put our keys

Abstract - A 150-250-word summary of a research article

Acceptance techniques – A cognitive behavior modification strategy in which the person comes to accept that which he/she cannot change

Accommodation - When novel information is obtained, we could update an existing schema or create a brand new one

Acquisition - The entire process of conditioning, to include when we first make the association between NS and US to its strengthening over time through repeated pairings

Adaptation - Schemas change due to direct experience with our environment

Adjusting schedule – A complex schedule in which after the organism makes 30 lever presses, the schedule changes to 35 presses, and then 40

Afferent neurons - Carry messages to the brain

Agoraphobia - When a person experiences fear specific to leaving their home and traveling to public places

Alternative activity – A different task students must be offered in lieu of participating in a research study

Amnesia - The loss of memories, such as facts, information, and experiences

Anterograde amnesia - When we experience difficulty learning new information since the onset of amnesia

Appetitive stimuli - Stimuli that an organism desires and seeks out

Applied Science – The type of science which desires to find solutions to real-world problems

Assimilation - When new information is made to fit into existing schemas

Attentional model – Model of conditioning which states that how much attention an organism will give a CS is dependent on how well the CS predicts the US

Aversive stimuli – Stimuli that are readily avoided

Avoidance theory of punishment – When an animal comes to avoid an aversive stimulus by engaging in the required behavior (i.e. moving to the other part of the shutter box) or not making an undesirable one

B

Backup reinforcers - The regular reinforcers the person has in their life that come to be associated with tokens in a token economy

Backward conditioning – When the US occurs before the NS in respondent conditioning

Baseline Phase – The phase of behavior modification before any strategy or strategies are put into effect; serves as a comparison with the treatment phase

Basic Science – The type of science concerned with the acquisition of knowledge for the sake of the knowledge and nothing else

Behavior - What people do, say, or think/feel

Behavioral contract - A written agreement between two people in which at least one of the two have agreed to engage in a specific level of the target behavior

Behavioral deficit – A behavior we want to increase as it is currently either not being performed or being performed not at the desired level.

Behavioral definition - A precise, objective, unambiguous description of the target behavior or a competing behavior

Behavioral excess – A behavior that we want to decrease because it is causing us some type of trouble in our life

Bias - When current knowledge, beliefs, and feelings skew our memory of past events

Biological preparedness - Says that organisms tend to learn some associations more readily than others

Blocking - When we experience the tip-of-the-tongue phenomena and just cannot remember something

Blocking - The compound stimulus is composed of a NS and a CS and the established CS interferes with learning a new CS relationship

Break point – When the rate of behavior decreases sharply or completely stop

C

Case studies – A detailed description of one person or a small group based on careful observation

Central executive – Tells us where to focus our attention and can even home in on specific aspects of a stimulus

Chained schedule - A reinforcer is delivered after the last in a series of schedules is complete, and each schedule is controlled by a specific stimulus

Change blindness – When we fail to notice a difference in two pictures presented in rapid succession, compared to side-by-side

Changing-Criterion Design – A research design in ABA in which the performance criteria changes as the subject achieves specific goals

Chunking – Taking larger lists of unrelated and meaningless material and grouping them into smaller, meaningful units

Cognition – a thought

Cognition - Concerns thinking and includes such processes as attention, learning, memory, language, reasoning, decision making, problem solving, and learning

Cognitive behavioral therapy – A type of therapy which focuses on exploring relationships among a person's thoughts, feelings and behaviors and seeks to reduce maladaptive cognitions

Cognitive coping skills training – A cognitive behavior modification strategy which teaches social skills, communication, and assertiveness through direct instruction, role playing, and modeling

Cognitive restructuring, also called rational restructuring – A cognitive behavior modification strategy in which maladaptive cognitions are replaced with more adaptive ones

Compensatory-response model – States that a CS that has come to be repeatedly associated with the a-process or primary response to a US will with time, elicit a compensatory response or b-process

Competing behavior - A behavior which interferes with the successful completion of a target behavior

Competing response – In habit reversal, this is a behavior that is incompatible with the habit and makes it occurrence nearly impossible or difficult

Complex schedules - Schedules characterized by being a combination of two or more simple schedules

Compound stimulus - When we are presented with two or more stimuli simultaneously

Concepts - Mental categories of objects, ideas, abstractions, events, relations, or activities that have common properties and are shared by all members of the category

