An Introduction to Behavior Analysis

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What Is Behavior?

What do we mean when we say "behavior." What counts as behavior, and what doesn't count? In this book, **behavior** is defined as *an individual living organism's activity, public or private, which may be influenced by external or internal stimulation.*

As an example, consider a fish as it searches its environment for something to eat. We watch it for a few moments as it faces into the gentle current, gliding along patiently. Suddenly, it swims rapidly upward, striking a bug that landed on the water's surface. The strike is a **response**—*a single instance of behavior.*

Source: Fly Fishing Waters/Adobe stock photos

As a second example of behavior, consider yourself as you think about your future, considering jobs that would make you happy while simultaneously allowing you to pay the rent. Having a thought is also a response—a single instance of a different kind of behavior. In light of these examples, let's dissect the definition of behavior provided in italics earlier. The first thing to note is that behavior is something *individuals* do—the fish that strikes a bug does so as an *individual.* Likewise, when you think about your career options, you think your own thoughts as an individual. Behavior is something that *individuals* do.

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Focusing on individual behavior is consistent with the goals of those who seek the expertise of a psychologist, counselor, or behavior analyst. The individual experiencing depression, the parent of a child diagnosed with a developmental disability, the manager of an underperforming employee, they all want the behavior of an individual—self, child, and employee, respectively—to change in an adaptive direction; that is, a reduction in depression, an increase in everyday living skills, and an increase in productivity. If you were depressed, you would not be satisfied with the services of your therapist if they said, "Sorry you aren't doing any better, but 4 of my other 10 patients are feeling great!" While that is nice for them, it helps you in no way. Your depression is experienced as an *individual*, and an effective therapist who treats individuals will seek to understand *your* behavior and the factors that can reduce *your* depression. This requires a focus on the behavior of the *individual*—you (Hayes et al., 2021).

The second component of our definition of behavior is that it is something that individual *living organisms* do. Applying an electric current to a dead fish will produce reflexive movement, but it will not produce a fish that strikes when its next meal floats downstream. Likewise, if you were dead, no amount of electrical stimulation to precise brain regions would revitalize your ability to contemplate a meaningful career path. While we acknowledge that advancements in artificial intelligence and robotics have created robots that learn and behave in ways remarkably like humans and animals, we will restrict our definition of behavior to the actions of biological organisms.

The next part of the definition—*public or private*—simply means that some behavior is *public* (everyone can observe it happening) and some behavior is *private* (you, the person doing the behaving, are the only person who can observe it). The bug-striking behavior of the fish is *public*—it can be observed by the fish, other nearby fish, and anyone who takes the time to set up an underwater camera.

Source: pressmaster/Adobe stock photos

By contrast, thinking about your career is a *private* behavior. Only you can observe the entirety of your thoughts as you think them. If you did your career contemplation while lying in a functional magnetic resonance imaging (fMRI) device, we could observe the areas of your brain that are active as you are thinking, but this would still not give us access to the specific content of your thinking. Hence, this behavior remains *private.*

The final component of the definition—*which may be influenced by external or internal stimulation*—means behavior can be affected (changed) by a **stimulus** (*something you see, hear, smell, taste, or feel*), and stimulus events can occur outside or inside your body. For example, the bug floating toward the fish is an *external* visual stimulus—the bug is outside the fish's body, and when the fish sees it, the visual stimulus increases the probability of striking. Without the visual stimulus, the probability of striking is very low. Likewise, hunger is an *internal stimulus* that increases the probability of searching for food and striking a bug when one is encountered.

Just like the fish, your own private behavior—contemplating career choices—is influenced by *external and internal stimulation.* If your biology instructor is charismatic and speaks convincingly of the joys of being a professor (external stimuli), the probability of contemplating this career path is increased. Simultaneously, several internal stimuli can increase (e.g., caffeine's stimulating effects) or decrease (e.g., a headache) the probability of a career contemplation session.

What Is Behavior Analysis?

Behavior analysis may be defined by its goals, its assumptions, and its major activities. We discuss each of these in the sections that follow. But before you read on, you should read the *How to Use This Book* section of this book's Preface. There, you will find important advice about how to read this book and how to study so you can (1) maximize your learning, (2) enhance your ability to use what you learn to improve your life (and the lives of those around you), and (3) earn a better grade in this class. The advice comes from scientific studies identifying effective ways to study. Interestingly, these studies find very few students use these techniques, opting instead for study methods that are much less effective (e.g., highlighting your textbook and re-reading it the night before the exam). You will find the advice provided in the Preface useful not only for this class but for all your classes! So, take a few moments to read the Preface now.

The Goals of Behavior Analysis

The broad goal of any science is to understand the phenomena being studied. Entomologists want to understand insects, astronomers help us understand the universe, and behavior analysts seek to understand the behavior of individuals. Whether it is you, me, your pet, or a mountain lion—behavior analysts are interested in the behavior of individual organisms. Behavior analysts want to improve the human condition (and that of the nonhuman animals with whom we share the planet), and this is reflected in the two goals of behavior analysis.

THE FIRST GOAL OF BEHAVIOR ANALYSIS

The first goal of behavior analysis *is to accurately predict behavior.* To understand why behavior analysts want to predict behavior, ask yourself, which would you prefer: a bus that arrives at a *predictable* time or a bus that arrives at an *unpredictable* time? The predictable bus arrives on the hour and the half-hour; it is never late. The unpredictable bus arrives at no particular time, but it arrives at the bus stop twice per hour. So, which bus would you prefer? The answer is obvious. We would all prefer the predictable bus.

Source: Oscar/Adobe stock photos

Let's make it obvious why we prefer the predictable bus. If the bus always arrives on time, then we can plan for its arrival. We can enjoy our conversation with friends a little longer, study a little longer, or finish a meal at a casual pace before we leave to catch the bus. By contrast, if the bus is unpredictable, then our behavior will be less efficient as we must spend more time doing what we do not want to do (sitting at the bus stop) and less time doing what we want to do (eating and talking with friends). We prefer the predictable bus because *predictability allows adaptive behavior.*

It is not just buses. We also like to predict the weather, and we check our weather apps regularly. Why? Because *predictability allows adaptive behavior.* If we know it is going to rain, we can wear a raincoat or grab an umbrella. If we know it is going to be sunny, we can leave both at home and pack the sunglasses and sunscreen instead.

Accurate predictions are even more critical when making life-or-death decisions. Consider a radiation therapist who must decide how much radiation to apply, precisely where to apply it, and for how long. Too little or too much will have disastrous outcomes for the cancer patient; accurate predictions can save their life.

Of course, behavior analysts are interested in predicting the behavior of individuals, not buses, weather, or the effects of radiation therapy. **What is the utility of predicting the behavior of individuals?** To answer this question, consider your roommate, who predictably joins you for breakfast at 8:30 a.m. each weekday morning. The utility of accurately predicting when your roommate will arrive is that *it allows adaptive behavior*—you can make extra coffee, clear a spot at the table, and leave out the box of cereal. Your roommate appreciates this, and these actions increase the probability that your roommate will return these kindnesses later.

If your roommate's behavior suddenly became unpredictable—sometimes getting up at 3 a.m., other times at 11 a.m.—your acts of kindness would no longer be *adaptive;* the coffee would go to waste, the spot cleared would not be used, and the cereal box would go unopened.

Predicting behavior is important to all of us because *it allows adaptive behavior.* Have you ever noticed that when you meet someone new (e.g., a new co-worker), you ask a lot of questions: What is your name? Where are you from? Are you in school? Which school? What is your major? Do you work? How many brothers and sisters do you have?

We all ask these questions. Why? Because the answers reduce uncertainty. They allow us to make predictions that facilitate our own adaptive behavior. If you learn, for example, that your new co-worker likes street tacos, then you can behave adaptively at lunchtime by saying "Hey, want to go to the taco truck for lunch?" There is no guarantee that the answer will be "yes," but the probability is higher than if you had said, "Hey, want to go to the vegan diner for a tofu bowl?" An accurate prediction is rewarded with tacos, conversation, and perhaps friendship.

We all try to accurately predict future behavior by observing and reflecting on past behavior patterns. For example, if our new co-worker insists on buying lunch, often brings treats for sharing on Fridays, and volunteers to cover shifts when others are sick, we would feel confident in asking them for help if our car broke down. We keep track of the behavior of others, and we use this information adaptively—we make predictions.

The extent to which we can accurately predict human behavior is a topic that we will return to throughout this textbook. For now, it is enough to remind you that the first goal of behavior analysis is to accurately predict behavior, and the reason that is important is that *it allows adaptive behavior.* Table 1.1 shows some predictions about behavior, adaptive behaviors that can occur if the prediction is correct, and the beneficial outcome of this adaptive behavior.

