

chapter 1

INTRODUCTION

chapter outline

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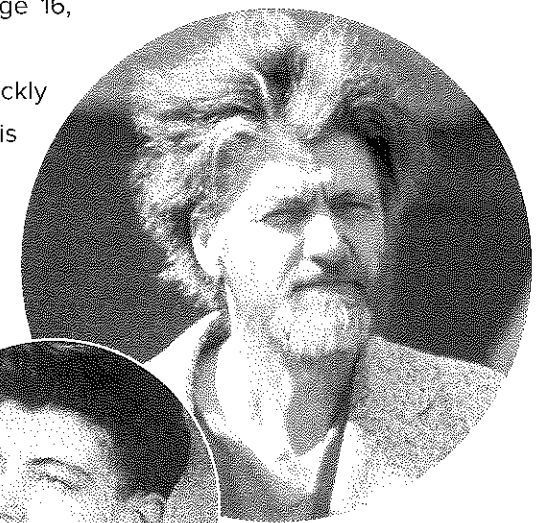
Ted Kaczynski sprinted through high school, not bothering with his junior year and making only passing efforts at social contact. Off to Harvard at age 16, Kaczynski was a loner during his college years.

One of his roommates at Harvard said that he avoided people by quickly shuffling by them and slamming the door behind him. After obtaining his Ph.D. in mathematics at the University of Michigan, Kaczynski became a professor at the University of California at Berkeley. His colleagues there remember him as hiding from social contact—no friends, no allies, no networking.

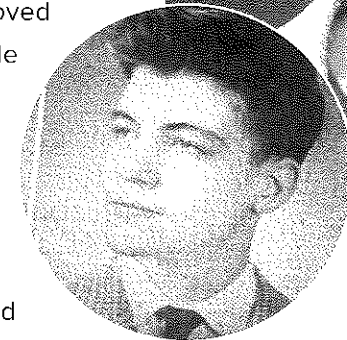
After several years at Berkeley, Kaczynski resigned and moved to a rural area of Montana where he lived as a hermit in a crude shack for 25 years. Town residents described him as a bearded eccentric. Kaczynski traced his own difficulties to growing up as a genius in a kid's body and sticking out like a sore thumb in his surroundings as a child. In 1996, he was arrested and charged as the notorious Unabomber, America's most-wanted killer. Over the course of 17 years, Kaczynski had sent 16 mail bombs that left 23 people wounded or maimed and 3 people dead. In 1998, he pleaded guilty to the offenses and was sentenced to life in prison.

A decade before Kaczynski mailed his first bomb, Alice Walker spent her days battling racism in Mississippi. She had recently won her first writing fellowship, but rather than use the money to follow her dream of moving to Senegal, Africa, she put herself into the heart and heat of the civil rights movement. Walker had grown up knowing the brutal effects of poverty and racism. Born in 1944, she was the eighth child of Georgia sharecroppers who earned \$300 a year. When Walker was 8, her brother accidentally shot her in the left eye with a BB gun. By the time her parents got her to the hospital a week later (they had no car), she was blind in that eye, and it had developed a disfiguring layer of scar tissue. Despite the counts against her, Walker overcame pain and anger and went on to win a Pulitzer Prize for her book *The Color Purple*. She became not only a novelist but also an essayist, a poet, a short-story writer, and a social activist.

Ted Kaczynski, the convicted Unabomber, traced his difficulties to growing up as a genius in a kid's body and not fitting in when he was a child.
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Ted Kaczynski, about age 15–16.
© WBBM-TV/AFP/Getty Images



Alice Walker won the Pulitzer Prize for her book *The Color Purple*. Like the characters in her book, Walker overcame pain and anger to triumph and celebrate the human spirit.
© AP Images



Alice Walker, about age 8.
Courtesy of Alice Walker



preview

What leads one individual, so full of promise, to commit brutal acts of violence and another to turn poverty and trauma into a rich literary harvest? If you have ever wondered why people turn out the way they do, you have asked yourself the central question we will be exploring. Consider this a window into the journey of human development—your own and that of every other member of the human species. In this chapter, we will explore what it means to take a life-span perspective on development, examine the nature of development, and outline how science helps us to understand it.

1 The Life-Span Perspective

LG1 Discuss the distinctive features of a life-span perspective on development.

The Importance of Studying Life-Span Development

We reach backward to our parents and forward to our children, and through their children to a future we will never see, but about which we need to care.