Concrete operations – The stage of cognitive development in which children now understand conservation, reversibility, and cause and effect but their thinking is still grounded in concrete experiences and concepts

Concurrent schedule – A complex schedule which presents an organism with two or more simple schedules at one time and it can choose which to follow

Conditioned emotional response (CER) technique – A procedure in which a subject is trained to press a bar and once responding reliably, is presented with a NS in the form of a light, tone, or noise paired with a mild foot shock (US) which causes fear (UR); in time the NS/CS alone elicits fear (CR)

Conditioned response – The response which is elicited by a CS, though it is not the same as the UR

Conditioned stimulus – The initially neutral stimulus that has been associated with a naturally occurring stimulus to bring about a response

Conditioned suppression theory of punishment - This theory asserts that punishment does not occur due to a weakening of a behavior, but because an emotional response is produced that interferes with the behavior's occurrence

Conditioning trial - The pairings of NS and US each represent a single trial

Conjunctive schedule – A complex schedule with two or more simple schedules which must have their conditions met before reinforcement is delivered

Connectionism – The idea that stimulus and responses were connected by the organism and this lead to learning; according to Thorndike

Contingency - When one thing occurs due to another; in terms of enhancing the effectiveness of reinforcers and punishers, it refers to the uniqueness of the consequence to the situation

Contiguity - Occurs when two events are associated with one another because they occur together closely, either in time (temporal) or space (spatial)

Contrived reinforcers – Reinforcers that are arranged to modify a behavior

Control group – The group in an experiment that does not receive the treatment or is not manipulated

Controlled response - The altered response

Controlling responses - Responses that do the altering

Cooperative schedule – A complex schedule which requires two organisms to meet the requirements together

Correlational Research – A research method which examines the relationship between two variables or two groups of variables

Counterconditioning - The reversal of previous learning

Covert - Behavior cannot be observed

Criterion - The specific "trigger" for when we advance from one goal to the next

Critical thinking - Our ability to assess claims made by others and make objective judgments that are independent of emotion and anecdote and based on hard evidence

D

Debriefed - When the true purpose of a study is revealed and participants are told where to go if they need assistance and how to reach the researcher if they have questions

Deception – When researchers intentionally withhold the true purpose of the study from participants

Deductive reasoning - When the procedure needed to draw a conclusion is clear and only one answer is possible

Deferred imitation - When we observe a model but do not show such learning until a later time

Delay conditioning - Involves the presentation of the NS before the US, but the NS overlaps with the US for a short period of time

Dependent variable – The variable in an experiment that is measured

Descriptive statistics – A type of statistic that provides a means of summarizing or describing data, and presenting the data in a usable form

Determinism - Says that every act is determine or caused by past events

Differential reinforcement – When we attempt to get rid of undesirable or problem behaviors by using the positive reinforcement of desirable behaviors

Differential Reinforcement of Alternative Behavior (DRA) - When we reinforce the desired behavior and do not reinforce undesirable behavior

Differential Reinforcement of High Rates of Responding (DRH) – When we reinforce a behavior occurring at a high rate or very often or seek to increase a behavior

Differential Reinforcement of Incompatible Behavior (DRI) – This strategy delivers a reinforcer when another behavior is used instead of the problem behavior; we substitute the behavior

Differential Reinforcement of Low Rates of Responding (DRL) – When we want to reduce the occurrence of a behavior, not eliminate it

Differential Reinforcement of Other Behavior (DRO) - When we deliver a reinforcer contingent on the absence of an undesirable behavior for some period

Discriminated avoidance procedure -An animal is provided with a signal that an aversive event is about to occur but has enough time to engage in a behavior to avoid this event

Discriminated behavior - When a behavior is more likely to occur in the presence of the S^D and not the S^Δ

Discriminative stimuli (also called a S^D) - When cues in the environment bring about a specific behavior

Discrimination hypothesis - Says that it is more difficult to discriminate between extinction and the partial schedule than it is extinction and the continuous schedule

Discrimination training - Involves the reinforcement of a behavior when one stimulus is present but extinguishing the behavior when a different stimulus is present

Discussion – In this section of a research article the researcher restates the main findings and hypothesis of the study, offers an interpretation of the findings and what their significance might be, and states strengths and limitations of the study which then allows for a listing of future directions