THE SECOND GOAL OF BEHAVIOR ANALYSIS

The ability to accurately predict behavior is great; in some sciences, predicting is all you can do. For example, astrophysicists can precisely predict where Mars will be 2 years from now, but they cannot practically influence the trajectory of the planet. Within a science of behavior, we seek to do more than just predict behavior, we want to influence it. Stated more formally, **the second goal of behavior analysis** *is to discover functional variables that may be used to positively influence behavior.*

A **functional variable** is *a variable that, when changed, reliably and systematically influences behavior.* Here is an analogy that may help us understand functional variables. Think of them as you would a faucet handle. When you turn a faucet handle ON, the water comes

Table 1.1 Predicting behavior is useful.

Prediction about behavior	Adaptive behavior	Beneficial outcome
I will snooze my alarm clock three times tomorrow morning	Set the alarm to go off 45 min before I need to get out of bed	Arrive at my appointment on time
Within the next 6 months, I will drop my phone and crack the screen	Buy insurance	Save money when I need a new screen
My roommate will eat my favorite leftovers	Hide the leftovers behind something my roommate dislikes	Leftovers are there when I want them
My boss will be grumpy during the dinner rush	Avoid talking to my boss during the dinner rush	Avoid getting yelled at

Note: This table shows some predictions about behavior, the adaptive behavior that the prediction allows, and then the beneficial outcome expected because the adaptive behavior occurred.

out; when you turn it OFF, the flow of water stops. Analogously, when a behavior analyst turns ON a functional variable, it increases a desired behavior. When you turn it OFF, the flow of behavior stops. Functional variables are the handles at our disposal, manipulated skillfully by a behavior analyst, they can positively influence behavior.

So, what exactly do we mean when we say our goal is to *positively influence behavior?* We mean that the behavior analyst can change behavior—to help the individual do something they would not otherwise do (e.g., meet studying goals) or help them stop doing an unwanted behavior (e.g., binge-watching instead of studying). Where we predict that a consequential maladaptive behavior will occur (e.g., drunk driving), the behavior analyst can use functional variables to decrease the probability of this behavior and increase the likelihood that the individual will choose to do something else—something more adaptive (e.g., call for a ride).

There are many ways to positively influence the behavior of individuals, and this textbook introduces these techniques. By carefully studying this book, you will learn how you can improve lives by positively influencing behavior.

DEMAND MORE OF YOUR SCIENCE

We encourage readers to embrace the twin goals of behavior analysis and apply them to any science with practical aspirations (e.g., medicinal chemistry, economics, and psychology). These goals are practical, useful, and, if realized, will improve our own lives and those of others (Baer et al., 1968; Hayes, 1993). For some sciences, like astrophysics, prediction and influence are not possible. NASA scientists can accurately predict Jupiter's location in 4 years, ensuring their atmospheric probe arrives at the right time and place. But these planetary predictors have no aspirations to *positively influence* the movement of Jupiter.

The social and behavioral sciences aspire to do more. When a psychiatrist makes a diagnosis like "depression," they are making a prediction—if nothing changes, the patient will continue to feel blue, unmotivated, and socially isolated. That is a useful prediction—it tells us that an intervention is needed. But suppose that the *only thing* the psychiatrist can do is make accurate predictions. In that case, they are of little use to the patient who could already

predict they will continue feeling blue, unmotivated, and socially isolated (it is why they went to the psychiatrist). We expect behavior therapists to turn ON and OFF functional variables to positively influence our behavior.

Behavior analysis is a very practical science—it is constantly on the lookout for new functional variables that can be turned ON and OFF. This is how behavior analysts positively influence behavior. The more "faucet handles" at our fingertips, the more effective we are in helping others. So, whatever social/behavioral science you study, it is worth asking: Can this science *both* accurately predict and positively influence behavior? If not, it may be time to demand more of your science.

Reading Quiz 1

Each chapter in this book will include a few reading quizzes embedded within the text. If you can answer these questions correctly, you will know you are reading the book carefully. The answers to these quiz questions are provided at the end of the chapter.

1. Behavior is something that _____ living organisms do.
2. _____ is defined as an individual living organism's activity, public or _____, which may be influenced by external or _____ stimulation.
3. A _____ is something you see, hear, smell, taste, or feel. These events can occur outside or inside your body.
4. Stimuli is the plural of _____.
5. One stimulus, two _____.
6. Buying a car is an instance of _____ (public/private) behavior.
7. Changing your clothes is an instance of _____ (public/private) behavior.
8. Thinking that you should not have bought that car because now you do not have enough money for new clothes is an instance of _____ (public/private) behavior.
9. The first goal of behavior analysis is to _____ _____ behavior.
10. The second goal of behavior analysis is to discover _____ variables that may be used to _____ _____ behavior.
11. Accurately predicting behavior is important because it allows _____ behavior.

The Assumptions of Behavior Analysis

Recalling from earlier that behavior analysis may be defined by its goals, its assumptions, and its major activities, we now turn to **two assumptions that guide behavior analysis**.

Assumption #1: Behavior Is Determined

Behavior analysts assume that behavior is determined.[1] **What does it mean to say, "behavior is determined?"** It means that *behavior has a cause, or multiple causes that may be found in the natural world.* This is an appropriate assumption for scientists who study behavior. If they assume that behavior is caused by knowable variables that exist in the real world,

then behavioral scientists will set out to discover those functional variables. If one assumes that behavior is not determined (i.e., behavior occurs without a cause), then one would not bother trying to discover functional variables that are assumed not to exist.

A quick note about the distinction between *functional variables* and *causes*. Behavioral scientists are reluctant to discuss "causes" because it implies that we know everything there is to know about behavior, and that clearly is not the case. In recognition of this incomplete knowledge, we talk about "functional variables." When a functional variable is changed, we can be confident that it will influence behavior. However, to suggest that the functional variable "caused" the behavior change is more than the evidence supports. For example, it is possible that the functional variable plays no causal role but is merely correlated with another (unmeasured) variable that is actually responsible for the behavior change. We will have more to say about correlations, functional variables, and behavior change in Chapters 2 and 3. For now, let's return to the assumption that behavior is determined.

For most members of Western cultures, this assumption of determinism is difficult to accept because we have been taught that some, if not all, of our behavior is self-determined and free from external causal variables. For example, most Westerners embrace the concept of *free will*. However, carefully considering this issue leads us to reject the idea that behavior is self-determined.

Consider your behavior right now. If we accept the concept of free will, then your current behavior (reading this book) is not influenced by any functional variables. If that were true, then it would not be influenced by biological variables like your brain, which is decoding the symbols on this page into meaningful sentences. It would not be influenced by experiences from long ago, such as learning to speak your native language or learning to read through systematic instruction provided by teachers and parents. It would not be influenced by experiences a few months ago; for example, a friend you trust recommended this class. And your behavior would not be influenced by recent experiences; for example, the instructor assigned this chapter and said that materials from the book will appear on upcoming exams. Behavior analysis holds that biological and environmental variables combine to determine your behavior. That assumption motivates us to discover new functional variables that can positively influence behavior.

MENTALISTIC EXPLANATIONS OF BEHAVIOR

When we learn how biological and environmental events combine to influence behavior (like reading this textbook right now) it makes sense to us. More importantly, understanding how biological and environmental events can change behavior enhances our ability to accurately predict and positively influence behavior. But this scientific way of thinking stands in contrast to how most of us explain why we, or those around us, do the things we do. Consider these examples of everyday explanations of behavior:

- "I ate a sweet potato because I decided I needed more potassium."
- "I went to the movie because I felt like laughing."
- "I hit him because I was angry."

In these sentences, the words before "because" identify the behavior that needs to be explained. The words after "because" provide the sorts of explanations that we all hear and give every day. In the first example, eating a sweet potato (behavior) is said to be caused by "I decided I needed more potassium." If your brother or sister said this while eating a baked

sweet potato you would accept the explanation without a second thought. However, this explanation has a fundamental problem—it explains the first behavior by appealing to a second behavior:

- I ate because I decided
- I went because I felt
- I hit because I was angry

So, now instead of having one behavior to explain (I ate) we have two behaviors to explain (I ate *and* I decided). These everyday explanations of behavior violate Occam's *law of parsimony*, which, when applied to behavior, holds that, all else being equal, the best explanations of behavior are the simplest explanations. Explaining one behavior by appealing to a second behavior lacks parsimony—what was once a simple task (explaining one behavior) is now more complex (explaining two behaviors).

