1 WHY AND HOW WE STUDY INFANT DEVELOPMENT

As we begin this journey of understanding development in infancy, we want to introduce you to six infants: Alison, Carter, Diego, Tesalia, Edwin, and Charlie. These are our own six babies, so we know them well. Throughout this book we will tell you stories about these children and how they developed. These six infants were different in many ways. Alison and Carter were born into a household where only English was spoken, whereas the other infants heard some combination of English and Spanish in their homes (to different degrees). Carter, Diego, and Edwin were quiet and cautious, whereas Charlie and Tesalia were rambunctious and fearless. Diego was always highly social with peers but quiet with adults. Edwin was highly social with adults but more reserved with peers. Tesalia and Charlie were outgoing with everyone but often preferred solitary play to social interactions. Alison always preferred to be with people—whether children or adults—than to be alone. As we discuss different aspects of development, we will describe some of the events from these six children's infancies to illustrate the many different ways in which typical development unfolds.

Despite the many differences among them, these six infants also have quite a lot in common, and they can provide insight into the many variations of culture, context, and experience that infants have around the world. All six of these infants were born to educated parents, their mothers were all developmental psychologists (who happened to study infancy), they were all exposed to music from an early age, and their infancy was full of the "stuff" of middle-class North American families (lots of books in the home, adults and other children with which to play, outings, multiple strollers, toys, etc.). Thus, they represent a fairly narrow slice of the world's infants. Many infants across the globe grow and develop in very different contexts (The movie *Babies* by Thomas Balmès shows how infants grow and thrive in very different environments.) We will use our own infants to illustrate development, but we recognize that they can't illustrate every context or environment of development. Our goal is to show not only what is common across infant development but also how infants thrive in many different environments, in different kinds of families, and with very different resources. Thus, as we discuss development, we will describe what we know of the development of infants from all around the world.

After reading this chapter you will be able to:

1. *Describe* several reasons why scientists are interested in *infancy*, and how the study of infancy addresses important scientific questions.

2. *Compare* methodological designs used to study development, and *identify* the contexts in which each is appropriate.

3. *Examine* infant development in context, and *consider* factors that influence or contribute to development.

WHY INFANCY?

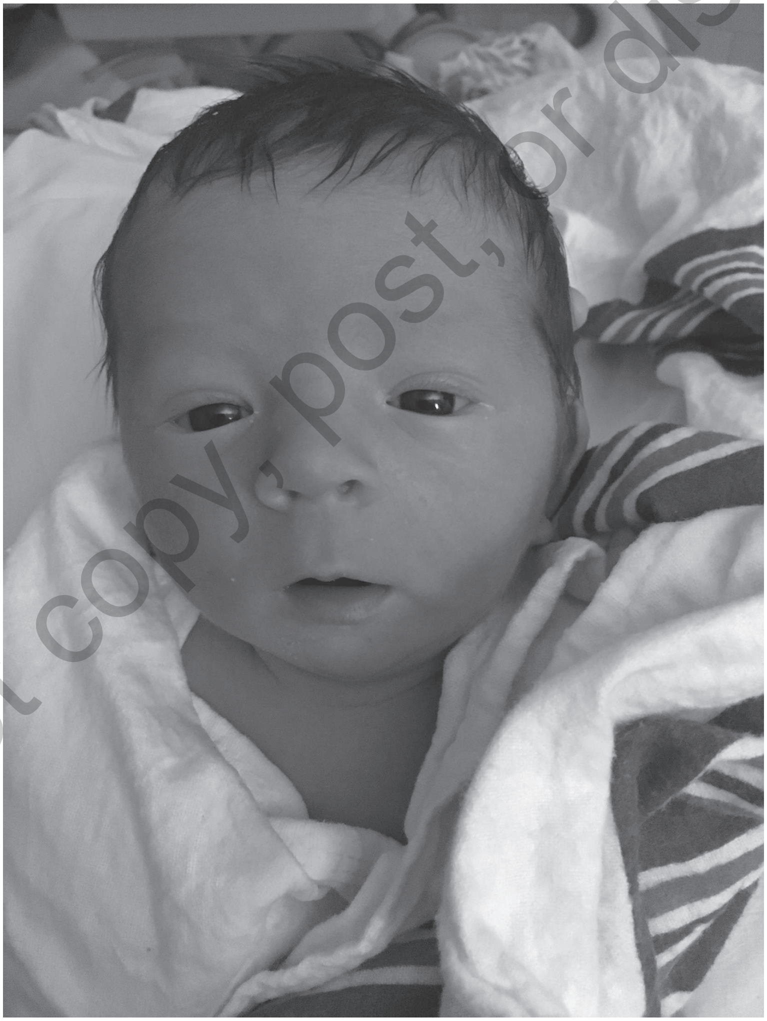
This book focuses only on development during **infancy**. The first question we need to answer is why focus just on *infant* development? You've probably taken courses—or at least heard of courses—that cover child development or even development over the entire lifespan. In this book we will cover many of the same topics that are covered in those other books and courses, but we will focus on the development that happens just in the first couple of years of life. In this first chapter, we will help you see why focusing on development during infancy is both important and exciting. We believe, and we hope you will agree, that studying how development unfolds in infants provides an important framework for appreciating development in older children and adults.

First, though, we need to be clear on what we mean by infancy. The term *infancy* comes from the Latin word *infans*, which means "unable to speak." Thus, many people have defined human infancy as the period before language. (We will talk about what is meant by language and how to distinguish it from communication in Chapter 9.) Obviously, this doesn't work well for other species that have periods of infancy but that never learn to speak. As you will learn in Chapter 9, this definition is a problem even for human infants, as researchers continue to discover that infants have some awareness and understanding of language at earlier and earlier ages. The journal *Infancy*, which is focused on reporting psychological research on infant development, defines infancy as the first 2 years. However, when describing infancy, researchers and scholars often include development during the prenatal period (see Chapter 3), and many researchers include the period between 2 and 3 years of age as well. For this book, infancy will include the period from conception through age 3, but our primary focus will be on birth to age 2.

So why focus on just this period of development? No doubt you already know that babies are cute, and that might be part of why you are interested in infant development. In fact, many people who study infants (including us) do so, in part, because babies are so darn cute. But we also focus on development in infancy to address important scientific questions and to understand how to care for infants and young children.

Studying Infants to Address Important Scientific Questions

Many questions important to scientists and scholars can be answered by studying the infancy period. For example, focusing on infancy can help us to understand *development,* or the process of change, itself. During infancy, development happens very quickly—more quickly than most other periods of the lifespan. Look at the pictures of Charlie as a newborn and as a 1-year-old. You can see that he changed a lot during that short 12 months! As a newborn, Charlie, like all infants, was pretty helpless and unable to control his body. Newborn infants depend on reflexes (see Chapter 3) to be able to eat. They cry when distressed, but they don't know why they're distressed or how to make themselves feel better (see Chapter 10). They are completely dependent on caregivers to meet their physiological needs, move them from one place to the other, and keep them safe from danger. However, within a few weeks and months after birth, infants become able to control their bodies, they recognize their own needs and desires, they can move from one place to another on their own, and their ability to understand the world around them develops. As you can see in second photo, by their first birthday, infants are engaging in social interactions, communicating, and moving themselves around. The fact that so many abilities change in such a short time gives researchers the ability to study development in a way that is more difficult when children are older and developmental change is more subtle and may happen over longer periods of time.



Newborn Charlie

Charlie, Age 1

By studying infants, we can gain insight into the developmental *process*. That is, as developmental scientists we do not only want to know *what* happens *when*, but we also want to know *how* development happens. Uncovering developmental processes is very difficult. We can easily see *changes* in infants—6-month-old infants don't talk yet, 18-month-old children have a handful of words, and 30-month-old children can carry on a conversation. But how can we see the *processes* that allow these changes to happen? This is a harder question to answer, and it is something that developmental scientists and scholars have argued over for quite some time. However, many researchers do agree that we can begin to understand developmental processes by studying infants (Table 1.1).

TABLE 1.1 ■ Scientific Questions Addressed by Studying Infancy

Scientific Question	Why Studying Infants Addresses This Question
Qualitative vs. quantitative change in development	Development in infancy is characterized both by dramatic qualitative change and by dramatic quantitative change.
The role of nature and nurture in development	Many experiences occur for the first time in infancy, allowing researchers to examine developmental change both in the absence of experience and after some experience has occurred.

Qualitative Versus Quantitative Change

One aspect of the developmental process is whether development is a series of gradual, continuous changes or big abrupt, discontinuous changes—in other words, whether development is best characterized as **qualitative change** or **quantitative change**. Qualitative change, or changes that are discontinuous, refers to changes in *kind*. With development, new features emerge and old ones disappear, or the features themselves actually change. For example, during the lifecycle of a butterfly the individual is both a caterpillar and a butterfly, which are two very different kinds of beings (i.e., they have different body parts, and they navigate in different ways). Many aspects of development across infancy seem qualitative. Consider again the comparison of newborn Charlie and 1-year-old Charlie. Although you might see similarities in some of his features, newborn Charlie is not just a smaller version of toddler Charlie. Newborn infants look physically different than older infants. At birth we have different body proportions, and our hair and eyes may be a different color than they will be later. Even our features, such as the shape of our nose and chin, are different. Notice that when Charlie was born he had dark brown hair and dark blue eyes. But at age 1, he had light blonde hair and dark brown eyes! It was not just that he had more hair or bigger eyes; the features of his hair and eyes changed *qualitatively* over the first year. There are lots of these qualitative changes in infancy. Remember, the term *infancy* itself refers to having no language. The development from being *prelinguistic* (or having no language) to being *linguistic* (or having some language) is a qualitative change. It is not a bigger, better version of what the child was; rather, the emergence of language seems to create an individual who has qualities and features that were not there before. When we were new parents, each of us felt disbelief that our helpless, uncommunicative newborn infant would become an articulate adult who can play basketball, read books, and create virtual worlds.

Of course, development during infancy also involves quantitative, or continuous, change. *Quantitative* changes are not changes in kind but rather changes in amount. Development during the first 2 years is not only a series of abrupt changes in features and skills; some things simply gradually increase over this period. One of the important measurements pediatricians take is the infants' weight. Although gaining weight might not seem that important, it is a good proxy for development. Healthy infants grow, and it is relatively easy to accurately measure weight. At the same time Charlie's eye and hair color were changing, he was steadily gaining weight, increasing his weight by a few pounds every month. His parents kept a chart of his growth and they watched as his weight increased from 7 ½ pounds at birth to just over 20 pounds on his first birthday. During infancy, these kinds of quantitative changes are seen only as children gain weight and grow inches, but also once they begin to crawl and walk, they develop from moving slowly for short distances to moving faster and going longer distances. During early language development, toddlers learn more and more new words. Clearly, some aspects of development are changes in *quantity*.