Dishabituation - Occurs when an organism's state of arousal is enhanced leading to an increase in the response that previously was habituated

Distal goals – Goals that are far off in the future

Distracted - When one stimulus interferes with our attending to another

Dual-process theory – States that the processes of habituation and sensitization are controlled by different mechanisms; habituation is controlled by the S-R system and sensitization by the state system

Dualism - Asserts that the body, as an extension of the physical world, functions much like a machine and produces involuntary, reflexive responses to external events while the *mind* has free will and produces voluntary behaviors

Duration - A measure of how long the behavior lasts

E

Efferent or **motor neurons** - Send commands out of or away from, the nervous system

Elicited behaviors - Behaviors that occur due to a specific environmental stimulus

Emotional intelligence or **EI** - Our ability to manage the emotions of others as well as ourselves and includes skills such as empathy, emotional awareness, managing emotions, and self-control

Empiricism - States that knowledge arises from sensory experience

Enactive learning - Learning by doing

Establishing operation - When an event makes a reinforcer or punisher more potent and so more likely to occur

Evaluative conditioning - When our initial evaluation of a stimulus changes due to it being associated with another stimulus that we already like or dislike

Exchange rate - How many tokens are needed to purchase a backup reinforce in a token economy

Excitatory conditioning – When the NS is associated with the presentation of the US

Experimental group – The group in an experiment that does receive the treatment or manipulation

Experiments – A controlled test of a hypothesis in which a researcher manipulates one variable and measures its effect on another variable

Extinction – When the CS is no longer paired with the US leading to no response when the CS is presented again

Extinction burst - When extinction first occurs, the person or animal is not sure what is going on and actually begins to make the response more often (frequency), longer (duration), and more intensely

Extrinsic reinforcement – States that some sources of reinforcement come from outside us, or are external

F

Fading - The gradual removal of a prompt(s) once the behavior continues in the presence of the S^D

Fast mapping - When children ascertain the meaning of a word from how it's used in a sentence (its context), what word it is contrasted with, and previous knowledge of words and word categories

Fixed duration (FD) schedule – States that the organism has to make the behavior continuously for a period of time after which a reinforcer is delivered

Fixed Interval schedule (FI) – A schedule of reinforcement in which we reinforce some set amount of time

Fixed Ratio schedule (FR) – A schedule of reinforcement in which we reinforce some set number of responses

Fixed time (FT) schedule - An organism receives reinforcement after a set amount of time

Flooding - Exposing the person to the maximum level of stimulus and as nothing aversive occurs, the link between CS and US producing the CR of fear should break, leaving the person unafraid

Fluency - A measure of the number of correct responses made per minute

Formal operations – The stage of cognitive development which begins in adolescence and lasts into adulthood. Teens become capable of abstract thinking and understand that ideas can be compared and classified, just as objects can

Free recall - Asking the person to demonstrate what they previously learned

Frequency - A measure of how often a behavior occurs

Functional relationship - When we can say a target behavior (DV) has changed due to the use of a procedure/treatment/strategy (the IV) and this relationship has been replicated at least one other time

G

Gaps - Holes in the literature; or topics needing additional research

Generalizability – In research, when we can make statements about the population from our sample

Generalized anxiety disorder - The most common anxiety disorder characterized by a global and persistent feeling of anxiety

Generalized imitation – Imitating the reinforced and non-reinforced behavior

Generalization training - When we reinforce behavior across situations until generalization occurs for the stimulus class

Generalized reinforcer – A reinforcer that obtains its name because of being paired with many other reinforcers

Gestural prompt – Making gestures with your body to indicate the correct action the person should engage in

Goal - An objective or result we desire that clearly indicates how our time and physical and psychological energy will be spent

Guided compliance - Physically guiding the person through the activity which is meant to be aversive and in the future he or she should engage in the desire behavior to avoid the discomfort of being guided

H

Habit - An acquired behavior pattern regularly followed until it has become almost involuntary (http://www.dictionary.com/browse/habit)

Habit disorder – When a habit becomes annoying for others due to an increase in frequency, duration, and/or intensity

Habit strength or **formation** – States that S-R connections are strengthened the more times reinforcement occurs

Habituation - When the size or probability of a response decreases in response to a repetitive stimulus