To make matters worse, when we explain one behavior by appealing to a second, the second behavior usually occurs *privately* (mentally) where others cannot observe it. "I decided…" appeals to private decision-making. "I felt…" and "I was angry…" appeal to private sensations. Behavior analysts refer to these as **mentalistic explanations of behavior**—and reject them.[2]

To get a better understanding of the problems with mentalistic explanations, imagine you are a behavior therapist and your patient (a college student identifying as a female) complains that she has no self-control. She smokes and drinks too much, she is constantly skipping classes, and when she attends, she mostly looks at her social media feed and posts selfies for her friends. In addition, she has occasional outbursts of anger, particularly with her partner. As the therapist, your job is to help this patient change her behavior.

Source: Generated with AI using DALL·E - OpenAI

If you believe one behavior (drinking too much alcohol) is caused by a second behavior (I mentally decided to have another drink), then the way to change the first behavior is to change the second behavior. Sounds like we have a plan—to change her alcohol choices we need to change a *private behavior*—her mental decision-making. How do we do that? Well, if we follow the same logic that drinking to excess (Behavior 1) is caused by mental decision-making (Behavior 2), then it must also be true that there is a Behavior 3 (the inner decision-maker's mental decision-making) that caused Behavior 2. Of course, if you found Behavior 3, you would be no closer to improving your client's choices because to change Behavior 3 you would have to find its cause—Behavior 4. Obviously, this search for mental causes is never-ending.

To change our patient's behavior, we must identify functional variables that can be turned ON and OFF. "Explaining" one behavior by appealing to another behavior will not do. Such explanations do not reveal functional variables that can be turned ON and OFF. Functional variables are practical tools used to positively influence behavior.

I AM NOT BUYING IT. I DETERMINE MY OWN BEHAVIOR

Source: Everton / goodfon.com

For many people, the idea that behavior is determined by biological and environmental variables is not easily accepted. Instead, most of us feel that we *will* our own behavior; that is, we feel that we mentally direct our own actions. The primary evidence for this feeling is that, occasionally, just before we engage in a behavior, we have an internal (private) dialogue in which we actively decide what to do next. For example, when deciding where to eat lunch, we might have thoughts like, "Man am I hungry. I sure could go for a hamburger. But I do not have enough money for a hamburger. I guess I could go home and eat. Yeah, I have that bread that is going to go stale if I do not eat it soon. I think I'll go home and make a sandwich." Because we hear this internal dialogue, many of us picture this process as a tiny person or several tiny people inside our heads, much like the characters in the Pixar *Inside Out* movie series.

Although the *Inside Out* series is great, there are at least *three problems* with the theory that a mental decision-maker wills behavior into motion:

1. ***Choice is behavior.*** Engaging in a mental decision-making process (choice) is an activity that meets the definition of behavior—it is an individual living organism's private activity, which may be influenced by external or internal stimulation. As noted earlier, suggesting that one behavior (choice) causes another behavior (making a sandwich) is unsatisfying because it leaves unanswered the question, what causes the choice? Another choice? If so, what causes that choice? You can see the parsimony problem here.
2. ***Choice is determined.*** When one makes a choice, what factors are considered before the choice is made? In the sandwich example, public events (the lack of money and having bread at home) combined to influence the decision to eat a sandwich. If any of these factors were different, it would influence the choice *and* what was eaten for lunch. For example, if bread was unavailable at home, the probability of choosing to eat a sandwich would be greatly reduced. If money was more abundant, we would have eaten a hamburger. These *functional variables* influence the choices we make.
3. ***Choices are made before we "choose" to make them.*** In a series of famous experiments, psychologists and neuroscientists asked participants to make a simple choice—respond whenever you feel like it. In these studies, scientists precisely measure the exact moment we choose to respond, when the response occurs, and the initiation of neural events underlying the response. If we really will our own actions, then what should happen is *choice → neural event → response.* But what actually happens is *neural event → choice → response.* In other words, a neural event in our brain initiates our response *before* we feel like we are consciously choosing to respond (Fried et al., 2011; Libet, 1985; Soon et al., 2008). We know, kind of mind-blowing, isn't it? The feeling that we consciously will our behavior appears to be an illusion (Wegner, 2003).

If you are shaking your head in disbelief, consider how often mind-blowing discoveries have been disbelieved in the natural sciences. No one believed Galileo when he said moons were rotating around Jupiter; indeed, he was nearly executed for saying these things! Quantum physics makes no sense to anyone, but it is how our universe works. Our intuition is a poor guide to scientific discovery, and we have more intuitions about behavior than perhaps any other area of science. To achieve the twin goals of behavior analysis, we must question our intuitions and disbelief.

If you, the reader, choose to reject the assumption that behavior is determined (and we expect most of you will), you should be aware of two important implications of your choice. First, if an undetermined will determines behavior, then the first goal of behavior analysis cannot be achieved—accurately predicting behavior. An advanced science of behavior must make predictions by considering the biological and environmental variables that influence behavior. If these variables play no role in human behavior, then accurate predictions are impossible. Recalling that the utility in predicting behavior is that it allows us to live more adaptively, we might hope the behavior analysts are right—behavior is determined—as this assumption has the potential to improve our quality of life.

Second, if an undetermined will determines behavior, the second goal of behavior analysis also cannot be achieved—discovering functional variables that will allow us to positively influence behavior. If will determines what behavior comes next, then the only way to positively influence behavior is to influence will. But if will is not caused by anything, then there is no way to influence will and therefore there is no way to influence behavior. This is bad news for all those individuals who hope that an advanced behavioral science can positively influence their behavior or the behavior of a loved one. Because this leaves us in a hopeless situation, behavior analysts assume that behavior is determined. Thus far, this assumption has proven useful. Extra Box 1.1 further explores how adopting a deterministic philosophy is useful in cultivating empathy and compassion for each other.

Assumption #2: The Scientific Method Is a Valid Way to Reveal the Determinants of Behavior

Source: Unknown author/Wikimedia Commons/Public Domain

A scientific approach to learning about the workings of the natural world originated in the 17th century with the work of great scientists like Copernicus, Galileo, and Sir Isaac Newton. Before the development of the scientific method, humans made very little progress in understanding the workings of the natural world. This is because pre-scientific explanations were not challenged. For example, during the medieval period, physicians explained behavior by referring to the balance of four liquids, called humors, in the human body—black bile, yellow bile, phlegm, and blood. If the physician's patient was depressed, it was "explained" by saying the patient possessed a surplus of black bile. The cure? Bloodletting, leaches, and mercury-containing medicines that induced vomiting and diarrhea.

EXTRA BOX 1.1: DETERMINISM PROMOTES EMPATHY AND COMPASSION

Source: Generated from Historic Photos with AI using Sora- OpenAI

In 1991, armed rebels in Ethiopia were nearing the capital, Addis Ababa, where they would violently overthrow the government in a military coup. At particular risk of persecution by the rebels was the Jewish population of Ethiopia. To address this risk, the government of Israel launched a secret overnight mission to airlift more than 14,000 people out of Ethiopia and into Israel. Among the refugees arriving in Jerusalem were more than 500 children. With insufficient time to prepare for the arriving refugees, the government randomly assigned the children to different schools in the cities where families were settled. Some lucky children were assigned to high-quality schools, while others, through no fault of their own, were enrolled in low-quality schools. These random assignments proved to be determinative—children assigned to high-quality schools scored 30% higher on their high-school exams and were 40% less likely to drop out of high-school than those who just happened to be assigned to a low-quality school (Gould et al., 2004). Those are huge effects!

Let's conduct a thought experiment. Imagine that you met one of these high-achieving students and did not know they were one of the lucky ones randomly assigned to a high-quality school. How much would you feel like their academic accomplishments were due to their intelligence, their grit, and their strong will to succeed? Similarly, if you met one of the low-achieving students and didn't know that they were randomly assigned to a low-quality school, to what extent would you think they were unintelligent, lacking industriousness, and weak willed? If you are like most of us, you would conclude that something inside these students (their drive, their heart, or their will) is responsible for their success or failure. One of them deserves our praise; the other deserves what they get—a lifetime of struggles. But of course, the truth is these students had equivalent potential when they arrived from Ethiopia; it is just that one of them "won the lottery" and the other did not.