This distinction between qualitative and quantitative changes is important for our understanding of developmental processes. When scientists and scholars think about these different kinds of changes, they also consider different mechanisms of change,or the precise reason why a change occurs. For example, changes in how fast information is processed or how quickly children can form a memory—quantitative changes—might be attributed to increased number of neurons or more myelination (see Chapter 2). The emergence of a new ability—qualitative changes, such as the emergence of language or the ability to walk—might be attributed to a reorganization within the brain or newly formed connections between different brain regions. Moreover, you may have noticed that development is not qualitative *or* quantitative, but it is both. The shift from having no language to having some language may be qualitative, but the gradual increase in vocabulary size is quantitative. Throughout the book, you will see discussions of both kinds of changes and how researchers have used those changes to speculate about developmental processes.

Nature and Nurture

The nature versus nurture debate is as old as history itself. As far back as the fourth century BCE, Ancient Chinese philosophers have discussed the relative contributions of innate qualities and external influences on human development (Chan, 2019). In Western thought, these ideas can be traced back to Plato, who argued in 300-400 BC that people have some concepts or ideas about the world from birth as a result of their souls having encountered these ideas in heaven before they are born. In contrast, Aristotle believed that experience is important in learning concepts. Western philosophers have debated these issues for centuries. Philosopher John Locke (1632–1704) argued that we are not born with any innate ideas or knowledge, but rather the human mind starts out as a *tabula rasa*, or a "blank slate." Locke believed that all of our ideas and knowledge are a product of experience. René Descartes (1596–1650), in contrast, argued that although some ideas (thoughts, knowledge) come from experience, or senses, some knowledge is inborn and unlearned.

These philosophical debates have had a significant influence on how psychologists have thought about the roles of nature and nurture in development. John B. Watson (1878–1958), the father of American behaviorism, believed that development was primarily (if not solely) determined by experience, or nurture. In his 1924 book *Behaviorism*, Watson wrote:

> *Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations and the race of his ancestors.* (Watson, 1924, p. 104)

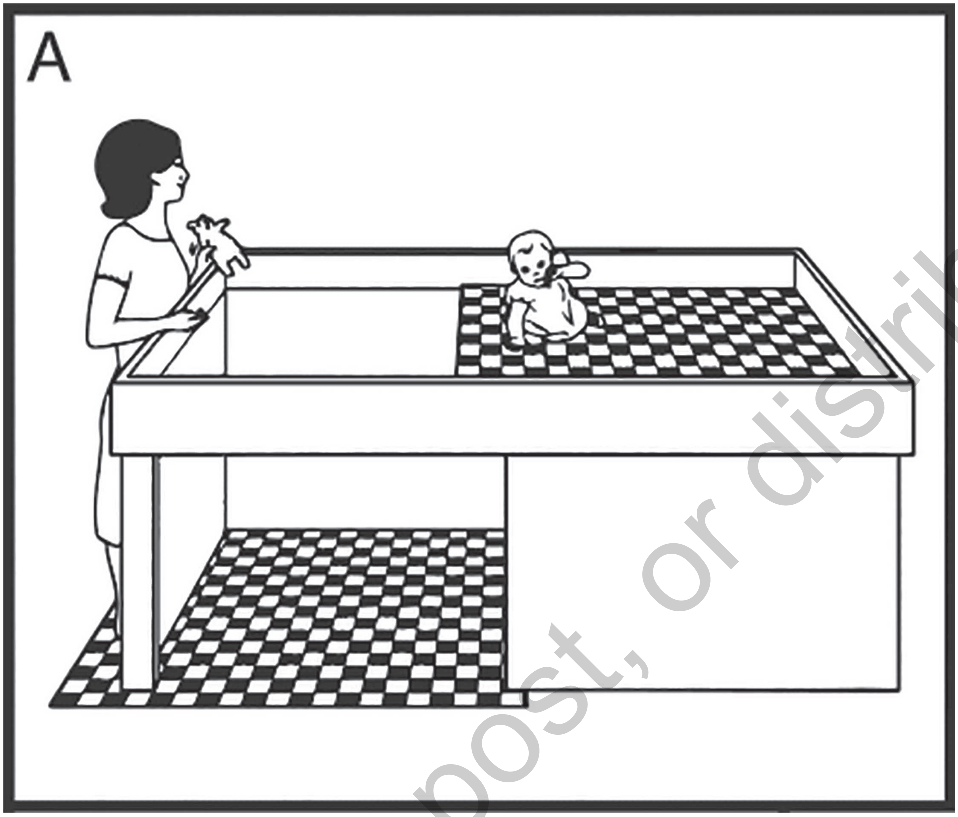
Arnold Gesell (1880–1961), who was a contemporary of Watson, argued instead that development reflected biology or *nature*. Influenced by Charles Darwin's theory of evolution and work in embryology, Gesell developed a *maturation* view of human development. He believed that the traits and individual differences that distinguish people are present from birth, and development is the result of factors internal to the child and, in particular, the genes. He did not discount the contribution of the environment, but his emphasis was on biological factors (see Chapter 5 for more on Gesell).

Contemporary theories take an intermediate position, recognizing that development must reflect *both* nature and nurture. Although theorists differ in how they balance these two influences, we know now that both nature and nurture are critically important for development. **Nature** refers to something inherent in the individual. Often, this is described as something that is innate. Researchers don't always agree about what it means for something to be **innate**, but in general when we use this term we are talking about something that is based in biology and it is not learned or gained from experience. When we conclude that development comes from nature, we mean that it is due to our genes or biology. **Nurture**, in contrast, refers to our treatment or experience. When we conclude that development comes from nurture, we mean that it is due to something in our experience.

Researchers have assumed that we can better understand how experience shapes development by studying infants. The logic is that if we observe that some ability, characteristic, or mental process is present early in infancy, it must be determined by nature because infants have had few experiences. If some ability, characteristic, or mental process emerges slowly over time, and varies in children in different countries, language communities, household configurations, etc., then it must be a function of nurture. You will see throughout this book how this classic nature versus nurture debate is a central theme in the study of infant development. If development is due to *nature*, and therefore there are innate, or inborn, abilities, knowledge, or characteristics, then we should be able to see those abilities, knowledge, or characteristics in very young infants—maybe even at birth. For example, some research has shown that minutes after birth, infants prefer to look at images that resemble human faces—infants will look longer at face-like images than other images, such as black and white stripes or random patterns (Goren et al., 1975). Because this happens at birth, before infants have much experience with human faces, it suggests that infants have some kind of biological predisposition that attracts them to human faces. Other studies have shown that at birth infants already have different temperaments, and infants' temperaments are consistent throughout infancy (Matheny et al., 1985). That is, infants who are highly active at birth also tend to be more active later. This kind of research is aimed at uncovering the effects of nature in development.

Other researchers have asked how experience shapes development by comparing infants who do and do not yet have specific experiences. For example, Joseph Campos and his colleagues studied the effects of crawling experience on how infants perceive depth (Campos et al., 1992). They used a classic "visual cliff" apparatus (see photo of visual cliff), which was designed to help researchers study infants' depth perception.

As you can see, the visual cliff is a tabletop with a red and white checkerboard pattern covered with a glass surface. On the "shallow" side of the table, the glass is right on the surface, but for the "deep" side, the pattern is several feet below the surface, giving the appearance of a large



Visual Cliff

Reprinted with permission from LoBue and Adolph (2019).

drop-off. Campos and his colleagues measured infants' heart rate as an experimenter placed them on the deep side of the cliff. Changes in heart rate can tell us something about how infants are perceiving the drop-off. They found that infants who had crawling experience showed a different pattern of heart rate changes than did infants who did not have crawling experience, suggesting that the experience of crawling changed their depth perception.

Most modern developmental psychologists ask how development is shaped by both nature and nurture. It is easy to think about how the two might have an *additive* effect on development. For example, a child inherits genes from his mother and father for height; a child with genes for being tall will be taller than a child with genes for being short. However, nutrition and exercise can add to the equation. If you are well fed and get adequate amounts of exercise, you will be more likely to reach, or even exceed, your genetic potential.

Consider the story of one of our grandmothers. This grandmother, Martha, was born in the 1920s and was raised by a single mother during the Great Depression. They were not extremely poor, but they did struggle, and this young mother was raising three children on her own during a very difficult time in U.S. history. As a result, Martha was not well nourished during her childhood. At age 17 she was about 5 feet 6 inches tall, a perfectly respectable height (and even a bit above average) for a woman. The same year, Martha went through a significant change in her life—she got married. Martha's new husband was well established and expected proper meals with meat, vegetables, and more. They were not wealthy, but for the first time, Martha began to eat regular, healthy meals. Over the first few years of her marriage, Martha grew a couple of inches. On their wedding day, Martha and her husband were about the same height; by their third anniversary, Martha was several inches taller than him. The point of this story is to show you how nutrition (and other factors) seem to *add* to genes in determining height, or conversely, how a lack of nutrition can stifle one's genetic potential. Martha had genes for being tall, but her ultimate height was influenced first by her poor nutrition and later by better nutrition.

But in most cases this isn't really how nature and nurture work together to determine development. Instead, the two factors usually *interact*. We now understand that these interactions really reflect how your genes (nature) make you susceptible or vulnerable to specific aspects of the environment (nurture). This will be discussed in more detail in Chapter 2, but let's consider a brief example here. Phenylketonuria (PKU) is a genetic condition. Individuals with PKU are unable to break down a protein (phenylalanine) that is found in many common foods, including meat and dairy. If a person with PKU eats these foods, a chemical builds up in the blood and will cause permanent damage to the nervous system.

Importantly, the effects of PKU show a *gene by environment (G X E) interaction*. The genetic condition makes the individual susceptible to protein in food. If PKU goes undetected, the individual will consume those foods and cause damage to the nervous system, which will eventually result in severe developmental delays. However, just having the genes for PKU is not sufficient for the damage to occur; if an infant is born with the genes for PKU and is exposed to a phenylalanine-free diet, that infant will develop normally, with no nervous system damage. Having the genes sets the stage for the damage but only if the environment is not well controlled. Newborn infants are routinely screened for PKU at birth, so parents know if they should avoid these foods.