—CARL JUNG
Swiss psychiatrist, 20th century

Characteristics of the Life-Span Perspective

Each of us develops partly like all other individuals, partly like some other individuals, and partly like no other individual. Most of the time our attention is directed to each individual's uniqueness. But as humans, we have all traveled some common paths. Each of us—Leonardo da Vinci, Joan of Arc, George Washington, Martin Luther King, Jr., and you—walked at about 1 year, engaged in fantasy play as a young child, and became more independent as a youth. Each of us, if we live long enough, will experience hearing problems and the death of family members and friends. This is the general course of our **development**, the pattern of movement or change that begins at conception and continues through the human life span.

In this section, we will explore what is meant by the concept of development and why the study of life-span development is important. We will outline the main characteristics of the life-span perspective and discuss various sources of contextual influences. In addition, we will examine some contemporary concerns in life-span development.

THE IMPORTANCE OF STUDYING LIFE-SPAN DEVELOPMENT

How might people benefit from examining life-span development? Perhaps you are, or will be, a parent or teacher. If so, responsibility for children is, or will be, a part of your everyday life. The more you learn about them, the better you can deal with them. Perhaps you hope to gain some insight about your own history—as an infant, a child, an adolescent, or a young adult. Perhaps you want to know more about what your life will be like as you grow through the adult years—as a middle-aged adult, or as an adult in old age, for example. Or perhaps you just stumbled onto this course, thinking that it sounded intriguing and that the study of the human life span might raise some provocative issues. Whatever your reasons for taking this course, you will discover that the study of life-span development is intriguing and filled with information about who we are, how we came to be this way, and where our future will take us.

development The pattern of change that begins at conception and continues through the life span. Most development involves growth, although it also includes decline brought on by aging and dying.

life-span perspective The perspective that development is lifelong, multidimensional, multidirectional, plastic, multidisciplinary, and contextual; involves growth, maintenance, and regulation; and is constructed through biological, sociocultural, and individual factors working together.

Most development involves growth, but it also includes decline (as in dying). In exploring development, we will examine the life span from the point of conception until the time when life (or at least life as we know it) ends. You will see yourself as an infant, as a child, and as an adolescent, and be stimulated to think about how those years influenced the kind of individual you are today. And you will see yourself as a young adult, as a middle-aged adult, and as an adult in old age, and be motivated to think about how your experiences today will influence your development through the remainder of your adult years.

CHARACTERISTICS OF THE LIFE-SPAN PERSPECTIVE

Although growth and development are dramatic during the first two decades of life, development is not something that happens only to children and adolescents (Kennedy & Raz, 2015). The traditional approach to the study of development emphasizes extensive change from birth to adolescence (especially during infancy), little or no change in adulthood, and decline in old age. But a great deal of change does occur in the five or six decades after adolescence. The life-span approach emphasizes developmental change throughout adulthood as well as childhood (Schaie & Willis, 2016).

Life Expectancy Recent increases in human life expectancy have contributed to the popularity of the life-span approach to development. The upper boundary of the human life span (based on the oldest age documented) is 122 years, as indicated in Figure 1; this maximum life span of humans has not changed since the beginning of recorded history. What has changed is life expectancy—the average number of years that a person born in a particular year can expect to live. In the twentieth century alone, life expectancy in the United States increased by 32 years, thanks to improvements in sanitation, nutrition, and medicine (see Figure 2). In the middle of the second decade of the twenty-first century, the life expectancy in the United States is 79 years of age (U.S. Census Bureau, 2015). Today, for most individuals in developed countries, childhood and adolescence represent only about one-fourth of their lives.

For the first time in U.S. history, there are more people over 60 years of age than under 15 years of age. In less than a century, more years were added to human life expectancy than in all of the prior millennia.

Laura Carstensen (2015) recently described the challenges and opportunities involved in this dramatic increase in life expectancy. In her view, the remarkable increase in the number of people living to an old age has happened in such a short time that science, technology, and social expectations have not kept pace. She proposes that the challenge is to change from a world constructed mainly for young people to a world that is more compatible and supportive for the increasing number of people living to age 100 and beyond.

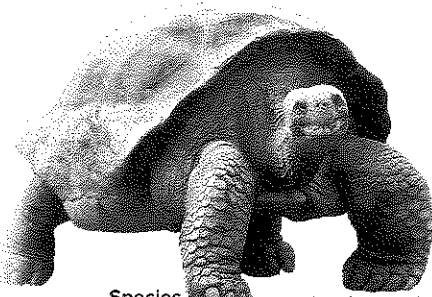
In further commentary, Carstensen (2015, p. 70) remarked that making this transformation would be no small feat:

... parks, transportation systems, staircases, and even hospitals presume that the users have both strength and stamina; suburbs across the country are built for two parents and their young children, not single people, multiple generations or elderly people who are not able to drive. Our education system serves the needs of young children and young adults and offers little more than recreation for experienced people.