When we know something about the determinants of human behavior (like the school we attended), it increases our empathy and compassion for those among us who were not so lucky to be born in a developed nation, attend a good school, and have parents who loved and treated us well. The determinist's assumption may be summed up as "there before the grace of God go I." That is, if my biology and lifetime of experiences were the same, I would behave the same. We do not get to choose our biology, or the functional variables experienced in life, so empathy and compassion are warranted. Perhaps the most constructive act of empathy and compassion is to roll up our sleeves and get to work discovering the determinants of behavior. Only then can we use that knowledge to, for example, improve educational efficacy and move toward greater equality. According to the Behavior Analyst Certification Board (BACB), a core ethical principle of behavior analysts is compassion for others (BACB, 2020).

If the medieval physician had been versed in the scientific method, he (they were almost all men) would test his prediction by taking a sample of bodily humors and objectively evaluating the amount of black bile in the sample. If he found high levels of black bile, then a precise amount of blood would be extracted, and if the patient's mood improved, the physician's prediction would prove correct. Unfortunately, medieval physicians did not do this. They did not empirically test the predictions of the humoral model. Instead, physicians accepted it without questioning the authority of their teachers and elders.

Because the theory of humors was not subjected to empirical tests, the ineffective medical practices informed by it continued for centuries. When the scientific method was eventually applied to medicine, the theory of humors was abandoned.

The widespread use of the scientific method is responsible for discoveries that have improved human lives (life-saving medications, modern forms of transportation, and the smartphone in your pocket; Pinker, 2018). Because the scientific method has proven so useful in revealing the workings of the world, behavior analysts assume that it is a valid method for discovering the determinants of behavior.

Reading Quiz 2

Remember, the answers to these questions are provided at the end of the chapter.

1. The first assumption of behavior analysis is that behavior is _____.
2. When we say, "behavior is determined," we simply mean that behavior has a _____, or multiple _____.
3. In our daily lives, we often explain behavior (I went to the movies) by pointing to private behaviors (I thought going to the movies was a good idea). Behavior analysts refer to these as _____ explanations of behavior.
4. The second assumption of behavior analysis is that the _____ _____ is a valid way to discover the determinants of behavior.

Scientific Method

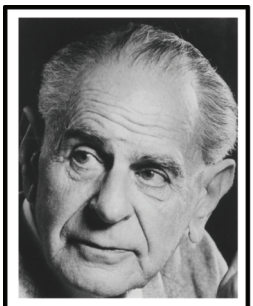
> *There is no pure, disinterested, theory-free observation.*
>
> ~Karl Popper, philosopher of science

> *The first principle [of science] is that you must not fool yourself—and you are the easiest person to fool.*
>
> ~Richard Feynman, physicist

The *scientific method* describes the behavior of all scientists as they go about discovering how the natural world works. Here, we briefly summarize the characteristics of the scientific method that are most relevant to behavior analysis. The scientific methods used by behavior analysts will be discussed in Chapters 2 and 3.

Objective: Behavior analysis strives to be an objective, unbiased, scientific approach to discovering how behavior works. Of course, humans are subject to many known biases (Kahneman & Tversky, 2013), so any *individual* behavior analyst cannot be entirely objective. Recognizing that biases can influence the outcome of their work, behavior analysts, like all good scientists, take steps to minimize this possibility. For example, data are recorded by computers or by people blinded to the study's purpose. Where we fail in our objectivity, other behavioral scientists will point out our failings. Indeed, they advance their careers by doing so. Therefore, while individual scientists are fallible and subject to bias, the *scientific enterprise* is self-correcting.

As noted by the great 20th-century philosopher Karl Popper, a second meaning of "objective" is that scientists regard no theory as a dogmatic truth. That is, our current understanding of behavior is not finalized. Behavior analysts recognize that we have much still to learn about behavior, and a goal of this textbook is to inspire the next generation of behavior analysts who will show us where we currently have it wrong. This objectivity directed toward the state of current knowledge was embraced by the influential behavior analyst, B. F. Skinner (1979) when he wrote, "Accept no eternal verity. Experiment" (p. 346).



Karl Popper (1902–1994)

Source: LSE Library/flickr

Quantitative: Behavior analysts specify the behavior of interest with enough precision that its occurrence can be *counted*. That is, the person measuring behavior has defined it with enough precision that instances and non-instances of the behavior may be easily differentiated. This allows behavior analysts to more objectively measure behavior before, during, and after conducting an intervention designed to positively influence behavior.

Systematic: When behavior analysts conduct an intervention designed to influence behavior, they make sure that it is *implemented exactly as it is supposed to be*. Failure to properly implement the intervention will make it impossible to evaluate its effectiveness (St. Peter, 2023). If a study is conducted to evaluate an intervention and it proves not to change behavior, a fan of the intervention could say, "Oh, well, they didn't implement the intervention correctly." This fan might be right, so behavior analysts must document that they implemented the intervention exactly as they were supposed to. If they document this and the intervention does not work, the fan has no basis for saying the intervention would have been effective if only the scientists had done things right.

Empirical: Behavior analysts require empirical evidence to support any claim about behavior. By "empirical," we mean that the *evidence must be observable*. We can do this by observing with the naked eye or with the aid of an unbiased measurement device. Nonempirical evidence, such as appeals to "common sense," to authority figures ("The President of the United States says…"), or to divine revelations ("According to the Bible…") holds no sway among scientists; empirical evidence is what counts.

Falsifiable predictions: As discussed previously, the first goal of behavior analysis is to accurately predict behavior. Predictions are derived from theories (conceptual models of how the world works). Good theories make accurate predictions, and incorrect (or incomplete) theories make inaccurate predictions.

Karl Popper went beyond this. He held that good theories make specific predictions about what happens *next*. Popper lived at the same time as Sigmund Freud, and he noticed

that Freud's predictions about human behavior pointed to what happened *before,* not what will happen *next.* For example, if Freud's patient was suffering from anxiety, he speculated about past events that caused the anxiety. For example, the patient had a rough time of toilet training; no, really, that was one of his theories. These theories are hard to disprove. If the patient could not remember traumatic toilet training, Freud held that these memories were repressed into the inaccessible subconscious.

Popper thought these kinds of theories were rubbish because they were *unfalsifiable;* there was no way to prove them wrong. Popper said scientists should conduct experiments to prove theories wrong—to falsify them. This practice makes science a destructive force; but so be it. Humans have no shortage of whacky ideas about the world, and especially about human behavior. So, owning a tool like a wrecking ball that can falsify crackpot theories is a good thing. The scientific method is that tool.

Imagine that you came up with one of these half-baked theories, and everyone around you loves it. They encourage you to give lectures, write books, and post videos online about your theory. Before long, many people are paying you lots of money to discuss your theory. After a few months, you are convinced that your theory is not so whacky after all. It must be true!

Now, how would you feel about taking out that wrecking ball called the scientific method and trying to disprove your theory? You are probably not going to be a big fan of that idea. After all, you have a lot to lose if your theory is falsified. So, being a good scientist means being brave—you have got to be willing to take out the wrecking ball and apply it to your own theories (even though you love them).

Sciences that make unfalsifiable predictions are, according to Popper, *pseudo-sciences.* Pseudo-sciences contribute nothing to our goals of prediction and influence. By contrast, *natural sciences* make falsifiable predictions about things that happen next. Behavior analysis is one of these natural sciences.[3] As we will see in later chapters, behavior analysts make specific, often quantitatively specific, predictions about behavior. When these predictions are confirmed, they strengthen our confidence in the theories upon which they are based. When the predictions are falsified, the theory is abandoned.

Experimentation: The most powerful scientific method is the experiment, and this method is extensively used in behavior analysis. In an experiment, the behavior of an individual is objectively measured until we are confident that, if nothing changes, the behavior will not change. Next, something is changed. This change is called the **independent variable**—*a publicly observable change, controlled by the experimenter, which is anticipated to influence behavior in a specific way.* In therapeutic settings, the independent variable is the intervention or the treatment. Everything else that might influence behavior is held constant in an experiment: therefore, if behavior changes, we will conclude that the independent variable is functional; it influenced behavior. If not, the prediction will be falsified.

Peer-review: When a group of behavioral scientists have discovered something important, they will prepare a written description of the study that led to the discovery. The document will outline how behavior was objectively and quantitatively recorded, how the independent variable was manipulated, and how all other variables that might affect behavior were held constant. If a theory is being tested, a falsifiable prediction will be provided, and the empirical outcomes will be presented.

Before this document can be published in a scientific journal, it will be evaluated by a handful of scientific experts. These reviewers will approach the paper skeptically, looking for problems with the study that might diminish confidence in the discovery. If the paper does not pass this peer-review process, the paper is not published. This peer-review process is designed to ensure that papers published in scientific journals can be trusted. That is, if you were to replicate the methods described in the published paper, you would get the same outcome. Of course, the only way to know for certain that you will get the same outcome is to give it a try.