These examples—Martha's ultimate height and the nervous system damage associated with PKU—are somewhat simpler than most of the questions asked by developmental psychologists. These are important examples to show how nature and nurture work together, but they are much easier to explain than examples such as why some children are shier than others or why some children develop motor abilities, such as sitting and walking, earlier than others. We'll get to those in later chapters.

In addition, the nature and nurture question becomes more complicated when we consider how children develop in the different cultures of the world. To show that development reflects nature, researchers have looked for commonalities across cultures. All children around the world learn to walk and talk and they all develop relationships with others, regardless of cultural practices and values. Does this mean those aspects of development reflect nature? The answer is not a clear yes, as children develop these abilities differently and at slightly different times in different cultures, probably because of different parenting practices and experiences in infancy. As you will see throughout the book, this complicated interaction of nature and nurture is discussed in many aspects of infant development.

We Study Infants Because Understanding Infancy Is Important for Caring for Children

There is an African proverb that says, "It takes a village to raise a child." This is especially true for infants who are unable to take care of even the most basic needs (like getting food or moving out of the way of danger). But, if the "village," or society, is going to be able to raise a child, it is important that we know *how*. And to do that, we need to know about development. As adult members of a society, we are involved in making decisions that directly affect the welfare of children, even if we don't realize it. We elect leaders and vote for laws that determine things like caregiver-to-child ratios in daycare centers, who should receive free food and medical care, and how children who are separated from their parents should be treated. By understanding and studying development, we as a society can make policy decisions about families and young children that support and nourish rather than harm development.

Consider an example. You may have heard of the WIC program, or the USDA Food and Nutrition Service's "Women, Infants, and Children" program. This is a program for pregnant women, new mothers (especially those who are breastfeeding), and infants and young children who are at nutritional risk (e.g., underweight or have a poor diet) to give them access to healthy food. Programs like these are informed by our understanding of the importance of development during the prenatal period and early childhood for brain development and for establishing strong physical and mental systems that will support the child throughout life.

People are not only concerned about this in the United States, but they are also concerned that children around the world are well fed and well cared for in the first 1,000 days, that is, the period from conception to about the second birthday. The focus on this period reflects the fact that we know from research that there are **critical periods** during this time. Critical periods are windows of time when development is most vulnerable or susceptible to variations in experience or conditions. (We will talk about critical periods for brain development in Chapter 2 and for language in Chapter 9.) With respect to brain development and nutrition, research has shown that these first 1,000 days are critically important for brain development. This is when the brain is "built." If the child experiences poor nutrition during this critical period, a smaller brain may result; if too severe, a smaller-than-normal brain (called microcephaly) can result in seizures, developmental delays, and motor problems. The first 1,000 days are when all the neurons are created and most of the connections between neurons are formed (more about this in Chapter 2). Good nutrition is needed for these processes. If the child experiences poor nutrition during this critical window—and, as a result, there are fewer neurons and connections between neurons at age 2 than is optimal—better nutrition later in life cannot correct those problems. That is why it is called a critical period; this is a time that is particularly important for the development of brain tissue. Programs like WIC are designed to help children during this critical period. Importantly, designers of such programs and policy makers who determine that these are important programs to fund rely on findings from research with infants; they only know that they should focus their efforts on this short period of time because of the kinds of research we will discuss in this book.

Another example relates to decisions made by leaders about whether children can grow and thrive in the absence of caregivers. As is clear from the discussions of immigration policies in the United States in 2016 through 2020, this is something that is important even in modern times. We know from extreme examples that infants do not thrive when they are separated from caregivers. In the 1980s, state infant centers—or institutions—in Romania became overcrowded. Many children in these centers were left there by parents who had the intention of returning to pick them up; other children were orphans and did not have parents. In 1989, the world became aware of the dire conditions of the children in these institutions. Images were released showing children crying in cribs, and it became known that these children were not well cared for. When children were adopted internationally, they were developmentally behind their non-adopted peers in those new countries. Although these institutionalized children improved considerably when they had consistent caregivers, better nutrition, and a stimulating environment, many of them never fully caught up in either physical size or mental ability.

In 2000, Charles Nelson, Nathan Fox, and Charles Zeanah launched the Bucharest Early Intervention Project (BEIP; Ghera et al., 2009; Nelson et al., 2009) to examine whether putting Romanian children in foster care, rather than having them raised in an institution, would result in fewer long-term problems. They found that infants raised in foster care did not experience as many developmental delays as their peers who stayed in institutions. In fact, the effects were so dramatic that although there remain institutions in Romania, there are now more foster parents, and fewer children are institutionalized.

Children in Romanian Orphanage
BSIP/Contributor/Getty

BOX 1.1—INFANCY IN REAL LIFE: HOW HAVE THE RESULTS OF RESEARCH SHAPED CHILDREN'S LIVES?

Parents and policy makers do not typically peruse the scientific literature to decide how to parent, vote on legislation, or put policies in place. When parents are trying to make research-based decisions, they often ask their pediatrician or read a parenting magazine. Parents trust that their pediatrician will be up on the latest research findings, and articles in parenting magazines are written in ways that are meant to help parents stay informed. Policy makers and parents also read articles in newspapers and on blogs and websites. Parents may find information on social media such as Twitter, Instagram, and Facebook.

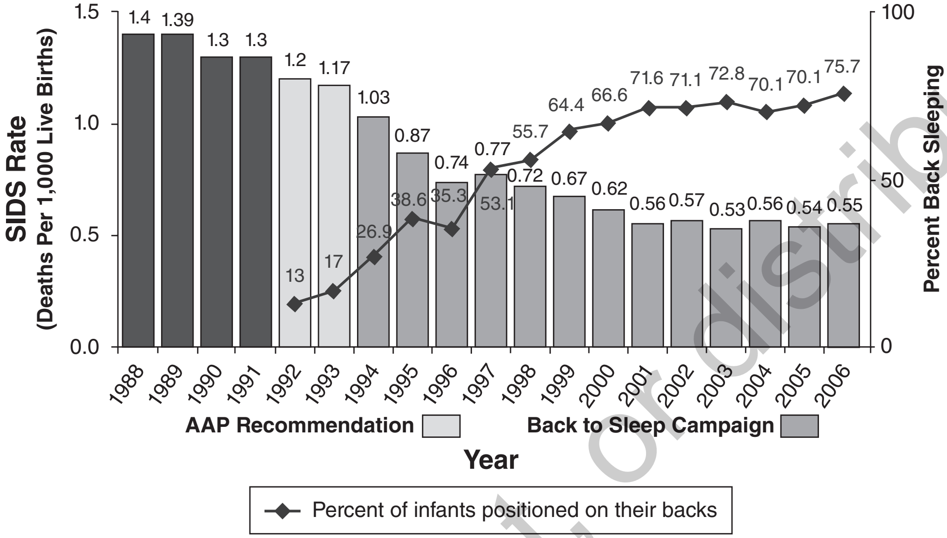
However, the articles that are found in newspapers, magazines, and media may not always be accurate and might actually mislead parents and policy makers. Consider the Mozart effect. In the 1990s, parents learned, mostly from the media, that listening to Mozart could make their infants smarter. This idea came from a 1993 study by Frances Rauscher, Gordon Shaw, and Catherine Ky (1993). These researchers found that undergraduate students' performance on a spatial IQ test was improved when they listened to Mozart compared to when they listened to a relaxation tape or listened to silence. This idea that Mozart, in particular, made people smarter was consistent with ideas promoted by French scientist Alfred Thomatis that listening to music helped the brain to heal and develop. These ideas were popularized first in an article in the *New York Times* in 1994 arguing that the study by Rauscher and colleagues showed the superiority of Mozart over Beethoven, and by a book in 1997 by Don Campbell in which he recommended playing Mozart to infants to help their mental development (Campbell, 1997). Although none of the actual research was done with infants, baby toys and materials were developed to promote brain development based on these theories, and the governor of Georgia even proposed that the state should provide every newborn with recordings of classical music (Sack, 1998)!

The problem is that the Mozart effect is not real. Not only was the original finding with adults and not infants, other researchers have not been able to replicate the results. To be clear, this was not necessarily a case of research creating real problems for infants and parents; the worst this did was make people spend money on classical music they might not have otherwise spent. But, it does show how research findings can be taken the wrong way and be popularized in a way that is not helpful.

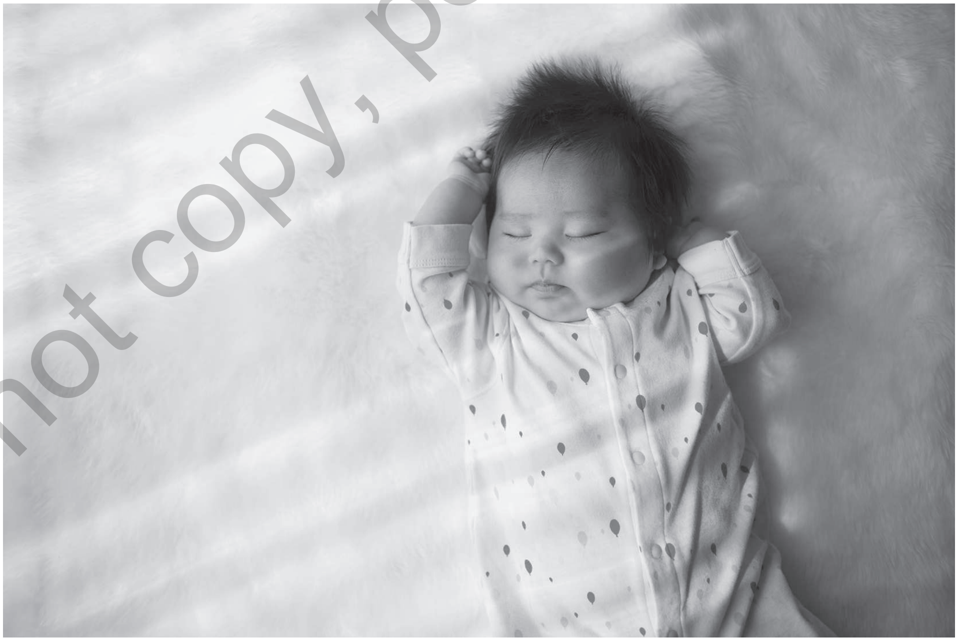
There are other examples showing how the results of research have had an important positive effect on infants' lives. A good example of this is the Back to Sleep campaign (now called the Safe to Sleep campaign), which also happened in the 1990s. This campaign resulted from the observation that in some cultures, infants were routinely put on their backs to sleep and sudden infant death syndrome (SIDS) was relatively rare. By the early 1990s, pediatricians in Europe and the United States began to encourage parents to position their infants on their back or sides when being put down to sleep. Later this recommendation was revised to be positioning infants only on their backs. The results were remarkable. As can be seen in Figure 1.1, as the percentage of infants positioned on their back increased (the diamonds), the number of infants who died from SIDS decreased dramatically (the light blue and gray bars). The Back to Sleep Campaign involved providing health care professionals and parents with materials and information about putting infants to sleep on their backs. Although we don't know exactly why putting infants on their backs seems to lower their risks for SIDS, this is an example of popularizing the results of research that likely saved many children's lives.