Heuristics – Mental shortcuts

Higher order conditioning – When a stimulus that is associated with a CS (formerly the NS) becomes a CS itself and elicits the CR

History - The study of the past – the people, places, and events that make it up

Hypothesis - A specific, testable prediction

I

Imitation – Copying the behavior of another person, called a model

Immediacy – When a reinforcer or punisher is delivered immediately

Inattentional blindness - When we miss a stimulus clearly present in our visual field when our attention is focused on a task

Independent variable – The variable in an experiment that is manipulated

Inductive reasoning - Used when there is no single correct solution to a problem

Inferential statistics – A type of statistics that allows for the analysis of two or more sets of numerical data

Informed consent - When the person agrees to participate because they are told what will happen to them

Inhibitory conditioning – When the absence of the US is associated with a NS

Intellectual Disability - A deficit in cognitive or intellectual functioning

Intelligence - Includes the ability to solve problems, acquire language and knowledge, think abstractly, adapt to one's environment, and engage in the manipulation of one's environment

Interference - When information that is similar to other information interferes in either storage or retrieval

Inter-rater reliability - How consistent different observers are when making judgments

Interstimulus interval - The period between the presentation of the NS and then the US (Panel C) within a conditioning trial

Intertrial interval - The period between conditioning trials

Intrinsic reinforcement – When we obtain reinforcement from the mere act of engaging in a behavior

Introduction – The first section of a research article designed to provide a summary of the current literature as it relates to the topic

Intensity - A measure of how strong the response is

Interval Recording – A type of recording method in which you take the observation period and divide it up into shorter periods of time; can be whole or partial

Introduction – The first section of a research article designed to provide a summary of the current literature as it relates to the topic

Introspection - The examination of one's mental state

J

K

L

Laboratory observation - Involves observing people or animals in a laboratory setting

Language - All the socially shared rules for what words mean, how to make new words, how to put them together, and what combinations work best in specific situations

Language acquisition device - An innate mechanism in the brain that makes the learning of a language possible

Lapse - When we make a mistake or slip up

Latency - Represents the time it takes for a behavior to follow from the presentation of a stimulus

Latent inhibition - States that it is easier to condition a novel stimulus than a familiar one

Law of Effect (Thorndike, 1905) - The idea that if our behavior produces a favorable consequence, in the future when the same stimulus is present, we will be more likely to make the response again, expecting the same favorable consequence. If our action leads to dissatisfaction, then we will not repeat the same behavior in the future

Learning - Any relatively permanent change in behavior due to experience and practice

Learning disorder - Characterized by the inability or difficulty processing academic or functional information in our environment

Literature review - When we conduct a literature search through our university library or a search engine such as Google Scholar to see what questions have been investigated already and what answers have been found

Load theory of attention - Posits that we can attend to task-irrelevant stimuli since only some of our cognitive resources have been used when engaged in low-load tasks, but high load tasks do not leave us any resources to process other stimuli

Long-term memory - Holds a great deal of information for an indefinite period of time, possibly for decades

M

Magnitude - How large a reinforcer or punisher is and has a definite effect on behavior

Maintenance Phase – The phase of behavior modification which follows the treatment phase and which involves the continued measurement of our behavior to ensure that the strategies we used to bring about meaningful behavioral change stand the test of time and future or unforeseen temptations

Maintenance Problem – A problem during maintenance phase linked to a loss of motivation

Materialism - States that everything that makes up the universe could be described in physical terms and by explained by the properties of matter and energy

Mechanism - Is the idea that the universe is a great machine

Memory - The ability to retain and retrieve information

Mental images - Pictures in the mind's eye; there is no direct sensory experience

Method – The section of a research article in which participants, materials or apparatus, and procedure are described in detail; it is like a cookbook

Misattribution - When we believe a memory comes from one source when it really came from another source

Mixed schedule – Complex schedule with more than one simple schedule, but they are <u>not</u> associated with a specific stimulus

Modal action pattern (MAP) – A complex type of reflex that is fairly complex, involve the entire organism and not specific muscles, and can vary and which leads to an organisms survival

Modeling – Behavior modification technique used to change behavior by having subjects observe a model in a situation that usually causes them some anxiety; . By seeing the model interact nicely with the fear evoking stimulus, their fear should subside

Motivating operations – When an event make a reinforcer or punisher more or less reinforcing or punishing

Multiple-baseline designs – A research design in ABA which involves use of a baseline and treatment phase for different people, behaviors, or settings

Multiple schedule includes two or more simple schedules, each associated with a specific stimulus

N

Natural reinforcers – Reinforcers that occur naturally in the environment

Naturalistic observation – When a scientist studies human or animal behavior in its natural environment

Negative Punishment (NP) – In operant conditioning, this is when something good is taken away or subtracted making a behavior less likely in the future.