Replication: The most important way to evaluate if scientific discoveries are true is through replication; that is, *repeating the experiment and obtaining the same outcome.*

"*replication is the essence of believability.*" (Baer et al., 1968, p. 95)

Being able to replicate the results of an experiment is important in any science, but it is particularly important in behavior analysis because many behavior analysts work with individuals with challenging or problem behavior. A behavior analyst who works with a child diagnosed with a developmental disability needs to know that the therapeutic methods being used will work.[4] Just like an engineer knows that the laws of physics can be relied upon when designing a building or a bridge, the behavior analyst needs therapeutic methods that produce replicable outcomes.

In 2015, a group of scientists known as the Open Science Collaboration published a paper in the prestigious journal *Science*. The paper described the group's attempts to replicate 100 prominent findings reported in top psychology journals. For example, in one of these studies, college students were randomly assigned to either read about determinism (that behavior is caused by biological and environmental factors) or a neutral topic. The original investigators (Vohs & Schooler, 2008) hypothesized that belief in free will was important in moral action, so they anticipated that reading about determinism would undermine participants' morality. That is what they reported; participants who had just read about determinism were more likely to cheat during the study. This study was widely cited because it made "common sense." But when the Open Science Collaboration group tried, they could not replicate this finding despite conducting the experiment exactly as described by Vohs and Schooler (2008). Indeed, the Open Science Collaboration (2015) report revealed that more than 60% of the findings published in top psychology journals could not be replicated. This finding has since been replicated (Klein et al., 2018). Psychologists were stunned by this outcome. Taken to its logical extension, it means that much of what you read in psychology journals is wrong. Yeah, kind of a big deal.

Replication has been a hallmark of behavior analysis from the beginning, and some scholars have pointed to the research methods of behavior analysts (those discussed in Chapters 2 and 3) as a pathway out of this "replication crisis" (Branch, 2019). By replicating behavioral outcomes over many sessions, the researcher or behavior therapist becomes increasingly confident in their findings. By replicating behavioral outcomes in several individuals, in several different studies, and in several different labs or settings, confidence is more robustly established. Rest assured that the principles of behavior analysis covered in this book have been replicated many times in many different labs and with many different species; they are believable. Where the evidence has not been replicated, we will point that out, so you may be skeptical.

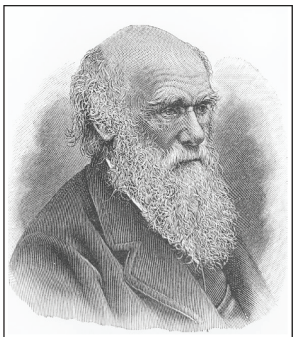
Reading Quiz 3

1. One of the most important characteristics of good science is that it is _____. Scientists recognize that humans are susceptible to biases that cloud how we evaluate evidence that supports and refutes our favorite theories. As scientists we must be careful to avoid and/or correct these biases.
2. When behavior analysts are being _____, they recognize that their current understanding of behavior is tentative and will be changed in the future as new findings support an alternative viewpoint that better allows us to predict and positively influence behavior.
3. _____ evidence for a scientific finding is either directly observable or observable with the aid of an unbiased measurement device.
4. When a scientist makes a prediction about behavior, the prediction is precise enough that it could be shown to be incorrect. These are referred to as _____ predictions.
5. When scientists discover something, it is important that their research be repeated to see if the finding can be obtained again. This repetition of experiments to evaluate if they produced reliable results is called _____.

What Are the Determinants of Behavior?

Scientists have, for the last century or so, studied the determinants of behavior, and the rest of this book will outline the discoveries that are most important to behavior analysts. Broadly speaking, the determinants of behavior can be organized into two categories: *nature* and *nurture*. Early in the history of behavioral science, researchers asked if behavior was determined by nature (i.e., our genetic inheritance) or nurture (i.e., events experienced during one's lifetime). Today, we recognize that behavior is determined by a combination of nature *and* nurture (Champagne & Mashoodh, 2009; Krause & Domjan, 2017).

Nature



Charles Darwin (1809–1882)

Source: ibreakstock/Getty Images

The behavioral determinants, collectively called "nature," include biological variables such as the species' evolutionary past and the individual's unique genome. Innate behaviors are the product of the evolutionary past of the species. Consider two innate behaviors of modern human infants—rooting and suckling. When an infant roots, it moves its mouth toward an object that is touching its cheek or lips. Once that object enters the mouth, the infant sucks on it (suckling). In the evolutionary past of the human species, infants who found and suckled on the mother's nipple survived; those who did not died. This survival advantage is how innate behaviors are naturally selected—surviving

means you live long enough to get your genes into the next generation. Genetic transmission through mating ensures your children will root and suckle too. The evolutionary past of the species is one determinant of behavior.

Another "nature" determinant of behavior is the unique genome of the individual. In sexually reproducing species (like humans), two parent genomes combine to produce a unique genome in the child. Mutations in this genome can dramatically affect the child's behavior. For example, children born with three copies of chromosome 21 (instead of the usual two) will have Down's syndrome, which profoundly impairs learning.

The genome need not be impacted by mutations to influence behavior. Behavioral tendencies in the parent(s) can be passed genetically to offspring. Consider the tendency to consume alcohol. Extensive studies of human twins (Verhulst et al., 2015), selectively bred nonhuman animals (Murphy et al., 2002), and genetically modified organisms (Roberts et al., 2001) have demonstrated that genes passed from parents to offspring can increase the consumption of alcohol.

Nurture

The behavioral determinants collectively referred to as "nurture" include all the events experienced during an individual's life. Although behavior analysts recognize that nature plays an important role in behavior, most of their efforts are focused on studying how **environmental events** influence behavior. By "environmental" we mean *everything you experience through your senses.* For example, you may see a sign that says your favorite food is available at half price today. Seeing the sign increases the probability of a specific behavior—buying that food. On another day, you might overhear someone saying something terrible about you. This environmental event will influence how you behave around that person in the future.

How individual behavior can be influenced by environmental events is the subject matter of this book. When an individual learns by interacting with their environment, the individual's behavior is changed, often in profound ways. Consider the acquisition of a new skill, like reading. When you learned to read, your environment was rich with reading materials, reading instruction, and immediate feedback from teachers and parents. After you learned to read, your behavior changed in profoundly adaptive ways. You were no longer dependent on your parents to read your favorite books to you. You could read advice on an online troubleshooting forum when your Nintendo Wii® stopped working. You could use your reading skills to acquire new behaviors at school (math, science, etc.).

Our interactions with environmental events also influence the frequency of our behavior. If you got your finger caught in the car door, instances of leaving your fingers in harm's way decreased in frequency. If saying "please, please, please, please, please" was an effective way to get what you wanted, that behavior increased in frequency.

Experiences also influence where and when we behave. If being noisy in the classroom leads to negative consequences but being noisy on the playground leads to positive consequences, then these outcomes will influence where your noisy behaviors occur. Likewise, if you attend class on the wrong day or at the wrong time, you will arrive in an empty classroom (or in a different class). This mistake will likely influence when you come to class. Clearly, environmental events influence our everyday behavior.

Behavioral Epigenetics

Behavioral epigenetics examines how nature and nurture can have a combined effect on behavior. When an environmental event influences gene regulation (specific genes are turned on or off), it influences the growth of brain neurons, the activity of these neurons, and the behavior of the individual. Some of these changes in gene regulation are passed on to the children. However, because they do not change DNA, these changes are not automatically passed on to the grandchildren or great-grandchildren.

Source: ibreakstock/Getty Images

One of the earliest discoveries in behavioral epigenetics was that a rat's behavior in a stressful environment was influenced by the maternal care it received as a pup. If the rat's mother was nurturing (licking and grooming it a lot), it coped with stressful situations well as an adult. Rats with neglectful mothers (licking and grooming needs not met) were much more anxious, reactive, and aggressive in stressful situations (Szyf et al., 2008).

Receiving lots of licking and grooming from mom up-regulates a cluster of genes, which affects the number of glucocorticoid receptors in an area of the brain known as the hippocampus (McGowan et al., 2011). When the stress hormone cortisol binds to these glucocorticoid receptors, well cared for rats' brains turn down the stress circuit, reducing their anxiety and their readiness to fight or flee from the stressor. Maternal neglect leaves the glucocorticoid receptor gene inactive, turns up the stress circuit, and increases these rats' reactivity to stressful situations; they are anxious, restless, and looking for a fight. When neglected or well cared for rats grow up and have pups of their own, the neglected females neglect their pups, and the nurtured females provide good maternal care to their offspring. Similar mechanisms and outcomes are observed in humans (Lester et al., 2018; Zhang et al., 2013).