FIGURE 1.1 ■ SIDS Rates and Back Sleeping (1988–2006)

Rates of sudden infant death syndrome (SIDS) in the United States over time as a function of the percentage of how many parents put their infants to sleep on their backs.



Source: From the National Institute of Child Health and Human Development.



Infant Sleeping on Her Back

iStock/Yagi-Studio

It is not always easy to translate research findings into good policies to help children. A dramatic example of this was the popularization of the finding that vaccines caused autism. In 1998, Andrew Wakefield and his colleagues published a study that they claimed showed that the measles, mumps, and rubella vaccine (MMR) was linked to the development of autism. The original study was published in a medical journal and claimed to show in a very small sample of children ($n = 12$) that the onset of autism corresponded to when the MMR vaccination was given. The study was later shown to be false—and in fact, Wakefield was discredited and lost his ability to practice medicine or do research (Flaherty, 2011). However, the damage was already done. When the study was published, there was a lot of publicity about the finding, particularly by celebrities who believed that their own children's autism was caused by the MMR vaccination. This has been a tragedy for children around the world, as parents began to resist life-saving vaccinations based on the unfounded fear that their child may become autistic. Diseases such as measles that were essentially nonexistent in many parts of the world began to show up in unvaccinated children. The controversy about vaccinations is tragic because the fear of vaccinations is based on this one flawed study, with results that the scientific community agrees are false. Many studies have shown that vaccines are safe, that the rates of autism are not greater in vaccinated than unvaccinated children, and that the health risks of being unvaccinated are much greater than the side effects of the vaccines (DeStefano & Shimabukuro, 2019). The point of this example is that although we do research in order to help infants, it is very important that the results of research are appropriately and accurately reported to the public so that decisions about policies and parenting are not based on misinformation that may end up doing more harm than good.

Check Your Learning

1. Give an example of a qualitative change in infant development and an example of a quantitative change in infant development. How do these two types of changes differ?
2. How would you define nature? How would you define nurture? Explain how nature and nurture can have an *additive* effect on development and how it can have an *interactive* effect on development.
3. How would you describe a critical period in development? Why is knowing about critical periods in development important for parents, educators, and policy makers?

HOW DO WE STUDY INFANT DEVELOPMENT?

Now that we have established why we study infants, we need to consider *how* we study infants. There are two major things we need to think about: (1) research designs for studying development, and (2) what can we actually measure in infants.

Research Designs

You probably already know something about different types of research designs, but we will review some basic concepts. Specifically, here we describe the differences between **correlational**, **experimental**, and **quasi-experimental** designs (Table 1.2). The differences between these designs are

TABLE 1.2 ■ Research Designs

	Defining Features	Benefits	Limitations	Appropriate Verbs
Correlation	Values on multiple variables are observed and relations between those variables is assessed	Can evaluate relations between variables that are impossible or unethical to manipulate	Difficult to draw cause and effect conclusions	Is linked to Is associated with Is correlated with Prefer May predict Are more/less likely to Is tied to Goes with
Experiment	Participants are randomly assigned to conditions or groups	Can assess the effect of one variable on another (e.g., cause and effect)	Some variables cannot be manipulated (e.g., age)	Causes Affects Changes Promotes Increases/decreases Results in
Quasi-experiment	"Natural" variables (e.g., age, sex, SES) are treated as groups	Can treat variables that are not manipulated (e.g., age) as grouping variables	At their core, these are correlational designs that do not allow causal conclusions	Is linked to Is associated with Is correlated with Prefers May predict Is more/less likely to Is tied to Goes with

important for understanding what studies using each kind of design actually tell us about development. You likely already know that correlational designs are when a researcher simply measures two (or more) features or characteristics, or variables, of a group of people and looks at how those characteristics are related. Remember the children raised in Romanian institutions? As part of this research, children's growth and development was measured when they were adopted into European households. The researchers also recorded how much time the children had spent in the Romanian institutions. This study showed that there was a correlation between how much time children spent in Romanian orphanages and their growth and development scores. Children who had spent more time in the orphanages were more delayed compared to children who spent less time in the orphanages. That is, time spent in orphanages was correlated with the amount of developmental delay.

What can we conclude from this finding? Because the researchers simply measured two variables (growth and time in the orphanage) and observed the relation between them, we can't draw any causal conclusions about that relation. It is tempting to think that these differences in children's development were *caused* by being raised in an institution. Indeed, this was part of the worldwide outrage that was expressed when the images emerged from Romania. People concluded that children's development was being harmed by being raised in an institution.

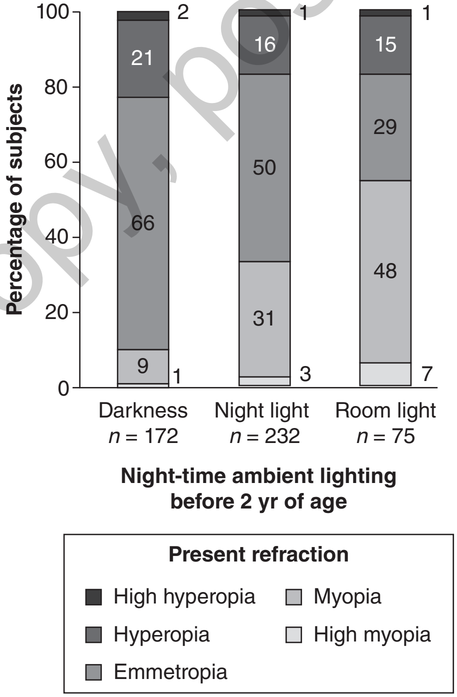
However, we can't actually know for sure if this is true based on this observation. Specifically, there may be other reasons why these two variables were related. The correlation between the amount of time children were in institutions and their growth and development might be due to the institutions not providing a context to support these children's development. It is also possible that parents were more likely to abandon children who were small and sick. In this case, living in the institution may have made it harder for them to thrive without *causing* their growth and developmental delays.

BOX 1.2—INFANCY IN REAL LIFE: CORRELATIONAL STUDIES AND ADVICE TO PARENTS

In 1999 Graham Quinn and his colleagues published a study that led to the conclusion, especially in the media, that exposure to light at night interfered with visual development during a critical period in infancy (Quinn et al., 1999). They asked parents of 437 children between the ages of 2 and 16 years about the child's light exposure across the lifespan. Children who were exposed to more light at night (e.g., with a night light or the room light on) before the age of 2 were found to have more significant vision problems (see Figure 1.2; emmetropia

FIGURE 1.2 ■ Myopia and Ambient Lighting at Night

The percentage of children with different levels of vision problems as a function of whether they slept in darkness, with a night light, or with the room light on.



Source: Reproduced with permission from Quinn et al. (1999).

is "normal" vision). Note that most of the children who slept in darkness had normal vision (66%), but only half of the children who had a night light and about one third of the children who slept with the room light on had normal vision. From this observation, researchers and the media concluded that exposure to light during the night caused the children to develop vision problems.

Several news outlets jumped on this conclusion, and articles appeared with headlines like "Night Lights Linked to Babies' Nearsightedness" (Maugh, 1999) and "Night Lights Linked to Vision Problems" (Associated Press, 1999). The problem is, of course, that these are causal conclusions drawn from correlational findings. From the original study, we know that night light use and poor vision are *associated*, but we don't actually know whether the night light use *caused* differences in infants' visual development. The two variables might be linked for a different reason. Karla Zadnik and her colleagues did a follow-up study and found that children who slept with night lights or room lights on were not more likely to have vision problems than were children who slept in the dark; that is, there was no correlation between vision problems and night light use (Zadnik et al., 2000). Zadnik and colleagues also measured the parents' vision problems. They found that parents with poor vision were more likely to use night lights in their children's rooms than were parents with normal vision; that is, there was a correlation between parental vision problems and night light use. Because many of the causes of vision problems are genetic, and parents can pass those problems to their children, Zadnik's study suggested that the correlation observed in Quinn's original study might be due to a third variable. Specifically, parents with poor vision used night lights and their children were genetically predisposed to poor vision. This is still a correlation, but it shows that the conclusions from Quinn's original study should not have been described to parents as night lights causing vision problems.

Unlike correlational designs, in experimental designs, study participants are *randomly assigned* to different groups to determine the levels of one or more variables. In an experiment, the variable we manipulate is the *independent variable*, and the variable we measure is the *dependent variable*. Because we randomly assign participants to different levels of the independent variable, we can conclude that differences in the dependent variable are *caused* by that assignment.

Even though we can't know from the original observation if time in the Romanian orphanage caused children's developmental delays, Charles Nelson and his colleagues in the BEIP study conducted an experiment that does answer this question. At the time of this study, foster care was virtually nonexistent in Romania. So Nelson and his colleagues created one. They found foster care families and randomly assigned children to be raised either in an orphanage or in a family household (i.e., foster care). In this case, the rearing environment is the independent variable and developmental outcomes—size, scores on cognitive tests, etc.—are the dependent variables. Because Nelson and his colleagues randomly assigned children to one of two rearing conditions, we know that the groups of children did not differ in some important way *before* they were assigned to one rearing condition or the other. Nelson and his colleagues observed that the children who were assigned to a foster family had better outcomes than children who remained in the institutions. This study allows us to conclude that children develop better when they are in a family context than when they are in an institution.

Given that experiments are the only way we can draw causal conclusions, why don't we always use this approach? This remarkable study was only possible because prior to this study Romania did not have a large foster system. Charles Nelson and his colleagues could randomly assign children to foster care because the foster care system in Romania was essentially nonexistent. However, it is not ethical to randomly assign children to grow up with their parents or in an institution. Further, some have argued that even Nelson's study was not ethical because even without the study it was clear that the treatment in these orphanages was not good for children. Unfortunately, at the time of the study, there wasn't widespread agreement in Romania that this was true (Zeanah et al., 2012), and improving the treatment of children *required* this kind of causal study. The issue is whether it is ethical to give only some children a "better" treatment and leave other children in the "standard treatment," especially if we have a strong belief that this standard treatment is harmful. This is a complex and difficult question. Although prior to the study, the Romanian government did not recognize that foster care was better, the American investigators surely did. But by conducting this experiment, the BEIP study encouraged the Romanian government to create a system that was better for all orphans. Now Romania does have a foster care system. In 2018, over 36,000 children in Romania were being raised in a family home and fewer than 7,000 children were being raised in institutions, and many of those children were children with disabilities placed in institutions that cared specifically for children with disabilities.