Negative Reinforcement (NR) – In operant conditioning, this is when something bad or aversive is taken away or subtracted due to your actions, making it that you will be more likely to make the same behavior in the future when some stimuli presents itself

Neurotransmitter – The chemical form that an actual code passes from one neuron to another

Neutral stimulus – A stimulus that causes no response

O

Observation period – The predetermined period of time when you observe behavior

Observational learning – Learning by watching others

Occasion setters - Stimuli that help an organism determine if the CS will be followed by a US leading to the CR

One-process theory of avoidance - States that avoidance behavior is negatively reinforced due to aversive stimulation with which it is associated occurring at a lower rate; utilizes operant conditioning only

Operant behaviors - Behaviors that are voluntary and controlled instead by their consequences

Operant conditioning - A type of associate learning which focuses on consequences that follow a response or behavior that we make and whether it makes a behavior more or less likely to occur

Opponent process theory of emotion - States that our primary emotional reaction to an emotion-arousing stimulus, or *a* process, is followed by an opposite after-reaction, or *b* process, which counteracts this shift

Overcorrection procedures - When a person is expected to engage in effortful behavior for an extended period after the occurrence of an undesirable behavior

Overshadowing - Two neutral stimuli are presented at the same time and the more salient of the two becomes a CS

Overt - Behavior that is observable

P

Panic attack - A sudden or abrupt surge of fear or impending doom along with at least four physical or cognitive symptoms

Panic disorder - When an individual experiences recurrent panic attacks consisting of physical and cognitive symptoms

Partial reinforcement effect – When a response continues being made for a while even though reinforcement is not being received

Perceptual set - Accounts for how our prejudices, beliefs, biases, experiences, and even our mood affect how we interpret sensory events called stimuli

Perception - The process of adding meaning to raw sensory data

Perceptual load - How difficult a task is

Persistence - When unwanted memories continue and are not forgotten

Philosophy - Is the love and pursuit of knowledge

Physical prompt – Guiding the person through physical contact to make the correct response

Positive practice – A form of overcorrection in which a person is made to engage in the correct form of the behavior over and over again

Positive Punishment (PP) – In operant conditioning, if something bad or aversive is given or added, then the behavior is less likely to occur in the future

Positive Reinforcement (PR) – In operant conditioning, if something good is given or added, then the behavior is more likely to occur in the future

Positivism - States that only natural phenomena or facts that are objectively observable should be pursued

Posttraumatic stress disorder - More commonly known as PTSD, is identified by the development of physiological, psychological, and emotional symptoms following exposure to a traumatic even

Prelinguistic communication - The type of communication that occurs before language is possible

Premack principle – States that reinforcers (the consequence) are behaviors and not stimuli, which leads to high-probability behavior being used to reinforce low-probability behavior

Preoperational stage – The stage of cognitive development characterized by acquisition of the symbolic function, less dependence on sensorimotor activity to learn about the world, and mental reasoning emerges

Preparatory-response theory – Theory that states the CR exists to prepare the organism for the presentation of the US

Primary – In operant conditioning, refers to reinforcers and punishers that have their effect without having to be learned

Primary drives – Drives associated with innate biological needs states that are needed for survival such as food, water, urination, sleep, air, temperature, pain relief, and sex

Problems - When we cannot achieve a goal due to an obstacle that we are unsure how to overcome

Processing capacity - How much information we can handle

Product or outcome recording - This technique can be used when there is a tangible outcome you are interested in

Progressive ratio (PR) schedule - Involves the requirement for reinforcement increasing in either an arithmetic or geometric way, and after each reinforcement has occurred

Progressive schedule - The rules determining what the contingencies are change in a systematic way

Prompts - A stimulus that is added to the situation and increases the likelihood that the desirable response will be made when it is needed

Prompt delay - When you present the S^D and then wait for the correct response to be made