Because epigenetic effects do not change DNA (just gene regulation), the effects of neglect can be reversed in many ways. In rats, if a neglected mother's pups are raised by a caring "foster-mother" rat, the pups will handle stress well and, if female, will grow up to be nurturing mothers (Masterpasqua, 2009). Similarly, medications and environmental living conditions can also reverse epigenetic effects (Hegde et al., 2020; Weaver et al., 2005). Behavioral epigenetics provides a nice illustration that nature *and* nurture can combine to influence individual behavior.

The Activities of Behavior Analysts

Early in this chapter we said that behavior analysis is defined by its goals, assumptions, and major activities. We have discussed the goals (to predict and influence behavior) and the assumptions of behavior analysis (determinism and the scientific method). Chapters 2 and 3 will discuss the specific scientific methods behavior analysts use to predict and influence behavior. In what remains of this chapter, we will examine the activities of behavior analysts.

Before going into specifics, it is important to note that there is strong demand for individuals who provide behavior-analytic services. In 2010 the BACB identified 789 job postings for certified behavior analysts. By 2024 that number had increased by more than 12,000% (BACB, 2025)! At this moment, as you are reading these sentences, there are over 100,000 job openings for certified behavior analysts. That means there are roughly 100,000 people who want the services of a qualified behavior analyst but cannot find one. So, if you are concerned that earning a degree in Psychology may not lead to a psychology-related career, perhaps you should study behavior analysis instead. Becoming fluent with the principles discussed in this book will not only get you a good grade but it can also start you on a path toward a rewarding, high-demand career.

The Experimental Analysis of Behavior

Although a good deal is known about the determinants of individual behavior, it would be naïve to suggest that our understanding is complete. Thus, many behavior analysts work to expand our ability to predict and influence behavior by conducting research in controlled laboratory settings. Such research is referred to as the "experimental analysis of behavior."

Research conducted in the experimental analysis of behavior is not designed to therapeutically improve behavior or to address socially relevant behavior problems. Pioneers in the experimental analysis of behavior include John B. Watson, Ivan Pavlov, Edward L. Thorndike, and B. F. Skinner. We will study the contributions of each of these scientists in later chapters. What unites these laboratory researchers is their passion for using the scientific method to make important discoveries about environmental events that influence behavior. Contemporary researchers in the experimental analysis of behavior continue to make important discoveries, and these are published in peer-reviewed scientific journals.

Much like Watson and Skinner, most contemporary scientists in the experimental analysis of behavior are employed as university professors. If you are thinking about pursuing such a career, you will need to attend graduate school after earning your bachelor's degree. In graduate school, you will take additional coursework and complete intensive research experiences for 4–6 years before earning your doctoral degree.

Applied Behavior Analysis

A second category of research in behavior analysis is applied behavior analysis. Applied behavior analysts also conduct rigorous scientific research; however, they focus on socially significant behavior in non-laboratory settings. For example, applied behavior analysts may conduct experiments exploring the most effective ways to teach children to read (Stockard et al., 2018), to increase adaptive behavior in children with developmental disabilities (Hagopian et al., 2013), or to create positive, supportive environments in schools (Lee & Gage, 2020). Extra Box 1.2 further explores the ideal components of applied behavior analytic research.

Applied behavior analysts are expected to demonstrate a level of effectiveness that is readily apparent to consumers. If the applied behavior analyst is trying to decrease an individual's drug use, the intervention would be deemed effective only if the drug user and their spouse (and perhaps the judge who ordered the user into therapy) agreed that there was

EXTRA BOX 1.2: DIMENSIONS OF APPLIED BEHAVIOR ANALYSIS

In a seminal article published in the first issue of the *Journal of Applied Behavior Analysis,* Donald Baer, Montrose Wolf, and Todd Risley defined the seven core dimensions of applied behavior analysis (Baer et al., 1968). Researchers working in the field aspire to these seven dimensions to this day. Chapters 2 and 3 outline how applied behavior analysts address each dimension.

1. ***Applied:*** The individual, behavior, and/or situation in which the individual behaves is socially important. If the applied behavior analyst can positively influence this behavior, it will improve the life of the individual and others affected by the same behavioral malady (e.g., heroin abuse, pathological gambling, or compulsive eating).
2. ***Behavioral:*** Because applied research is important, it is critical to objectively and accurately measure behavior. Asking people to tell you what they did is an inadequate foundation upon which to base a behavioral science (e.g., Chermack et al., 2000; Mertz et al., 1991).
3. ***Analytic:*** An experimental design is employed, and adequate replications are conducted, thereby allowing the applied behavior analyst to confidently conclude which component(s) of the intervention is/are responsible for the behavior change (see Chapter 3).
4. ***Technological:*** Scientific reports on intervention efficacy will provide enough technical details that others can replicate the methods and evaluate the intervention's efficacy. The "replication crisis" in psychology underscores the importance of this technological requirement.
5. ***Conceptual systems:*** The scientific theories and empirically supported principles of behavior that underlie intervention components are identified. Interventions are not pulled out of the air, nor are they a mere "bag of tricks"; they are derived from an existing empirical science (Baer et al., 1968).
6. ***Effective:*** Socially significant and clinically significant behavior changes are obvious and meaningful to the stakeholders (client, parents, teacher, etc.). If stakeholders indicate that the behavior change has made no *practical difference*, then the intervention lacks efficacy.
7. ***Generality:*** Applied interventions have generality if they produce a durable (long-lasting) change in behavior that may be observed in various settings where the behavior is adaptive.

a noticeable decrease in drug use. In addition, the intervention must be acceptable to the client and others affected by it. In sum, applied behavior analysis aims to develop practical interventions that produce meaningful improvements in socially significant behavior.

Like those working in the experimental analysis of behavior, applied behavior analysts earn a doctoral degree and are most often employed as university professors. In addition, applied behavior analysts must pass a national certification exam administered by the BACB.

Behavioral Service Delivery

Those behavior analysts who use the discoveries of laboratory and applied behavior analysts to address the needs of patients are employed in *behavioral service delivery.* Many of these professionals work with children and adults diagnosed with a range of behavioral and intellectual disorders. Others work with individuals in traditional talk therapy settings, addressing issues of anxiety, phobias, depression, obsessive-compulsive disorders, and so on (Madden et al., 2016).

The increase in the prevalence of autism over the last 20 years, combined with the rigorous scientific evidence supporting behavior-analytic therapy in the treatment of autism (National Autism Center, 2015; Reichow, 2012; U.S. Surgeon General, 1999; Wong et al., 2015) has led to a dramatic increase in the number of professionals employed in behavioral service delivery. At present, 38 U.S. states license behavior analysts to provide services (BACB.com). These licensed professionals are certified through the BACB after classroom training, supervised internships, and passing their certification examination. Demand for licensed and/or board-certified behavior analysts has grown continuously for decades. One level of certification, the BCaBA, is available to students after they earn their bachelor's degree and have completed supervised training in service provision. So, if you enjoy this class and want to work in the field without going to graduate school, this is the level of certification for you. More information may be found on the BACB website (BACB.com).

On this topic, we would be remiss to not inform the reader of some negative sentiments on the topic of applied behavior analysis (ABA) therapy, leading many autistic adults to publicly share that they perceived their history of behavioral intervention as abusive. This has led many people in the neurodivergent community to call for the avoidance of ABA treatment. It is important to recognize that some of the early autism treatment methods (e.g., those used in the 1970s), conducted in the name of "behavior modification" were horrific (see Rutherford, 2006). Sadly, these methods are now conflated with modern ABA therapy. If we recall the "applied" dimension of ABA (interventions that improve the lives of individuals), these unethical behavior-modification practices failed both the client and the basic ethical standards of today. These are not the ABA practices that this textbook endorses or aspires to. Many behavior analysts work with the neurodivergent community to recognize and enhance awareness of this history and to facilitate more ethical action today and in the future consistent with the underlying value of our ethics code to "treat others with respect, dignity, and compassion" (BACB, 2020). Together we can work to ensure ABA is the compassionate practice it is intended to be (e.g., Rohrer et al., 2021; Taylor et al., 2019).