Indeed, the very conception of work as a full-time endeavor ending in the early 60s is ill suited for long lives. Arguably the most troubling is that we fret about ways the older people lack the qualities of younger people rather than exploit a growing new resource right before our eyes: citizens who have deep expertise, emotional balance, and the motivation to make a difference.

Certainly some progress has been made recently in improving the lives of older adults. In our discussion of late adulthood, you will read about progress in understanding topics related to aging such as modifying the activity of genes related to aging, improving brain function in the elderly, and slowing or even reversing the effects of various chronic diseases. You'll also learn about ways to help people plan for a better life when they get old, become more cognitively sharp as they age, improve their physical fitness, and feel more satisfied with their lives as older adults. But much more remains to be accomplished, as described earlier by Laura Carstensen (Antonucci & others, 2016).

The Life-Span Perspective The belief that development occurs throughout life is central to the life-span perspective on human development, but this perspective has other characteristics as well. According to life-span development expert Paul Baltes (1939–2006), the **life-span perspective** views development as lifelong, multidimensional, multidirectional, plastic, multidisciplinary, and contextual, and as a process that involves growth, maintenance, and regulation of loss (Baltes, 1987, 2003; Baltes, Lindenberger, & Staudinger, 2006). In Baltes'



Species (common name)	Maximum Life Span (years)
Human	122
Galápagos turtle	100+
Indian elephant	70
Chinese alligator	52
Golden eagle	46
Gorilla	39
Common toad	36
Domestic cat	27
Domestic dog	20
Vampire bat	13
House mouse	3



FIGURE 1
MAXIMUM RECORDED LIFE SPAN FOR DIFFERENT SPECIES. Our only competitor for the maximum recorded life span is the Galápagos turtle. (Tortoise image on top) © Digital Vision/PunchStock RF; (mouse image at bottom) © Redmond Durrell/Alamy RF



One-hundred-year-old Don Pellman from Santa Clara, California, keeps breaking world records in track for older adults, beating many contestants who are 20 to 30 years younger than he is. © Sandy Huffaker/The New York Times/Redux

Time Period	Average Life Expectancy (years)
2015, USA	79
1954, USA	70
1915, USA	54
1900, USA	47
19th century, England	41
1620, Massachusetts Bay Colony	35
Middle Ages, England	33
Ancient Greece	20
Prehistoric times	18

FIGURE 2
HUMAN LIFE EXPECTANCY AT BIRTH FROM PREHISTORIC TO CONTEMPORARY TIMES. It took 5,000 years to extend human life expectancy from 18 to 41 years of age.



Paul Baltes, a leading architect of the life-span perspective on development, converses with one of the long-time research participants in the Berlin Aging Study that he directs. She joined the study in the early 1990s and has participated six times in extensive physical, medical, psychological, and social assessments. In her professional life, she was a practicing medical doctor.
Margaret M. and Paul B. Baltes Foundation

normative age-graded influences Influences that are similar for individuals in a particular age group.

normative history-graded influences Influences that are common to people of a particular generation because of historical circumstances.

nonnormative life events Unusual occurrences that have a major impact on an individual's life.

view, it is important to understand that development is constructed through biological, socio-cultural, and individual factors working together. Let's explore each of these components of the life-span perspective.

Development Is Lifelong In the life-span perspective, early adulthood is not the end-point of development; rather, no age period dominates development. Researchers increasingly study the experiences and psychological orientations of adults at different points in their lives. Later in this chapter, we will describe the age periods of development and their characteristics.

Development Is Multidimensional No matter what your age might be, your body, mind, emotions, and relationships are changing and affecting each other. Consider the development of Ted Kaczynski, the Unabomber discussed at the beginning of this chapter. When he was 6 months old, he was hospitalized with a severe allergic reaction and his parents were rarely allowed to visit him. According to his mother, the previously happy baby was never the same after his hospitalization. He became withdrawn and unresponsive. As Ted grew up, he had periodic "shutdowns" accompanied by rage. In his mother's view, a biological event during infancy warped the development of her son's mind and emotions.

Development has biological, cognitive, and socioemotional dimensions. Even within a dimension, there are many components (Lustig & Lin, 2016; Reuter-Lorenz, Festini, & Jantz, 2016). For example, attention, memory, abstract thinking, speed of processing information, and social intelligence are just a few of the components of the cognitive dimension.