In other cases, random assignment simply is not possible. For example, we could test whether exposure to night lights affects visual development by randomly assigning some infants to sleep with a night light and other infants to sleep in the dark, and then measure their vision later on. This experiment not only poses an ethical problem (if we believe that sleeping with a night light will cause vision problems), but it is likely that the random assignment won't work. Some children can't sleep with a night light on and other children won't sleep without one. Therefore, even if you did randomly assign children to night light or no night light conditions, your study might fail because children in each group would be unable to sleep, and parents might end up doing what they wanted to anyway. Indeed, this is one benefit of correlational studies: They allow us to examine the relation between two variables that are impossible or unethical to manipulate.

In many studies, researchers treat existing group differences (e.g., whether or not an infant sleeps with a night light, sex or gender, age) as independent variables. This design is called a quasi-experiment because we have variables that look like conditions in an experiment, but we didn't randomly assign people to those conditions. In the original observation of children raised in Romanian orphanages to children raised in homes with their biological parents, the conditions that were being compared were not randomly assigned, but rather children were "assigned" to an orphanage or a home based on aspects of their life circumstances (i.e., where they were born). This design is sometimes referred to as a natural experiment, because the conditions reflect people's "natural" state. In the night light study described in Box 1.2, children were grouped into "darkness," "night light," or "ambient light." But, they weren't randomly assigned to those groups; these are their groupings based on their experience. So, it *looks* like an experiment—because we have groups—but it is really a correlation.

This is the design we are using whenever we compare groups of children of different ages. Consider, for example, a researcher interested in comparing perception from 4 months to 8 months. It is impossible to randomly assign some children to be 4 months and others to be 8 months. Instead, we find infants who are 4 months old and we find other infants who are 8 months old, and we compare them. We will talk about designs for comparing different ages of children later, but for now it is important to remember that whenever we compare children of different ages, we are doing a quasi-experiment.

Designs for Studying Infant Development

Because we are interested in development, we need to design studies that look at change. The main way we do this is by comparing children at different ages. This allows us to draw conclusions about how children of different ages respond on those tests. The two main designs for studying development are **cross-sectional** and **longitudinal** designs. These two designs differ in whether the *same* children are tested at different ages (longitudinal designs), or whether *different* children are tested at each age (cross-sectional designs).

Imagine you want to know at what age infants first start sitting on their own—that is, when can you put them on the floor and let go and they will be able to sit without falling down? Perhaps we think this develops between 5 and 8 months of age. We could study this using a cross-sectional design by asking parents of infants who are 5 months, 6 months, 7 months, *or* 8 months to our lab for testing. We might have 15 infants at each age come to the lab and we would record them sitting. Maybe we find that 1 of the infants at 5 months could sit, 3 of the infants at 6 months could sit, 9 of the infants at 7 months could sit, and all of the infants at 8 months could sit. We might conclude that 7 months is when infants learn to sit on average and that infants can sit by the time they are 8 months old.

This study would give us important insight into when we can expect that children in general will be able to sit. But this study doesn't really tell us anything about when the infants we tested first learned to sit. For example, we don't know *when* the nine 7-month-old infants who could sit actually acquired that ability. They may have started sitting when they were 5 months old, or they may not have started sitting until the week before they came to the lab. So, although this cross-sectional study allows us to determine when children can sit on average, it does not tell us much about how individual infants learn to sit.

To answer this question, we would need to test the *same* infants over time. Instead of having different groups of 5-, 6-, 7-, and 8-month-old infants visit the lab once, we would ask parents to bring their infants into the lab 4 times—once each month between 5 and 8 months. Now we would be able to determine when each infant learned to sit.

How do researchers decide which kind of design to use? Each has benefits and each has limitations (Table 1.3). As we just saw, longitudinal studies allow us to look at the development of individuals. But, it might be hard to get parents to agree to come to the lab every month for testing, so a longitudinal study might be harder to conduct. In addition, a longitudinal study will take *longer* to conduct. In our example, it would take us 4 months to test our subjects. If we were interested in bigger age differences—for example, some difference between 1-year-old and 2-year-old children—it would take even longer. If you conduct a cross-sectional study, however,

TABLE 1.3 ■ Designs for Studying Development

Type of Design	Defining Features	Benefits	Limitations	Type of Conclusion
Cross-sectional	Different children are examined at each age	Relatively quick and requires less of a commitment from families	Age differences are confounded with group differences	Age-related differences
Longitudinal	The same children are examined across time	Allows the evaluation of how the same children develop, and allows the study of the individual differences	Takes longer and requires a bigger commitment from families; differences across repeated testing may reflect differences in age or the effect of repeated testing	Developmental change, continuity and stability
Cohort-sequential	Groups of children are examined multiple times, at overlapping ages	Can explore development longitudinally over a relatively long time span in less time; less of a commitment from each family	Different cohorts of children may be different in ways other than age	Both age-related and developmental change, continuity and stability within a cohort
Microgenetic	The same children are examined multiple times at short intervals, usually at a time of developmental transition	Can actually observe development in real time; can help us understand how development unfolds	Requires commitment from families to several sessions; effects of multiple testing sessions	Developmental trajectories
Age-held-constant	All children are the same age but differ in some other characteristic or experience	Allows the evaluation of the role of some experience or milestone without the effect of age	Only tests children at one time	How behavior is different in children with and without specific experience

you can test all the ages at the same time. In the case of our sitting example, you could test the 5-, 6-, 7-, and 8-month-old infants at the same time, perhaps completing the testing in less time than it would take you to follow a single infant from 5 to 8 months. The benefit is even clearer when we consider comparing 1-year-old and 2-year-old children; in this case, you can test children of both ages in the same weeks or months (rather than waiting a year for your children to reach the next age), thus keeping the time to finish the study much shorter.

Another potential problem with longitudinal studies is that age and number of visits is confounded. A *confound* is an extra variable that might influence your results in unintended ways.

In this example, when children are older, they necessarily have participated in more visits. If you find that children in your longitudinal study are better or faster when they are older compared to when they were younger, it might be because they are older *or* it might be because they are more familiar with the study setting or materials. That is, we need to be careful to design our study so that children don't improve simply because of repeated testing. When we test children cross-sectionally, this isn't a problem. In a cross-sectional study, the oldest children are tested on their first visit, just like the youngest children. Thus, the fact that they are better or faster can't be because they are more familiar with the setting. For this reason, researchers may use a **cohort-sequential** design, which combines elements of both cross-sectional and longitudinal designs. As in a longitudinal design, all children in a cohort-sequential design are evaluated at multiple time points. However, different groups, or cohorts, of children are tested, each starting the study at different ages. This has the advantage of being able to compare the same children at different time points, while at the same time testing different groups of children reducing both the effects of repeated testing and the time required to complete the entire study.

These are practical reasons for why you might choose one approach or the other, but the most important difference between the two kinds of designs is what conclusions can be drawn from differences between older and younger children. In cross-sectional studies, you can draw conclusions about *age-related differences.* In the sitting example, you could conclude that the number of infants who could sit increased at each age. You can't draw conclusions about *development*, however. Because you see each child only one time, it is impossible to know anything about a child's skills or abilities before they visited the lab or how those skills and abilities changed after their lab visits. In cross-sectional studies, we can only make conclusions about how groups of children are similar or different *on average*.

Longitudinal studies, in contrast, do allow for conclusions about development. Because we observe the same child at different time points, we can learn about when particular children achieve a skill or ability, how some skills or abilities develop into different skills or abilities, and importantly, how different children show different patterns of development.

In fact, it is this last feature of longitudinal designs that is particularly important. The only way we can know about the development of individual children is by doing longitudinal studies. This gives us insight into *individual differences*, or differences between individual children, and whether those differences are stable. Both Edwin and Carter were somewhat cautious as infants, whereas Charlie and Tesalia were practically fearless. If we only evaluated how they were at 12 months of age, for example, we would only know that some infants are cautious and others are not. However, Carter and Edwin remained cautious throughout infancy and were a bit shy as preschoolers. Tesalia and Charlie remained fearless as toddlers, and both became social butterflies once they entered school. So, if we followed these children from 12 months to 3 years, we would see that these differences between them remained pretty stable.

Given how important longitudinal designs are for understanding development and individual differences, it might seem odd that people do cross-sectional studies at all. However, even if we might ultimately be interested in development and individual differences, sometimes the main question is simply whether older and younger children differ. We might know more if we studied this longitudinally, but the cost and time and potential problems with a longitudinal study just aren't worth it given what our primary questions are. Many studies have shown that older and younger infants differ in motor development, perceptual abilities, emotional responses, and much more. These studies provide an important foundation for our understanding of development in infancy. And they provide a good starting point for designing a more costly and time-intensive longitudinal study later on.

A variation of a longitudinal design is to study children frequently separated by a short time interval. In these **microgenetic** studies, children are observed daily or weekly. Typically, these studies do not follow children for months or years, as in a traditional longitudinal study. Rather, children are observed repeatedly after short intervals but only for a relatively short time period. As an example, consider a study conducted by Manuela Lavelli and Alan Fogel (2013). The goal of this study was to understand how mother–infant face-to-face communication changed over the first 3 months after birth. The researchers observed mother–infant pairs every week as they interacted face-to-face. The first observation was when the infants were 1 week old and the last was when the infants were 14 weeks old. By observing these interactions every week, Lavelli and Fogel were able to identify *developmental trajectories*—that is, how mothers and infants' behaviors changed over time. If they had observed the pairs less frequently—for example, just in the first and last session—they would have observed developmental changes, but they would not have seen how those behaviors changed gradually over time.

Microgenetic studies are especially useful for understanding how change happens during times of transition. In traditional longitudinal studies involving more spread-out repeated assessments, researchers can link behaviors across time. Microgenetic studies can show how behavior changes from day to day or week to week. Such studies can be important for learning how development unfolds.