In our affirmation of neurodiversity and striving for the highest ethical practices, it is important that modern ABA not be categorized as a continuation of past problematic practices (Allen et al., 2024). Doing so may have the effect of stigmatizing behavioral services that are needed by hundreds of thousands of children and adults who rely on these services for daily-living skills acquisition, receptive and expressive language acquisition, and, in some cases, treatment for life-threatening aggression and self-injurious behavior (particularly with clients exhibiting profound needs; see discussion by Graber & Graber, 2023; also see Lord et al., 2022). Practitioners of ABA must address client concerns while simultaneously meeting the needs of families who are desperately seeking treatment. Again, the

demand for board-certified behavior analysts far outstrips the supply of these professionals. Final word: the intention of ABA is not to reverse neurodivergence, it is to help individuals acquire the skills compatible with a good life. Where those services are not needed, they should not be provided.

Organizational Behavior Management

The application of behavior analysis to business settings is called Organizational Behavior Management. The focus of behavior analysis on objective measurement of individual behavior has proven highly compatible with a business focus on employee performance. Identifying functional variables that can be practically changed, and that will produce measurable performance improvements translates in corporate settings to improved customer satisfaction, employee satisfaction, and profitability. Several consulting companies specialize in Organizational Behavior Management. The minimum educational requirement for employees in these companies is a master's degree in behavior analysis.

Certified Applied Animal Behaviorists

A final career path for behavior analysts is focused on nonhuman animal behavior. Certified applied animal behaviorists work in applied settings such as zoos, preserves, and organizations that train companion animals. They can also work in private practice, providing pet owners with behavior analysis training so they can humanely teach adaptive behavior to their pets. Certified applied animal behaviorists have a high level of knowledge of the principles covered in this book (and more advanced coursework in animal learning), as well as training in ethology, comparative psychology, and research methods. Earning certification through the Animal Behavior Society requires at least a master's degree and extended experience working with nonhuman animals. Want to learn more? Google *Canine Behavioral Blueprints* or the *Applied Animal Behavior & Welfare Lab* at Virginia Tech.

Summary

Behavior analysis has been defined by its goals, assumptions, and activities. Like a species, behavior analysis has evolved over time as scientists working in the experimental analysis of behavior, as applied behavior analysts, or as scientists in allied disciplines such as psychology have made new discoveries requiring that the field update its understanding of the determinants of behavior. Each update expands our understanding of behavior and increases the ability of those working in behavioral service delivery to provide an intervention that positively influences behavior and improves human and animal lives. There is little doubt that the evolution of behavior analysis will continue in the decades to come. Perhaps you will be one of the behavior analysts who help evolve the field and make a difference in the well-being of all.

Reading Quiz 4

1. Over 100 years of research has demonstrated that individual behavior is influenced by _____ *and* _____.
2. Those working in the _____ analysis of behavior most often conduct their research in laboratory settings, where nuisance variables will not get in the way of identifying determinants of behavior.
3. Behavior analysts who conduct scientific research in clinical settings are called _____ behavior analysts.
4. Individuals who deliver behavioral services that are based on the research of laboratory and applied behavior analysts are employed in the field of behavioral _____ _____.

Reading Quiz Answers

Reading Quiz 1

1. individual
2. behavior; private; internal
3. stimulus
4. stimulus
5. stimuli
6. public
7. public—this one can be tricky. Although we often change clothes in private, changing clothes is a public behavior. It can be observed by anyone who looks in on us. Thinking about changing clothes, however, is a private behavior.
8. private
9. accurately predict
10. functional; positively influence
11. adaptive

Reading Quiz 2

1. determined
2. cause; causes
3. mentalistic
4. scientific method

Reading Quiz 3

1. objective
2. objective
3. empirical
4. falsifiable
5. replication

Reading Quiz 4

1. nature; nurture (the order of these answers does not matter)
2. experimental
3. applied
4. service delivery

Notes

1. Behavioral scientists recognize the role of randomness (e.g., quantum mechanics) in the causal system that determines behavior. Thus, the state of the universe over time is not lockstep determined and, likewise, random events play a role in human behavior (e.g., random genetic mutations).
2. It is important to note that when behavior analysts reject mentalistic explanations, they are not rejecting the idea that brains (and other parts of the individual) play an important role in behavior. A complete scientific explanation of behavior will include environment and biology (brains, hormones, etc.). Mentalistic explanations do not refer to biology or environment in any meaningful way. Therefore, they are rejected as explanations of behavior.
3. A natural science confines itself to things that exist in the physical world. Applied to behavior analysis, we study the behavior (public and private) of physical organisms. The functional variables that influence behavior are all physical—biology, neurochemistry, physical stimuli, and accumulated experiences with these stimuli.
4. As neurodivergent-affirming behavior analysts, we recognize that the autistic community has no shared consensus on the preference for identity- or person-first language (see Taboas et al., 2023). In our effort to be as inclusive as possible, we will purposefully switch between identity- and person-first language throughout the remainder of this textbook.

References

Allen, L. L., Mellon, L. S., Syed, N., Johnson, J. F., & Bernal, A. J. (2024). Neurodiversity-affirming applied behavior analysis. *Behavior Analysis in Practice*. https://doi.org/10.1007/s40617-024-00918-0

BACB (2020). *Ethics code for behavior analysts*. https://Bacb.Com/Wp-Content/Ethics-Code-for-Behavior-Analysts/

BACB (2025). *US employment demand for behavior analysts*. www.bacb.com/wp-content/uploads/2025/02/Lightcast2025_250204-a.pdf

Baer, D. M., Wolf, M. M., & Risley, T. R. (1968). Some current dimensions of applied behavior analysis. *Journal of Applied Behavior Analysis, 1*(1), 91–97. https://doi.org/10.1901/jaba.1968.1-91

Branch, M. N. (2019). The "reproducibility crisis": Might the methods used frequently in behavior-analysis research help? *Perspectives on Behavior Science, 42*(1), 77–89. https://doi.org/10.1007/s40614-018-0158-5

Champagne, F. A., & Mashoodh, R. (2009). Genes in context: Gene–environment interplay and the origins of individual differences in behavior. *Current Directions in Psychological Science, 18*(3), 127–131. https://doi.org/10.1111/J.1467-8721.2009.01622.X

Chermack, S. T., Roll, J., Reilly, M., Davis, L., Kilaru, U., & Grabowski, J. (2000). Comparison of patient self-reports and urinalysis results obtained under naturalistic methadone treatment conditions. *Drug and Alcohol Dependence, 59*(1), 43–49. https://doi.org/10.1016/S0376-8716(99)00106-4

Fried, I., Mukamel, R., & Kreiman, G. (2011). Internally generated preactivation of single neurons in human medial frontal cortex predicts volition. *Neuron, 69*(3), 548–562. https://doi.org/10.1016/J.NEURON.2010.11.045

Gould, E. D., Lavy, V., & Paserman, M. D. (2004). Immigrating to opportunity: Estimating the effect of school quality using a natural experiment on Ethiopians in Israel. *The Quarterly Journal of Economics, 119*(2), 498–526. https://doi.org/10.1162/0033553041382193

Graber, A., & Graber, J. (2023). Applied behavior analysis and the abolitionist neurodiversity critique: An ethical analysis. *Behavior Analysis in Practice, 16*, 921–937.

Hagopian, L. P., Dozier, C. L., Rooker, G. W., & Jones, B. A. (2013). Assessment and treatment of severe problem behavior. In G. J. Madden (Ed.), *APA handbook of behavior analysis: Vol. 2* (pp. 353–386). American Psychological Association.

Hayes, S. C. (1993). Analytic goals and the varieties of scientific contextualism. In S. C. Hayes, L. J. Hayes, H. W. Reese, & T. R. Sarbin (Eds.), *Varieties of scientific contextualism* (pp. 11–27). Context Press.