Development Is Multidirectional Throughout life, some dimensions or components of a dimension expand and others shrink. For example, when one language (such as English) is acquired early in development, the capacity for acquiring second and third languages (such as Spanish and Chinese) decreases later in development, especially after early childhood (Levitt, 1989). During adolescence, as individuals establish romantic relationships, their time spent with friends may decrease. During late adulthood, older adults might become wiser because they have more experience than younger adults to draw upon to guide their decision making (Lim & Yu, 2015), but they perform more poorly on tasks that require speed in processing information (Aichele, Rabbitt, & Ghisletta, 2015; Salthouse, 2014).

Development Is Plastic Even at 10 years old, Ted Kaczynski was extraordinarily shy. Was he destined to remain forever uncomfortable with people? Developmentalists debate how much plasticity people have in various dimensions at different points in their development (Kuhn & Lindenberger, 2016). Plasticity means the capacity for change. For example, can you still improve your intellectual skills when you are in your seventies or eighties? Or might these intellectual skills be fixed by the time you are in your thirties so that further improvement is impossible? Researchers have found that the cognitive skills of older adults can be improved through training and acquisition of better strategies (Willis & Belleville, 2016). However, possibly we possess less capacity for change as we grow older (Salthouse, 2014). Understanding plasticity and its constraints is a key element on the contemporary agenda for developmental research (Kobayashi & others, 2016; Luchetti & others, 2016).

Developmental Science Is Multidisciplinary Psychologists, sociologists, anthropologists, neuroscientists, and medical researchers all share an interest in unlocking the mysteries of development through the life span. How do your heredity and health limit your intelligence? Do intelligence and social relationships change with age in the same ways around the world?

How do families and schools influence intellectual development? These are examples of research questions that cut across disciplines.

Development Is Contextual All development occurs within a context, or setting. Contexts include families, schools, peer groups, churches, cities, neighborhoods, university laboratories, countries, and so on. Each of these settings is influenced by historical, economic, social, and cultural factors (Cushner, McClelland, & Safford, 2015; Kerig, 2016).

Contexts, like individuals, change (Gauvain & Perez, 2015). Thus, individuals are changing beings in a changing world. As a result of these changes, contexts exert three types of influences (Baltes, 2003): (1) normative age-graded influences, (2) normative history-graded influences,

and (3) nonnormative or highly individualized life events. Each type of influence can have a biological or environmental impact on development.

Normative age-graded influences are similar for individuals in a particular age group. These influences include biological processes such as puberty and menopause. They also include sociocultural factors and environmental processes such as beginning formal education (usually at about age 6 in most cultures) and retiring from the workforce (which takes place during the fifties and sixties in most cultures).

Normative history-graded influences are common to people of a particular generation because of historical circumstances (Carstensen & others, 2015; George & Ferraro, 2016; Karlsson & others, 2015; MacDonald & Stawski, 2015, 2016). For example, during their youth American baby boomers shared the experience of the Cuban missile crisis, the assassination of John F. Kennedy, and the Beatles invasion. Other examples of normative history-graded influences include economic, political, and social upheavals such as the Great Depression in the 1930s, World War II in the 1940s, the civil rights and women's rights movements of the 1960s and 1970s, the terrorist attacks of 9/11/2001, as well as the integration of computers and cell phones into everyday life during the 1990s (Schaie, 2013, 2016). Long-term changes in the genetic and cultural makeup of a population (due to immigration or changes in fertility rates) are also part of normative historical change.

Nonnormative life events are unusual occurrences that have a major impact on the lives of individual people. These events do not happen to everyone, and when they do occur they can influence people in different ways. Examples include the death of a parent when a child is young, pregnancy in early adolescence, a fire that destroys a home, winning the lottery, or getting an unexpected career opportunity.

Development Involves Growth, Maintenance, and Regulation of Loss Baltes and his colleagues (2006) assert that the mastery of life often involves conflicts and competition among three goals of human development: growth, maintenance, and regulation of loss. As individuals age into middle and late adulthood, the maintenance and regulation of loss in their capacities takes center stage. Thus, a 75-year-old man might aim not to improve his memory or his golf swing but to maintain his independence and his ability to play golf at all. In the chapters on "Physical and Cognitive Development in Middle Adulthood" and "Socioemotional Development in Middle Adulthood" we will discuss these ideas about maintenance and regulation of loss in greater depth.