Sometimes development can be best understood by conducting a study in which all participants are the same age. This is particularly true when the researcher is interested in the role of a specific kind of experience on development. In these **age-held-constant** designs all children tested are the same age, but they vary in some other way that we believe influences or contributes to development. In these studies, researchers compare children who are the same age—and thus who have experienced the same amount of time developing—but who have different experiences. For example, researchers might compare infants who were exposed to one language with infants who were exposed to multiple languages (Brito & Barr, 2012), or infants who are crawlers with infants of the same age who do not yet crawl (Campos et al., 1992).

Measuring Infant Development

As we will discuss throughout this book, infants have limited abilities. Unlike older children and adults, infants can't talk, follow directions, fill out questionnaires, or press keys on a computer keyboard. It is hard to get them to point or hand you an object that you ask them for, even once they have those abilities. On top of that, they get bored easily and cry or fuss if they are tired or hungry. How in the world can we measure their development?

What Can We Measure in Infants?

There are some things that infants can do, and all of those things can be potential variables—either variables to correlate or dependent variables in an experiment (Table 1.4). For example,

TABLE 1.4 ■ Measurements of Infant Development

What Measured	How Measured	Benefits	Limitations
Behavior (sitting, crawling, walking)	Observation Parental report	Naturally occurring	If infants haven't yet developed a behavior (e.g., crawling), it can't be used to measure other aspects of development
Looking	Observation Eye tracking	Easy to observe Present from birth	Researchers don't always know why infants look at a stimulus
Physiological responses (heart rate, EEG)	Electrodes record the physiological response	Automatic response	Requires special equipment; researchers don't always know why infants show a physiological response

BABY CRAWLING TO MOM: An example of an infant crawling to a caregiver, or engaging in proximity seeking.

iStock/fotostorm

infants can move, and thus, infants' motor behavior is something we can measure. Many researchers are interested in how infants perceive the world and what they think and feel. We could measure infants' motor behavior to help us understand these aspects of development. For example, researchers who use the visual cliff apparatus (depicted earlier) are mostly interested in studying depth perception, reasoning that infants won't cross the visual cliff if they can perceive depth. Similarly, in Mary Ainsworth's strange situation (see Chapter 11), infants' relationship to their caregiver is measured, in part, by how much they "seek proximity," or work to remain close to that caregiver. Both are useful ways of measuring infant development, and we have learned a lot by measuring infants' behavior.

But, measuring motor behavior isn't always possible, and in some cases, can be problematic. If an infant does not yet have the ability to crawl, we won't know if they "refuse" to crawl on the deep side of the visual cliff because they don't perceive depth or because they don't yet have the ability to crawl. Similarly, we might be able to measure proximity seeking in terms of how much the infant looks at his mother, or reaches for her, but it will be harder to judge whether or not a non-crawling infant is (or is not) seeking proximity than a crawling infant. In each of these cases, our interpretation of the infant's behavior is influenced both by the behavior we are interested in measuring and in whether or not infants have developed the ability required to produce that behavioral response. In fact, this was one of the biggest criticisms of Piaget, who is considered the father of the study of cognitive development. As you will see in Chapter 7, many people believed that Piaget underestimated infants' cognitive abilities because he relied on their motor behaviors to uncover those abilities. For example, a classic Piagetian task involves hiding one object (such as a toy) under a cloth or a cup. Piaget concluded that infants have *object permanence*, or recognize that the object continues to exist even when it is out of sight, if they remove the cover and retrieve the object. However, researchers have argued that infants could fail this test of object permanence because they have forgotten that the object existed *or* because they have difficulty reaching for and removing the object covering the hidden object.

So when specific motor behaviors fail us, what other things can we measure in infants? One of the most common behaviors that researchers measure is infant looking behavior. In the 1950s, a developmental psychologist named Robert Fantz first discovered that we can measure infants' looking behavior. Before his studies, people believed that very young infants were essentially blind and that looking was learned, just as all behaviors are learned. Fantz made an amazing discovery. He found that when he presented infants different images, infants looked longer—or preferred—some images to others. For example, in one study Fantz (1963) found that infants who were just a few days old looked longer at patterned images (e.g., black and white stripes, a face-like image) than at unpatterned images (e.g., a solid red image). By simply recording how long infants looked at images, Fantz could conclude that newborn infants can see. As you will see in later chapters, where infants look has become one of the most common dependent variables in infancy research.

Technological advances have made measuring where infants look even easier. Researchers can now use automatic eye trackers, which involve infrared light sources and special cameras, to precisely record infants' looking behaviors. Look at the next photo. This infant is being tested in an experiment using an eye tracker. The infant is seated in an undecorated room on the father's lap. They are in front of a computer screen and there are interesting images on the screen. As you can see here, it is not too hard to tell that the infant is looking at the images.

So far we have focused on which *behaviors* we can measure in infants. In addition to these behaviors, we can measure *physiological responses*. Physiological responses are automatic physical responses triggered by the presentation of a stimulus. For example, when someone says "boo"

An Infant's Looking at an Experimental Stimulus

loudly behind you, your heart rate increases. When you are about to take a test, your palms sweat. We can measure these kinds of responses in infants to gain insight into their development. The most common physiological responses are *heart rate*, or echocardiogram (ECG), and *brain activity*, or electroencephalogram (EEG). These two physiological responses can be measured simply by attaching electrodes to the infants' chest (for ECG) or scalp. These electrodes will painlessly record the infants' heart rate or brain activity as they are exposed to stimuli. For example, Joseph Campos and his colleagues (in the visual cliff study described earlier) measured changes in heart rate as infants were placed on the deep side of the cliff. Campos could test infants who did not yet crawl by measuring heart rate and placing infants on the cliff, rather than evaluating whether or not infants would crawl across the cliff. Similarly, researchers can measure brain activity from electrodes attached to the head. These electrodes record the electrical activity that is produced when different regions of the brain are active. For example, Martha Ann Bell and Nathan Fox (1992) found that infants who could solve Piaget's object permanence tasks (described earlier) had different EEG patterns than did children who could not yet solve those tasks.

We will talk more about these physiological measures in other chapters, but there are several things to keep in mind. Unlike motor behaviors and looking, physiological measures are *automatic*. Changes in heart rate or brain activity happen—and can be recorded—regardless of whether or not the infant wants to look more at one stimulus than another or crawl across a

INFANT EEG. An EEG recording cap being put on an infant's head.

visual cliff. For this reason, these measures have advantages over the other behaviors we might measure. But to accurately record physiological responses, you need special equipment and training. It may be harder to get infants to cooperate with the procedures needed to get good physiological measures. So, although they are widely used to study infant development, they have both advantages and disadvantages over other measures.

What Can We Conclude From the Things We Can Measure in Infants?

Even when you can accurately measure behaviors in infants, it isn't always obvious what you can (and can't) conclude from those behaviors. When Alison was just over 6 months old, she started to crawl. She was an enthusiastic crawler. There was a coffee table in the living room with a lip that hung down. Little Alison would crawl under the coffee table and bang her head into that lip. Despite the fact that it clearly hurt every time, she did it over and over again. What can we conclude from this behavior? Well, we can certainly conclude that Alison could crawl. But it's harder to know what we can conclude from the fact that she crawled right into the coffee table over and over again. Did she have a vision problem and she couldn't see that part of the coffee table? Did she not understand her body size in relation to the coffee table? Did she not understand that the coffee table was made of solid wood and could not be crawled "through"? Was she so determined to get under the table that she ignored all obstacles in her way?

This story shows how difficult it is to understand *why* infants behave in the way they do. When we study older children and adults, we give them instructions. They may not follow those instructions, but we hope that by giving them a goal, they will engage in specific kinds of behaviors. If we tell subjects that they will need to remember items for a test later, they will (hopefully) engage in memory processes. If we ask subjects to judge a set of pictures for who they'd like to play with, we assume that their judgments will reflect something about their appraisal of the people in the pictures. We can't give infants such instructions.

This is an important point because in studies of infant development there are often multiple explanations for the behavior we observe. That is, we measure a behavior (e.g., infant looking), but we draw conclusions about an underlying **psychological construct,** the concept we wish to measure (e.g., infant preference). The psychological construct is the underlying *process*, for example, the infants' preference or perception or memory. The difficulty is knowing whether the behavior we record is a **valid measure** of that construct (see Table 1.5). In other words, are we recording something that accurately reflects the process we are interested in measuring? In the Fantz study described earlier, newborn infants looked longer at patterned images than at unpatterned images. Fantz concluded that newborn infants could see patterned images. This is a valid conclusion from this study—if infants couldn't *see* the images, they would not have had a preference. Thus, measuring whether or not infants prefer a patterned image over an unpatterned image accurately reflects whether or not infants can

TABLE 1.5 ■ Comparing Constructs and Observable Behaviors

Construct	Behavior or Response
Fetal learning (see Chapter 3)	Changes in fetal heart rate
Preferences (see Chapter 4)	Looking time
Memory for an action (see Chapter 6)	Imitating a modeled action
Object permanence (knowing that an object exists even when out of sight, see Chapter 7)	Searching for a hidden object
Understanding the meaning of a word (see Chapter 8)	Looking at a labeled object
Emotion (see Chapter 9)	Facial expression, heart rate change
Attachment security to caregiver (see Chapter 10)	Seeking closeness to caregiver, looking at caregiver

see the pattern. But others might want to draw other kinds of conclusions. For example, a researcher might observe the same pattern Fantz did and conclude that infants *liked* the patterned images better. That is, infants looked longer at the patterned images not only because they could see them but also because those images caused them to have some sort of pleasant feeling. Another researcher might conclude that infants found the unpatterned images boring and infants prefer excitement. A third researcher might conclude that infants prefer stimuli that offer information for them to learn, and they couldn't learn anything from the unpatterned images. We don't know if any of these conclusions are correct, and we can't know simply from the fact that infants prefer to look at patterned images than at unpatterned images. In other words, we don't know whether infants' preference is a valid measurement of what they liked, their drive for excitement, or their interest in learning new information. All we really know is that they looked longer at the patterned images.

This example illustrates a real problem in interpreting how infants respond in many research studies. Often researchers are most interested in these more difficult-to-measure constructs, things like infants' emotional reactions, their reasoning, or their surprise. However, given the limitations of infants' abilities, it is not always clear whether measures we use to assess those abilities are valid. In some areas, such as emotional responding, this issue has led some to argue that we need to look at multiple measures (LoBue et al., 2020).