Prompt fading - When the prompt is gradually removed as it is no longer needed; can fade within a prompt or across prompts

Propositions - Units of meaning that are composed of concepts and express a relationship between the concepts

Proximal goals – Goals that are closer in time

Pseudoconditioning – When an elicited response is not actually caused by the NS/CS but by sensitization

Psychology - The scientific study of behavior and mental processes

Punishment – Due to the consequence, a behavior/response is less likely to occur in the future. It is weakened

Purposive behaviorism - Goal-directed behavior; advanced by Tolman

Q

R

Random assignment – When participants have an equal chance of being placed in the control or experimental group

Random sampling - When everyone in the population has an equal chance of being included in the sample

Rate - A measure of change in response over time, or how often a behavior occurs

Real-time recording – A type of recording method in which you write down the time when the behavior starts and when it ends, and then do this each time the behavior occurs

Reductionism - Focuses on breaking things down to their basic components

Reflex - Indicates the relationship between innate behaviors and the environmental events or stimuli that elicit them

Reflex arc – Includes afferent neurons, interneurons, and efferent neurons which demonstrate the connection between stimulus and response

Reinforcement – Due to the consequences, a behavior/response is more likely to occur in the future. It is strengthened

Reinforcement schedule - In operant conditioning, the rule for determining when and how often we will reinforce a desired behavior

Relapse – When an isolated mistake becomes a pattern of behavior

Repetition blindness - When we experience a reduction in the ability to perceive repeated

stimuli if flashed rapidly before our eyes

Replication - Repeating the study to confirm its results

Rescorla-Wagner Model – Theory of conditioning which states that a given US can only support so much conditioning and must be spread out among the CSs that are present

Research design – Our plan of action of how we will go about testing the hypothesis

Resistance to extinction – The idea that the behavior does weaken, but gradually

Respondent behaviors - Behaviors that are involuntary and reflexive in nature

Respondent conditioning - When we link or pair a previously neutral stimulus with a stimulus that is unlearned or inborn

Response – A behavior

Response costs – A type of negative punisher in which some amount of a reinforcer is removed when a problem/undesirable behavior is engaged in

Restitution – A type of overcorrection procedure in which an individual is made to restore the environment to a condition that is better than it was before the undesirable behavior occurred

Response deprivation hypothesis - Says that the behavior falls below its baseline or preferred level

Results – In this section of a research article the researcher states the outcome of the experiment and whether it was statistically significant or not

Retention interval - A period during which you are not practicing what you previously learned

Retrograde amnesia - When we cannot remember past events and previous familiar information

Rules – Tools that add order, predictability, and reliability to our plan

S

Schemas - Organized ways of making sense of experience

Scientific method - A systematic method for gathering knowledge about the world around us

Secondary or conditioned – In operant conditioning, refers to reinforcers and punishers that must be learned.

Secondary drives – Drives that are learned and associated with environmental stimuli that lead to the reduction of primary drives, thereby becoming drives themselves

Selective attention – When we voluntarily focus on specific sensory input from our environment

Self-control – The will power to resist temptation

Self-efficacy - Our sense of self-esteem and competence and feeling like we can deal with life's problems

Self-instructions - Statements you write or say to yourself as positive affirmations and motivational tools

Self-management – Use of behavior modification principles and procedures by an individual to bring about change in their own behavior; Also called self-modification

Self-monitoring – When you monitor your own behavior

Self-regulation - Our ability to carefully consider our actions and the effect they have on others or ourselves, and to make adjustments

Sensation - The detection of physical energy that is emitted or reflected by physical objects

Sensitization - When the size or probability of a response increases in response to a repetitive stimulus

Sensorimotor stage - When infants focus on developing sensory abilities and learn to get around in their environment

Sensory memory - Holds all incoming sensory information detected from our environment for a very short period of time

Sensory preconditioning - Situations in which a stimulus becomes a CS making other stimuli it was paired with likely candidates to become a CS in the future too

Shaping by successive approximations or **shaping** – When we get a person or animal to make some desired behavior that they would not normally know to make by reinforcing approximations of that behavior gradually

Short-term memory - Holds a limited amount of information for about 15-20 seconds

Shuttle box – An apparatus consisting of two compartments separated by a wall with an opening at floor level