Development Is a Co-construction of Biology, Culture, and the Individual Development is a co-construction of biological, cultural, and individual factors working together (Baltes, Reuter-Lorenz, & Rösler, 2012). For example, the brain shapes culture, but it is also shaped by culture and the experiences that individuals have or pursue. In terms of individual factors, we can go beyond what our genetic inheritance and our environment give us. We can author a unique developmental path by actively choosing from the environment the things that optimize our lives (Rathunde & Csikszentmihalyi, 2006).

SOME CONTEMPORARY CONCERNS

Pick up a newspaper or magazine and you might see headlines like these: "Political Leanings May Be Written in the Genes," "Mother Accused of Tossing Children into Bay," "Gender Gap Widens," "FDA Warns About ADHD Drug," "Heart Attack Deaths Higher in African American Patients," "Test May Predict Alzheimer's Disease." Researchers using the life-span perspective are examining these and many other topics of contemporary concern. The roles that health and well-being, parenting, education, and sociocultural contexts play in life-span development, as well as how social policy is related to these issues, are a particular focus of this textbook.

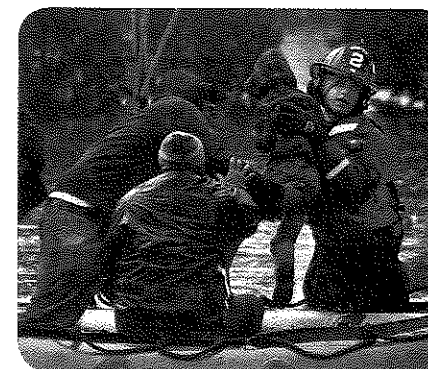
Health and Well-Being Health professionals today recognize the powerful influences of lifestyles and psychological states on health and well-being (Donatelle, 2015; Insel & Roth, 2016). In every chapter of this book, issues of health and well-being are integrated into our discussion.

Clinical psychologists are among the health professionals who help people improve their well-being. Read about one clinical psychologist who helps adolescents who have become juvenile delinquents or substance abusers in *Connecting with Careers*.

Parenting and Education Can two gay men raise a healthy family? Are children harmed if both parents work outside the home? Are U.S. schools failing to teach children how



What characterizes the life-span perspective on development?
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Nonnormative life events, such as Hurricane Sandy, in 2012, are unusual circumstances that have a major impact on a person's life.
© Adam Hunger/Reuters/Landov

developmental connection

Middle Age

Adults typically face more losses in middle age than earlier in life. Connect to "Physical and Cognitive Development in Middle Adulthood."

developmental connection

Exercise

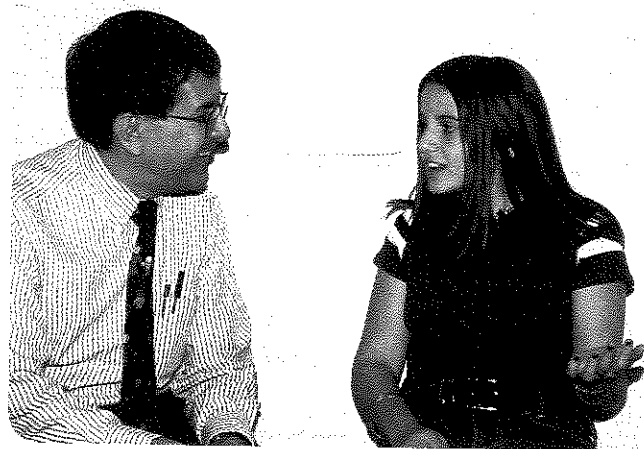
What effect might exercise have on children's and older adults' ability to process information? Connect to "Physical and Cognitive Development in Middle and Late Childhood" and "Physical Development in Late Adulthood."

Luis Vargas, Clinical Child Psychologist

Luis Vargas is Director of the Clinical Child Psychology Internship Program and a professor in the Department of Psychiatry at the University of New Mexico Health Sciences Center. He also is Director of Psychology at the University of New Mexico Children's Psychiatric Center.

Vargas obtained an undergraduate degree in psychology from St. Edward's University in Texas, a master's degree in psychology from Trinity University in Texas, and a Ph.D. in clinical psychology from the University of Nebraska–Lincoln.

Vargas' main interests are cultural issues and the assessment and treatment of children, adolescents, and families. He is motivated to find better ways to provide culturally responsive mental health services. One of his special interests is the treatment of Latino youth for delinquency and substance abuse.



Luis Vargas (left) conducts a child therapy session. Courtesy of Luis Vargas

For more information about what clinical psychologists do, see the *Careers in Life-Span Development* appendix.