Hayes, S. C., Merwin, R. M., McHugh, L., Sandoz, E. K., A-Tjak, J. G. L., Ruiz, F. J., Barnes-Holmes, D., Bricker, J. B., Ciarrochi, J., Dixon, M. R., Po-Lun Fung, K., Gloster, A. T., Gobin, R. L., Gould, E. R., Hofmann, S. G., Kasujja, R., Karekla, M., Luciano, C., & McCracken, L. M. (2021). Report of the ACBS Task Force on strategies and tactics of contextual behavioral science research. *Journal of Contextual Behavioral Science, 20*, 172–183. https://doi.org/10.1016/j.jcbs.2021.03.007

Hegde, A., Suresh, S., & Mitra, R. (2020). Early-life short-term environmental enrichment counteracts the effects of stress on anxiety-like behavior, brain-derived neurotrophic factor and nuclear translocation of glucocorticoid receptors in the basolateral amygdala. *Scientific Reports, 10*(1), 14053. https://doi.org/10.1038/s41598-020-70875-5

Kahneman, D., & Tversky, A. (2013). Choices, values, and frames. In L. C. MacLean, & W. T. Ziemba (Eds.), *Handbook of the fundamentals of financial decision making* (pp. 269–278). World Scientific. https://doi.org/10.1142/9789814417358_0016

Klein, R. A., Vianello, M., Hasselman, F., Adams, B. G., Adams, R. B., Alper, S., Aveyard, M., Axt, J. R., Babalola, M. T., Bahník, Š., Batra, R., Berkics, M., Bernstein, M. J., Berry, D. R., Bialobrzeska, O., Binan, E. D., Bocian, K., Brandt, M. J., Busching, R., ... Nosek, B. A. (2018). Many Labs 2: Investigating variation in replicability across samples and settings. *Advances in Methods and Practices in Psychological Science, 1*(4), 443–490. https://doi.org/10.1177/2515245918810225

Krause, M. A., & Domjan, M. (2017). Ethological and evolutionary perspectives on Pavlovian conditioning. *APA handbook of comparative psychology: Perception, learning, and cognition* (pp. 247–266). American Psychological Association. https://doi.org/10.1037/0000012-012

Lee, A., & Gage, N. A. (2020). Updating and expanding systematic reviews and meta-analyses on the effects of school-wide positive behavior interventions and supports. *Psychology in the Schools, 57*(5), 783–804. https://doi.org/10.1002/pits.22336

Lester, B. M., Conradt, E., LaGasse, L. L., Tronick, E. Z., Padbury, J. F., & Marsit, C. J. (2018). Epigenetic programming by maternal behavior in the human infant. *Pediatrics, 142*(4), e20171890. https://doi.org/10.1542/peds.2017-1890

Libet, B. (1985). Unconscious cerebral initiative and the role of conscious will in voluntary action. *The Behavioral and Brain Sciences, 8*, 529–566. https://doi.org/10.1017/S0140525X00044903

Lord, C., Charman, T., Havdahl, A., Carbone, P., Anagnostou, E., Boyd, B., ... & McCauley, J. B. (2022). The Lancet Commission on the future of care and clinical research in autism. *The Lancet, 399*(10321), 271–334. https://doi.org/10.1016/ S0140-6736(21)01541-5

Madden, G. J., Hanley, G. P., & Dougher, M. J. (2016). Clinical behavior analysis. In J. C. Norcross, G. R. VandenBos, & D. K. Freedheim (Eds.), *APA handbook of clinical psychology: Vol. 1 Roots and branches* (pp. 351–368). American Psychological Association.

Masterpasqua, F. (2009). Psychology and epigenetics. *Review of General Psychology, 13*(3), 194–201. https://doi.org/10.1037/a0016301

McGowan, P. O., Suderman, M., Sasaki, A., Huang, T. C. T., Hallett, M., Meaney, M. J., & Szyf, M. (2011). Broad epigenetic signature of maternal care in the brain of adult rats. *PLoS ONE, 6*(2), e14739. https://doi.org/10.1371/journal.pone.0014739

Mertz, W., Tsui, J. C., Judd, J. T., Reiser, S., Hallfrisch, J., Morris, E. R., Steele, P. D., & Lashley, E. (1991). What are people really eating? The relation between energy intake derived from estimated diet records and intake determined to maintain body weight. *The American Journal of Clinical Nutrition, 54*(2), 291–295. https://doi.org/10.1093/ajcn/54.2.291

Murphy, J. M., Stewart, R. B., Bell, R. L., Badia-Elder, N. E., Carr, L. G., McBride, W. J., Lumeng, L., & Li, T. K. (2002). Phenotypic and genotypic characterization of the Indiana university rat lines selectively bred for high and low alcohol preference. *Behavior Genetics, 32*(5), 363–388. https://doi.org/10.1023/A:1020266306135

National Autism Center. (2015). *Findings and conclusions: National standards project, phase 2*. https://nationalautismcenter.org/national-standards/phase-2-2015/

Open Science Collaboration. (2015). Estimating the reproducibility of psychological science. *Science, 349*(6251), aac4716. https://doi.org/10.1126/science.aac4716

Pinker, S. (2018). *Enlightenment now: The case of reason, science, humanism, and progress*. Viking.

Reichow, B. (2012). Overview of meta-analyses on early intensive behavioral intervention for young children with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(4), 512–520. https://doi.org/10.1007/s10803-011-1218-9

Roberts, A. J., Gold, L. H., Polis, I., McDonald, J. S., Filliol, D., Kieffer, B. L., & Koob, G. F. (2001). Increased ethanol self-administration in delta-opioid receptor knockout mice. *Alcoholism: Clinical and Experimental Research, 25*(9), 1249–1256. https://doi.org/10.1111/j.1530-0277.2001.tb02344.x

Rohrer, J. L., Marshall, K. B., Suzio, C., & Weiss, M. J. (2021). Soft skills: The case for compassionate approaches or how behavior analysis keeps finding its heart. *Behavior Analysis in Practice, 14*(4), 1135–1143. https://doi.org/10.1007/s40617-021-00563-x

Rutherford, A. (2006). The social control of behavior control: Behavior modification, individual rights, and research ethics in America, 1971–1979. *Journal of the History of the Behavioral Sciences, 42*(3), 203–220. https://doi.org/10.1002/jhbs.20169

Skinner, B. F. (1979). *The shaping of a behaviorist*. Knopf.

Soon, C. S., Brass, M., Heinze, H.-J., & Haynes, J.-D. (2008). Unconscious determinants of free decisions in the human brain. *Nature Neuroscience, 11*(5), 543–545. https://doi.org/10.1038/nn.2112

St. Peter, C. C. (2023). On the importance of fidelity, integrity, and adherence in behavior-analytic publications: An introduction to the special issue on procedural fidelity. *Education and Treatment of Children, 46*(3), 195–199. https://doi.org/10.1007/s43494-023-00105-w

Stockard, J., Wood, T. W., Coughlin, C., & Rasplica Khoury, C. (2018). The effectiveness of direct instruction curricula: A meta-analysis of a half century of research. *Review of Educational Research, 88*(4), 479–507. https://doi.org/10.3102/0034654317751919

Szyf, M., McGowan, P., & Meaney, M. J. (2008). The social environment and the epigenome. *Environmental and Molecular Mutagenesis, 49*(1), 46–60. https://doi.org/10.1002/em.20357

Taboas, A., Doepke, K., & Zimmerman, C. (2023). Preferences for identity-first versus person-first language in a US sample of autism stakeholders. *Autism, 27*(2), 565–570. https://doi.org/10.1177/13623613221130845

Taylor, B. A., LeBlanc, L. A., & Nosik, M. R. (2019). Compassionate care in behavior analytic treatment: Can outcomes be enhanced by attending to relationships with caregivers? *Behavior Analysis in Practice, 12*(3), 654–666. https://doi.org/10.1007/s40617-018-00289-3

U.S. Surgeon General (1999). *Mental health: A report of the surgeon general*.

Verhulst, B., Neale, M. C., & Kendler, K. S. (2015). The heritability of alcohol use disorders: A meta-analysis of twin and adoption studies. *Psychological Medicine, 45*(5), 1061–1072. https://doi.org/10.1017/S0033291714002165

Vohs, K. D., & Schooler, J. W. (2008). The value of believing in free will: Encouraging a belief in determinism increases cheating. *Psychological Science, 19*(1), 49–54. https://doi.org/10.1111/j.1467-9280.2008.02045.x

Weaver, I. C. G., Champagne, F. A., Brown, S. E., Dymov, S., Sharma, S., Meaney, M. J., & Szyf, M. (2005). Reversal of maternal programming of stress responses in adult offspring through methyl supplementation: Altering epigenetic marking later in life. *The Journal of Neuroscience, 25*(47), 11045–11054. https://doi.org/10.1523/JNEUROSCI.3652-05.2005

Wegner, D. M. (2003). *The illusion of conscious will*. MIT Press.

Wong, C., Odom, S. L., Hume, K. A., Cox, A. W., Fettig, A., Kucharczyk, S., Brock, M. E., Plavnick, J. B., Fleury, V. P., & Schultz, T. R. (2015). Evidence-based practices for children, youth, and young adults with autism spectrum disorder: A comprehensive review. *Journal of Autism and Developmental Disorders, 45*(7), 1951–1966. https://doi.org/10.1007/s10803-014-2351-z

Zhang, T. Y., Labonté, B., Wen, X. L., Turecki, G., & Meaney, M. J. (2013). Epigenetic mechanisms for the early environmental regulation of hippocampal glucocorticoid receptor gene expression in rodents and humans. *Neuropsychopharmacology, 38*(1), 111–123. https://doi.org/10.1038/npp.2012.149