There is another problem with what we conclude about infants' behavior. Not only does the process or ability we are studying develop, but so does the behavior itself. You might be surprised to know that even infants' looking behavior develops. We will talk about this in Chapter 4, but it turns out that infants' ability to look away develops in the first months. As a result, a 3-month-old infant may look for a very long time at an image not because she prefers it, finds it interesting, or is surprised, but because she is "stuck" and doesn't yet have a well-developed ability to look away from an image when she is no longer interested in it. What this means is that a long look by a 3-month-old infant might mean something completely different than a long look by a 6-month-old infant. The same behavior—looking at an image for a long time—in the young infant might reflect the inability to "let go" of the look, and in the older infants it might reflect how the infant is learning or thinking about the image.

Another important thing to remember about interpreting infants' behavior is that most infant research focuses on averaging behaviors of groups of infants. For example, going back to the example of Joseph Campos's visual cliff study, he found that *on average,* infants' heart rate *increased* as they were placed on the deep side of the visual cliff. The researchers came to this result by measuring the heart rate change of several infants and calculating an average of those heart rate changes. This tells us something about how most infants tend to respond to a drop-off. However, it is almost always the case that the individual infants in studies respond somewhat differently. In Campos's study, for example, most infants' heart rates went up when lowered onto the visual cliff, but there were likely at least some infants whose heart rates didn't change at all when being lowered onto the drop-off, or whose heart rates actually went *down*. Because most infants showed the same response—an increase in heart rate—the average was an increase.

But, studies that report only group averages don't tell us anything about individual differences among the infants or why some infants were different from the rest of the group. On one hand, it could be that some infants just weren't paying attention when being lowered onto the drop-off and that differences in their behavior when compared to the group just reflected the fact that their mind was wandering. On the other hand, it's also possible that any infant who showed an increase in heart rate had more crawling experience than the few infants who didn't show a heart rate increase. These "nonresponding" infants might have been more like the noncrawlers in this study, and infants might need some experience crawling to respond physiologically to the drop-off.

This example is relevant to our discussion of the different kinds of experimental designs and what conclusions can be drawn from them. Campos and his colleagues studied the relation between crawling and heart rate changes in response to the visual cliff by comparing groups of different infants (all the same age), some who had crawling experience and some who did not. This age-held-constant design is similar to a cross-sectional design, except that the groups of infants differed in experience rather than age. But, as in a cross-sectional study, all we can conclude is whether the groups of infants were the same or different. We can only understand whether infants show the same or different patterns across development by studying infants longitudinally, in this case measuring their heart rate changes to the visual cliff both before and after they began crawling.

BOX 1.3—INFANCY RESEARCH: WHO IS TESTED IN INFANT RESEARCH?

In this chapter, we have discussed several issues with respect to conducting research to understand infant development. We have described designs for conducting research and how we measure infant development. What we have not tackled is *who* is studied in infancy research. Throughout this book, you will see descriptions of findings from studies that we (like others in the field) will use to draw conclusions about how infants develop. It is important to point out, however, that not all infants are studied in psychological research and that what we know about infant development is based on research with specific populations. In particular, because research with infants is conducted primarily on college and university campuses, the families who participate are often families who live near those campuses. In addition, participating in research takes time and requires (usually) that families visit labs, often in the middle of a weekday. Further, most researchers studying infant development are in North America or western Europe. Thus, in general, subject populations in infant research are likely to be White, have educated parents, and be from middle-class families. Infants who have a stay-at-home parent are also more likely to be able to participate in studies. These *convenience samples* are the families who are easiest for researchers to identify, contact, and recruit for their studies, and these are the families who have the time and resources to volunteer to participate in research.

For decades, the use of convenience samples was not thought to be a problem. If we are studying basic processes like visual abilities, memory, or mother–infant

Infants From Different Racial, Ethnic, and Cultural Backgrounds

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bonding, it shouldn't matter who our subjects are, right? It was believed that relying on convenience samples was scientifically acceptable because our findings should apply broadly to children raised in different circumstances. There were some researchers who explicitly asked how differences in culture contributed to differences in development. However, these **cross-cultural approaches** to development often focused on differences between our convenience samples and other samples from different cultural, economic, or regional contexts and were not considered central to our understanding of development.

As you will see throughout this book, however, cross-cultural comparisons have revealed important differences in development—differences that make it clear that we should not assume that the patterns observed when testing convenience samples are universal. Instead, infants' environments and their experiences shape development in important ways, and differences in families, culture, practices, environments, and so on, all likely impact development. Thus, an important factor to keep in mind is how those variables have contributed to the development of whatever behavior we are studying.

Unfortunately, the field has only relatively recently understood the importance of considering who is studied. Thus, there are decades of published research that does not report important details about the infants, like their race or ethnicity, the education level of their parents, if they are raised in an urban or rural environment, what languages are spoken in the home, and whether the parents are wealthy or live in poverty. In fact, sometimes it is not even clear what country the children lived in when a study was conducted! Although it is now a requirement in most journals to publish this kind of information, there is a large body of research that does not include this kind of potentially important information about the subject population.

We will not be able to describe the subject population for every study we include here. However, in an effort to be as clear as possible who was studied, we will include information about the infants who were included in a study or what the general population is of the body of work when we can. But it's important to keep in mind when thinking about this research that developmental psychology, like all areas of psychology, still has a long way to go in making sure our samples are representative and sufficiently diverse.

Check Your Learning

1. Describe the difference between a correlational study and an experiment. What are the advantages and disadvantages of using correlations versus experiments to study infant development?
2. What is the difference between a "true" experiment and a quasi-experiment? How do these differences influence the ability to draw causal conclusions?
3. What is the difference between a longitudinal and cross-sectional study?
4. How are behavioral and physiological measures different? What are the advantages and disadvantages of each?
5. Give an example of a psychological construct, and explain why it is important that a measure be valid.

DEVELOPMENT DOES NOT HAPPEN IN A VACUUM

One of the important themes in this book is that infant development does not happen in a vacuum. You will see that studies often focus on only a single ability or development. Researchers might ask questions about how infants' color vision develops or how they come to recognize emotions in others. Such studies provide an important starting point for understanding infant development, but they are not the whole picture. In the real everyday lives of actual infants, color vision emerges as other aspects of vision are developing and as the infant becomes better able to direct where his head is pointed. In addition, during this same period, infants' emotional responses are becoming refined and differentiated, they are gaining control over their bodies, and their ability to form memories of the sights they encounter is undergoing change. Connections between brain regions are emerging and the infant is growing. Although we may understand something about how the infant sees the world by studying only their color vision, it is clear that changes in color vision are happening at the same time as many other changes across the infants' whole body, brain, and mind. Thus, although this very textbook is parsed into isolated topics like perceptual, cognitive, and emotional development, it is important to keep in mind that all of these systems interact over the course of development and that development is happening in the **whole child**, and not just in a single isolated system. Throughout this text, we will point you to connections across the chapters.

In addition, the child is developing in a family, cultural, and societal context. Variations in family composition, cultural values with respect to infancy, and societal expectations for parenting all provide the context for infant development. Often research assumes that such factors are unimportant in determining development, unless the development in question is directly related to those factors. But, as we will see, just as individual systems do not develop in isolation, individual infants develop in a context and their development reflects the people and practices of that context. In this final section we will introduce how such factors might influence infant development.

Families With Infants

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Emphasis on the Whole Child

Many modern theories of development acknowledge that development occurs in the whole child. According to such theories, it is difficult to really understand development of a system if it is studied completely in isolation, without considering how the development of that system reflects and is influenced by other systems in the child. Two approaches that make this connection explicit are the **dynamic systems theory** of development (Thelen & Smith, 1994) and the idea of **developmental cascades** (Oakes & Rakison, 2019). Each of these approaches acknowledges how the development of systems are dependent on one another.

In dynamic systems views, behaviors, such as walking or reaching for a hidden object, emerge as the result of multiple, independent systems. In the case of walking, for example, Esther Thelen (e.g., Thelen & Ulrich, 1991) argued that the emergence of independent walking depends on the development of several abilities, including to balance on one leg, monitor and perceive the environment, and anticipate and plan for changes in the terrain (e.g., obstacles, change in surface), to name just a few. The ability to *walk* is assembled from these other developing abilities and emerges when they all have developed enough so that walking is possible when used together. The point is that no single system or behavior is responsible for walking; walking reflects the co-development and coordination of many systems.

In a developmental cascade, achievements that occur at one point in development have effects at a later point, even in a different area of development. For example, once infants are able to crawl, their whole interaction with the world changes. Infants can now move across a room to seek out a favorite toy. They can approach a parent or caregiver and begin an interaction. And, for the first time, they have the ability to reach objects that might be dangerous, which could change the emotional environment when their mothers tell them not to do things they might very much want to do, like stick their fingers in sockets or play with knives.

Thus, changes in one area (the ability to crawl) influence how infants interact with and learn from the world. For example, advances in walking are linked to advances in language development (Karasik et al., 2014). You might scratch your head at this association—why would the development of walking and talking be related? They presumably involve different brain systems and different parts of the body. Language and walking also have different functions in the infant's life. But, once infants develop the ability to walk, they can carry objects much more easily than an infant who is crawling. This means that infants who can walk are better able to include objects in their interactions with others, providing more opportunities for object naming. And in this case, Lana Karasik and colleagues found that mothers of walking infants talk to their infants more than mothers of crawling infants, providing specific directions on what objects or things to bring to them. The point is that two infants who are the same age may have very different experiences because of their difference in motor skills. An infant who can crawl but not yet walk will be able to initiate interactions with caregivers, but those interactions will be less likely to include objects than if the infant can walk. So, advances in one domain, such as the transition from crawling to walking, may create opportunities to gain more input, such as caregiver speech, which in turn, can benefit an infant's acquisition of language.