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culture The behavior patterns, beliefs, and all other products of a group that are passed on from generation to generation.

cross-cultural studies Comparison of one culture with one or more other cultures. These provide information about the degree to which development is similar, or universal, across cultures, and the degree to which it is culture-specific.

ethnicity A characteristic based on cultural heritage, nationality characteristics, race, religion, and language.

socioeconomic status (SES) Refers to the grouping of people with similar occupational, educational, and economic characteristics.

gender The characteristics of people as males or females.

to read and write and calculate adequately? We hear many questions like these involving pressures on the contemporary family and the problems of U.S. schools (Cicchetti & Toth, 2015, 2016). In later chapters, we will analyze child care, the effects of divorce, parenting styles, child maltreatment, intergenerational relationships, early childhood education, links between childhood poverty and education, bilingual education, new educational efforts to improve lifelong learning, and many other issues related to parenting and education (Fecney, Moravcik, & Nolte, 2016; Pianta, 2016).

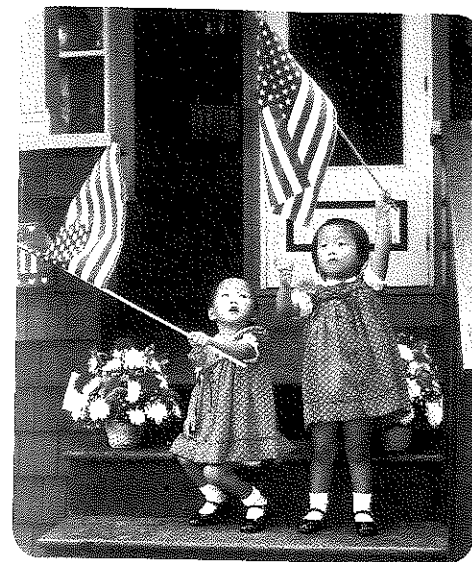
Sociocultural Contexts and Diversity

Health, parenting, and education—like development itself—are all shaped by their sociocultural context. To analyze this context, four concepts are especially useful: culture, ethnicity, socioeconomic status, and gender.

Culture encompasses the behavior patterns, beliefs, and all other products of a particular group of people that are passed on from generation to generation. Culture results from the interaction of people over many years (Cole & Tan, 2015; Packer & Cole, 2016). A cultural group can be as large as the United States or as small as an isolated Appalachian town. Whatever its size, the group's culture influences the behavior of its members (Hooyman, Kiyak, & Kawamoto, 2015; Masumoto & Juang, 2017).

Cross-cultural studies compare aspects of two or more cultures. The comparison provides information about the degree to which development is similar (or universal) across cultures, or is instead culture-specific (Chen & Liu, 2016; Putnick & others, 2015).

Ethnicity (the word *ethnic* comes from the Greek word for “nation”) is rooted in cultural heritage, nationality, race, religion, and language. African Americans, Latinos, Asian Americans,



Two Korean-born children on the day they became United States citizens. Asian American and Latino children are the fastest-growing immigrant groups in the United States. How diverse are the students in your life-span development class? How are their experiences in growing up likely to have been similar to or different from yours?

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Native Americans, European Americans, and Arab Americans are a few examples of broad ethnic groups in the United States. Diversity exists within each ethnic group (Banks, 2015; Gonzales & others, 2016). A special concern is the discrimination and prejudice experienced by ethnic minority children (Cheng, Goodman, & the Committee on Pediatric Research, 2015; Spencer & Swanson, 2016).

Socioeconomic status (SES) refers to a person's position within society based on occupational, educational, and economic characteristics. Socioeconomic status implies certain inequalities (George & Ferraro, 2016). Differences in the ability to control resources and to participate in society's rewards produce unequal opportunities (Marks & others, 2015; Wadsworth & others, 2016).

Gender refers to the characteristics of people as males and females. Few aspects of our development are more central to our identity and social relationships than gender (Bigler, 2015; Leaper, 2015).

In the United States, the sociocultural context has become increasingly diverse in recent years. The U.S. population includes a greater variety of cultures and ethnic groups than ever before. This changing demographic tapestry promises not only the richness that diversity produces but also difficult challenges in extending the American dream to all individuals (Banks, 2015). We will discuss sociocultural contexts and diversity in each chapter.

A special cross-cultural concern is the educational and psychological conditions of women around the world (UNICEF, 2016). Inadequate educational opportunities, violence, and mental health issues are among the problems faced by many women.

Considerable progress has been made in many parts of the world in girls' school attendance (UNICEF, 2015). However, in some regions, girls continue to receive less education. For example, in secondary



their daughters' future. Doly says that the girls in her UNICEF group are far more aware of their rights than their mothers ever were. (UNICEF, 2007).