Sign stimuli – The releasing stimuli in a modal action pattern

Simultaneous conditioning – When the NS and US occur at the same time

Social anxiety disorder - Occurs when an individual experiences anxiety related to social or performance situations, where there is the possibility that they will be evaluated negatively

Social desirability - When a participant answers questions dishonestly so that he/she is seen in a more favorable light

Social learning theory – States that learning occurs due to observational learning and operant conditioning

Specific phobia - Observed when an individual experiences anxiety related to a specific object or subject

Spontaneous recovery – When the person or animal tries to make the response again in the future even though it stopped being reinforced in the past (in operant conditioning); When the CS elicits the CR after extinction has occurred in respondent conditioning

Statistical significance - An indication of how confident we are that our results are due to our manipulation or design and not chance

Stimuli - The environmental events that have the potential to trigger behavior

Stimulus class - Antecedents that share similar features and have the same effect on behavior

Stimulus control - When an antecedent has been consistently linked to a behavior in the past it gains control over the behavior

Stimulus discrimination - When the CR is elicited by a single CS or a narrow range of CS

Stimulus enhancement – States that we will focus our attention on a stimulus if others are paying attention to it

Stimulus generalization - When a number of similar CS or a broad range of CS elicit the same CR

Stimulus substitution theory – States that respondent conditioning is a matter of substituting one stimulus with another, or the CS acts as a substitute for the US

Subgoals - Waypoints toward the final goal

Suggestibility - When false memories are created due to deception or leading questions

Surveys – A questionnaire consisting of at least one scale with some number of questions which assess a psychological construct of interest

Synapse - The point where the actual code passes from one neuron to another

Systematic desensitization - An exposure technique that utilizes relaxation strategies to help calm the individual as they are presented with the fearful object

T

Tandem schedule - A reinforcer is delivered after the last in a series of schedules is complete, but without a discriminative stimuli

Target behavior - Whatever behavior we want to change

Temperament - Base level of emotionality and reactivity to stimulation

Temptations - Anything or anyone that might lead you to engage in the undesired or problem behavior and not make the desired or target behavior

Theory – The systematic explanation of a phenomenon

Time out - When a person is removed from an activity because they are engaging in an undesirable or problem behavior

Tokens – Something that is accrued (and accumulated over time) once the target behavior occurs; part of a token economy

Token economy - An individual is provided with something that represents desired reinforcers and takes that "something" and cashes it in later for those reinforcers

Tolerance – In relation to drug use, occurs when a person no longer responds to the drug the way he or she initially did; higher doses of the drug are needed to obtain the same effect achieved early on

Topography - Represents the physical form a behavior takes

Trace conditioning – When the NS is presented ahead of the US in time; there is no overlap

Transduction - Converting physical energy into electrochemical codes

Transfer Problem – A problem during maintenance phase linked to a desirable behavior not transferring or generalizing as expected

Transformation rules - Help us to convert a simple sentence into other voices such as past, future, conditional, or passive tenses

Transience - When our memories decrease in accessibility over time

Treatment Phase - Occurs when the strategy or strategies are used, or you might say when the manipulation is implemented

Trial - One instance or attempt at learning

Trial and error learning - Making a response repeatedly if it leads to success

Two-process theory of avoidance (and punishment) - States that to learn an avoidance response, two processes are involved – respondent (or classical) conditioning and operant conditioning

U

Unconditioned response – The response which occurs naturally when the US is present

Unconditioned stimulus – The stimulus that naturally elicits a response

Universal grammar - A mechanism that allows children to identify many of the basic features of language

US preexposure effect - Exposure to a US before conditioning occurs can make subsequent conditioning more difficult

V

Variable - Anything that varies over time or from one situation to the next

Variable duration (VD) schedule - The behavior must be made continuously for some varying amount of time to receive reinforcement

Variable Interval schedule (VI) - A schedule of reinforcement in which we reinforce a changing or varying amount of time

Variable Ratio schedule (VR) – A schedule of reinforcement in which we reinforce some varying number of responses

Variable Time (VT) schedule - Reinforcement occurs after a varying amount of time has passed, regardless of whether the desired behavior is being made

Vicarious reinforcement/punishment - Learning by observing others and seeing the consequences of their behavior

W

Working memory – When we move information from long term memory to be manipulated in some way

X

Y

Z

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Index

#

A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

X

Y

Z