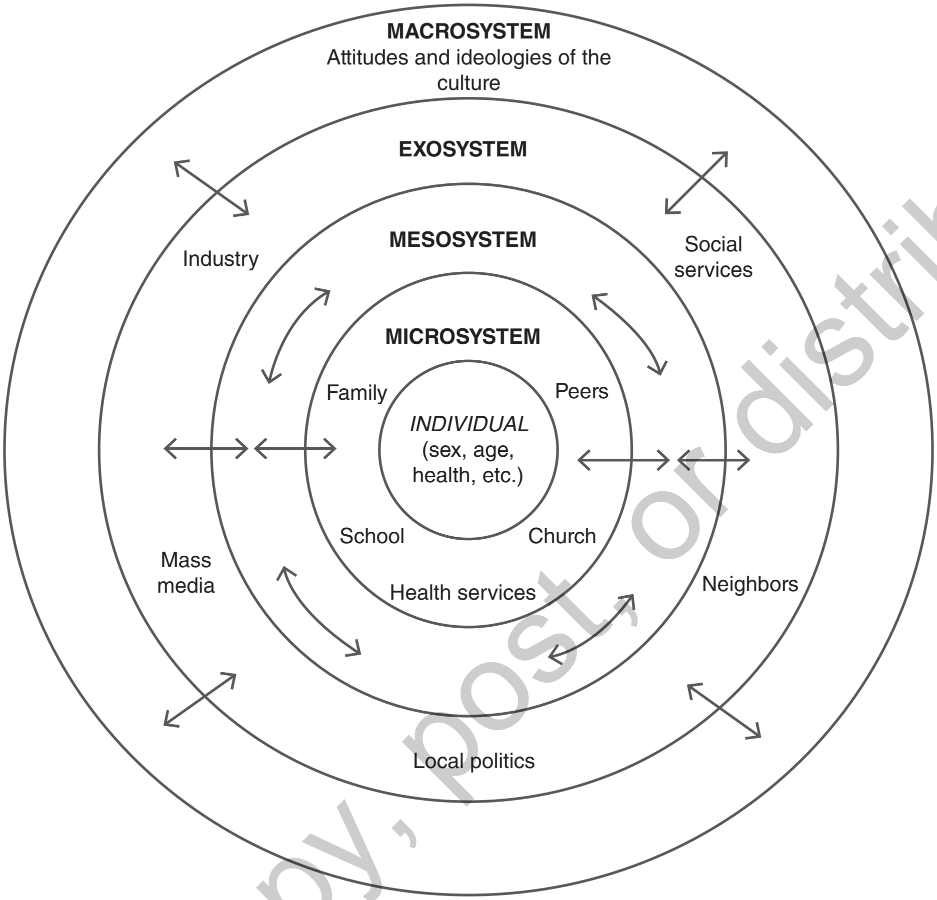
Both the dynamic systems theory and the developmental cascades approach recognize that development happens across the whole child. Although we will again discuss many developmental achievements in this book that have been studied in isolation, when possible we will try to focus on how systems work together and influence each other.

Family and Social Context

Just as development involves the whole child, the child develops in the context of a broader system, and aspects of that system play an important role in how children develop. Urie Bronfenbrenner's (1979) **ecological systems theory** of development is often used to understand how different aspects of the social and cultural context influence development. The theory is depicted in Figure 1.3. The child is at the center of the figure, and characteristics such as the child's personality, age, and health will determine, to some extent, the child's development. This is the nature part of the model.

The other rings show different kinds of environmental influences—or the nurture influences on development. What is important is that the rings that are closer to the individual are presumed to play a larger role. Notice that the innermost ring includes family, peers, and other daily influences on development. For infants, family is likely the most important of these. Infants are born into families with one or two (or more) parents and with no siblings, one sibling, or multiple siblings. Infants may live in a house, an apartment, or a yurt. Families may live in isolation, far from grandparents, aunts, uncles, and cousins. Or they may live close to relatives and larger family groups. The infant may be in a culture where multiple caregivers typically care for the child or one in which there is a single caregiver. Infants may be part of a society in which

FIGURE 1.3 ■ Bronfenbrenner's Ecological Theory of Development



caregivers are given time away to be with their infant, whereas in other societies caregivers must return to work soon after the birth of the infant.

Considering the larger family and social context of an infant allows us to understand how government, communities, and family structure can impact aspects of early development. A new parent who has the resources to be with their newborn will have greater opportunities to bond than a parent who needs to begin work soon after the birth of their child. One of us remembers meeting an expectant mother in a childbirth class. This mother worked at a gas station convenience store and was thinking she could take at most 2 weeks off when she gave birth before returning to work. The mother was saying that breastfeeding would be impossible with her schedule. As professors, we recognize that we all had the privilege of good maternity leave, time to bond with our newborns, and the ability to breastfeed as long as we wished. These differences in the resources available to new mothers influence development. Mothers who are better supported feel less stress during this early period. Maternal stress can affect prenatal infant development (see Chapter 3). Although this example is about differences in the experiences of mothers in the United States, there are even bigger differences across cultures. For example, in Canada, most employed mothers can have up to a year of maternity and parental leave after the birth of a child. In France, mothers are *required* to take 8 weeks of leave following the birth of a child and may take up to 16 weeks of leave. India has a generous maternity leave policy, allowing 26 weeks of leave for new mothers; however, only a small fraction of working mothers are eligible.

Infants are also raised in families that differ in many ways. They may have a single parent, two parents, or parents plus other caregivers, such as grandparents. Importantly, parents are not all the same. Not only do parents differ in their level of support and stress, they vary in their personalities, their experience with children, their expectations, and their confidence in their parenting. All of these factors will influence how they interact with their children. In addition, children may or may not be born into a family that already has other children. Older siblings influence development, especially aspects of social and emotional development. For example, having a sibling is related to demonstrating more prosocial emotions like sympathy (Harper et al., 2016). Importantly, it is not that children with older siblings develop *better* than children without older siblings; simply the context of development is different, which can influence aspects of the developmental trajectory.

The overall social context plays a role in development as well. The outer rings in the ecological theory are about factors such as politics, neighborhood, and cultural attitudes and practices. We discussed earlier in this chapter how politics and social policy can influence development. Local politics may determine how much funding is spent on schooling and early childhood education versus policing. Neighbors vary in terms of how much social support they provide one another. These issues became quite clear during the global pandemic of 2020. During the winter and spring of that year, COVID-19 infections rose across the world. The experience young children had in this situation varied as a function of local politics, neighborhood, and region of the world. While Spain did not allow children outside for months, U.S. states allowed outdoor activities. Within countries, children's experiences varied as a function of poverty, race, and neighborhood. Privileged educated families who could easily work from home arranged "pods" where they could share childcare and provide support for each other. Poorer families who depended on delivery or factory jobs for their livelihood, struggled with school closing and the lack of dependable childcare. Not only did these differences yield differences in how stressful the pandemic was for families, but they also created differences in terms of how much children were exposed to illness, how much schooling children experienced, and other factors that no doubt influenced their development. What was striking was how different political and cultural systems created different environments for child development.

The outermost ring is the most distal influence, but it is nevertheless very important. This influence refers to cultural attitudes and ideals. Most of what we know about infant development derives from work on infants from Western cultures, specifically with only a subset of infants in those cultures (see Box 1.3). When work has been done comparing development across cultures, the differences sometimes have been striking. For example, researchers examined infant–parent relationships in the United States and Japan, using a tool that was developed in the United

States. This work suggested that Japanese infants were not as secure in their relationships with parents as were U.S. infants (Rothbaum et al., 2000). This conclusion is problematic, however, because the tool used emphasizes the infants' autonomy, independence, and exploration. These are Western values for children. Japanese culture has different goals for infants; secure infants are those who are connected to others. They value interdependence rather than independence. As a result of these different cultural values, the expectations for infants' behaviors are different and what looks like a "good" mother–child relationship is not the same. The point is that cultures vary in their expectations for infants and their goals for the period of infancy. We see these differences in parenting practices and how those parenting practices are related to when and how infants develop particular skills.

The major point is that understanding infant development should not be an attempt to identify when all infants reach milestones at the same time, at the same age, and in exactly the same way. Despite the fact that much of the research we discuss focuses on general patterns of behavior across groups of infants, all infants (and children) are unique in their development. One infant may crawl at the average age, another may crawl several weeks later, another may "crawl" within the typical milestone window but have a unique form to their crawling (always extending one leg and dragging it along). There is no one pattern of development that fits all infants, and many, many factors play a role in determining developmental trajectories. Throughout this book we will describe these differences when such work exists. Importantly, this is not a discussion of how some infants differ from some standard or "normal" developmental trajectory, but rather to understand how development is influenced by the different environmental systems in which children live. We will revisit these ideas again in the final chapter.

Check Your Learning

1. What does it mean to focus on the *whole child* when thinking about development?
2. Name two ways that cultural differences might influence infant development.
3. What is the ecological systems theory?

SUMMARY

This chapter presented an introduction to this textbook, previewing many of the important themes and ideas that will reemerge throughout the book. As you read the chapters, think about qualitative and quantitative change. Consider whether researchers are emphasizing nature or nurture in their explanations. Carefully examine the research designs used and what conclusions researchers draw from those designs. As you read about studies, think about the measures used and the valid conclusions from those measures. Finally, consider development in the context of the whole child, recognizing who was studied in the research discussed; what role culture, politics, and society might have in that development; and what changes might need to be made for research findings in this area to be more broadly applicable to infants around the world.

KEY TERMS

age-held-constant design
cohort-sequential design
correlational design
critical periods
cross-cultural approach
cross-sectional design
developmental cascades
dynamic systems theory
ecological systems theory
experimental design
infancy
innate
longitudinal design
microgenetic design
nature
nurture
psychological construct
qualitative change
quantitative change
quasi-experimental design
valid measure
whole child

REVIEW QUESTIONS

1. What are the issues that studying development in infancy gives insights into?
2. How can studying infant development help policy makers argue for programs for supporting families with children under 5 years? What are some examples of infant development informing policies?
3. Describe the designs used to study development. What are the advantages and disadvantages of each? What are the factors that researchers must consider when deciding which design to use to study development?
4. What infant behaviors and physiological responses are used to study infant development? Why are these behaviors and responses used, and how are they limited?
5. What are the different levels of context that are acting on infant development?

CRITICAL THINKING QUESTIONS

1. Your friend is about to have a baby and wants her baby to love food the way she and her partner do. She has heard that food preferences might be genetic but also that what babies eat is important. Given what you know about how nature and nurture can shape development, what do you tell her? Do you think food preferences might reflect an interactive or additive influence of nature and nurture? Why?
2. Why is it important for policy makers and parents to know about infant development when making decisions about how infants should be treated? Can you think of examples of recent decisions made by policy makers or politicians that were (or should have been) informed by research with infants?

3. You want to study how infants learn new words during the first 2 years. Which methodological design would you choose to study this aspect of development, and why? What would be its advantages? And what would be its disadvantages?

4. Consider the BEIP study done with Romanian orphans. What aspects of this study were a *correlation*? What aspects were an *experiment*?

5. Why are studies of development often *quasi-experiments*?

6. What is the difference between a *measure* and a *construct*? Choose one example from Table 1.5 to illustrate this difference.

7. Use experiences from your own life to explain how development doesn't happen in a vacuum. Consider a specific developmental milestone (e.g., learning to read, learning to talk, learning to walk). What aspects of the context shaped this development?