Naser Siddique/UNICEF Bangladesh

Doly Akter, age 17, lives in a slum in Dhaka, Bangladesh, where sewers overflow, garbage rots in the streets, and children are undernourished. Nearly two-thirds of young women in Bangladesh marry before they are 18. Doly organized a club supported by UNICEF in which girls go door-to-door to monitor the hygiene habits of households in their neighborhood. The monitoring has led to improved hygiene and health in the families. Also, her group has managed to stop several child marriages by meeting with parents and convincing them that it is not in their daughter's best interests. When talking with parents in their neighborhoods, the girls in the club emphasize the importance of staying in school and how this will improve



Marian Wright Edelman, president of the Children's Defense Fund (shown here advocating for health care), has been a tireless advocate of children's rights and has been instrumental in calling attention to the needs of children. What are some of these needs?

Courtesy of the Children's Defense Fund and Marian Wright Edelman

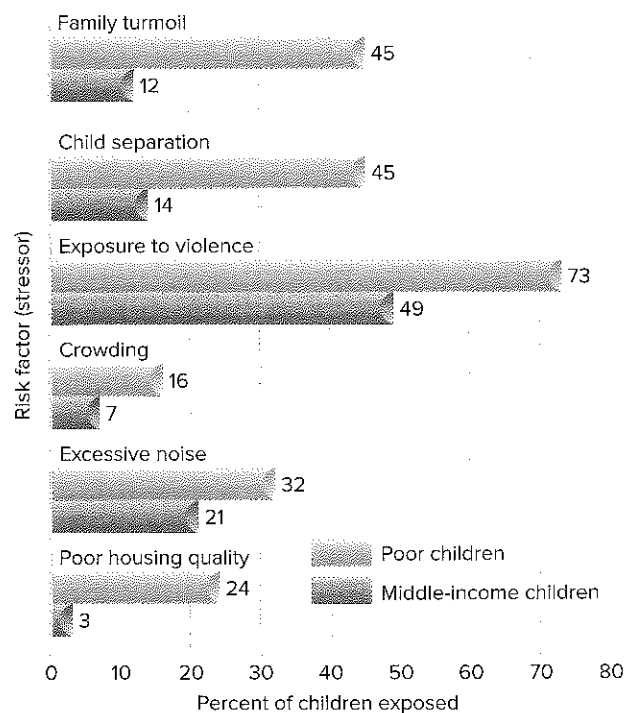


FIGURE 3
EXPOSURE TO SIX STRESSORS AMONG POOR AND MIDDLE-INCOME CHILDREN. One study analyzed the exposure to six stressors among poor children and middle-income children (Evans & English, 2002). Poor children were much more likely to face each of these stressors.

social policy A national government's course of action designed to promote the welfare of its citizens.

schools in West and Central Africa, only 76 girls are enrolled for every 100 boys (UNICEF, 2015).

Social Policy Social policy is a government's course of action designed to promote the welfare of its citizens. Values, economics, and politics all shape a nation's social policy (Hudson, 2016; Yeung & Mui-Teng, 2015). Out of concern that policy makers are doing too little to protect the well-being of children and older adults, life-span researchers are increasingly undertaking studies that they hope will lead to effective social policy (Duncan, Magnuson, & Votruba-Drzal, 2015; Lerner & others, 2015; Sommer & others, 2016).

Statistics such as infant mortality rates, mortality among children under 5, and the percentage of children who are malnourished or living in poverty provide benchmarks for evaluating how well children are doing in a particular society (Murry & others, 2015). Marian Wright Edelman, a tireless advocate for children's rights, has pointed out that indicators like these place the United States at or near the lowest rank for industrialized nations in the treatment of children.

Children who grow up in poverty represent a special concern (Duncan, Magnuson, & Votruba-Drzal, 2015; Wadsworth & others, 2016). In 2014, 21.1 percent of U.S. children under 18 years of age were living in families with incomes below the poverty line, with African American and Latino families with children having especially high rates of poverty (more than 30 percent) (De Navas-Walt & Proctor, 2015). In 2014, 12.7 percent of non-Latino White children were living in poverty. Compared with non-Latino White children, ethnic minority children are more likely to experience persistent poverty over many years and live in isolated poor neighborhoods where social supports are minimal and threats to positive development abundant.

The 21 percent figure represents an increase from 2001 (16 percent) but reflects a slight drop from a peak of 23 percent in 1993. The U.S. figure of 21 percent of children living in poverty is much higher than the rates in other industrialized nations. For example, Canada has a child poverty rate of 9 percent and Sweden has a rate of 2 percent.

As indicated in Figure 3, one study found that a higher percentage of U.S. children in poor families than in middle-income families were exposed to family turmoil, separation from a parent, violence, crowding, excessive noise, and poor housing (Evans & English, 2002). One study also revealed that the more years children spent living in poverty, the higher were their physiological indices of stress (Evans & Kim, 2007).

Edelman says that parenting and nurturing the next generation of children is our society's most important function and that we need to take it more seriously than we have in the past. To read about efforts to improve the lives of children through social policies, see *Connecting Development to Life*.

Some children triumph over poverty or other adversities. They show *resilience* (Luthar, Crossman, & Small, 2015; Masten, 2015; Masten & Cicchetti, 2016). Think back to the chapter-opening story about Alice Walker. In spite of racism, poverty, low socioeconomic status, and a disfiguring eye injury, she went on to become a successful author and champion for equality.

Are there certain characteristics that make children like Alice Walker resilient? Are there other characteristics that influence the development of children like Ted Kaczynski, who, despite his intelligence and education, became a killer? After analyzing research on this topic, Ann Masten and her colleagues (Masten, 2006, 2009, 2011, 2013, 2014a, b, c, 2015; Masten, Burt, & Coatsworth, 2006; Masten & Monn, 2015; Masten & others, 2015) concluded that a number of individual factors, such as good intellectual functioning, influence resiliency. In addition, as Figure 4 shows, the families and extrafamilial contexts of resilient individuals tend to share certain features. For example, resilient children are likely to have a close relationship with a caring parent figure and bonds to caring adults outside the family.



Ann Masten (far right) with a homeless mother and her child who are participating in her research on resilience. She and her colleagues have found that good parenting skills and good cognitive skills (especially attention and self-control) improve the likelihood that children in challenging circumstances will do well when they enter elementary school.
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connecting development to life

Improving Family Policy

In the United States, the actions of the national government, state governments, and city governments influence the well-being of children (McCartney & Yoshikawa, 2015; Yoshikawa & others, 2016). When families seriously endanger a child's well-being, governments often step in to help. At the national and state levels, policy makers have debated for decades about whether helping poor parents ends up helping their children as well. Researchers are providing some answers by examining the effects of specific policies (Lerner & others, 2015).

For example, the Minnesota Family Investment Program (MFIP) was designed in the 1990s primarily to influence the behavior of adults—specifically, to move adults off the welfare rolls and into paid employment. A key element of the program was its guarantee that adults participating in the program would receive more income if they worked than if they did not. When the adults' income rose, how did that affect their children? A study of the effects of MFIP found that increased incomes of working poor parents were linked with benefits for their children (Gennetian & Miller, 2002). The children's achievement in school improved, and their behavior problems decreased. A current MFIP study is examining the influence of specific services on low-income families at risk for child maltreatment and other negative outcomes for children (Minnesota Family Investment Program, 2009).

There is increasing interest in developing two-generation educational interventions to improve the academic success of children living in poverty (Gardner, Brooks-Gunn, & Chase-Lansdale, 2016; Sommer & others, 2016). For example, a recent large-scale effort to help children escape from poverty is the *Ascend* two-generation education intervention being conducted by the Aspen Institute (2013; King, Chase-Lansdale, & Small, 2015). The focus of the intervention emphasizes education (increasing postsecondary education for mothers and improving the quality of their children's early childhood education), economic support (housing, transportation, financial education, health insurance, and food assistance), and social capital (peer support including friends and neighbors; participation in community and faith-based organizations; school and work contacts).

Developmental psychologists and other researchers have examined the effects of many other government policies. They are seeking ways to help families living in poverty improve their well-being, and they have offered many suggestions for improving government policies (McLoyd, Purtell, & Hardaway, 2015; Spencer & Swanson, 2016).

Earlier, we learned that children who live in poverty experience higher levels of physiological stress. How might a child's stress level be affected by the implementation of MFIP?

At the other end of the life span, the well-being of older adults also creates policy issues (Hooyman, Kiyak, & Kawamoto, 2015; Hudson, 2016). Key concerns are escalating health care costs and the access of older adults to adequate health care (Lynch, Elmore, & Kotecki, 2015). One study found that the U.S. health care system fails older adults in many areas (Wenger & others, 2003). For example, older adults received the recommended care for general medical conditions such as heart disease only 52 percent of the time; they received appropriate care for undernutrition and Alzheimer disease only 31 percent of the time.

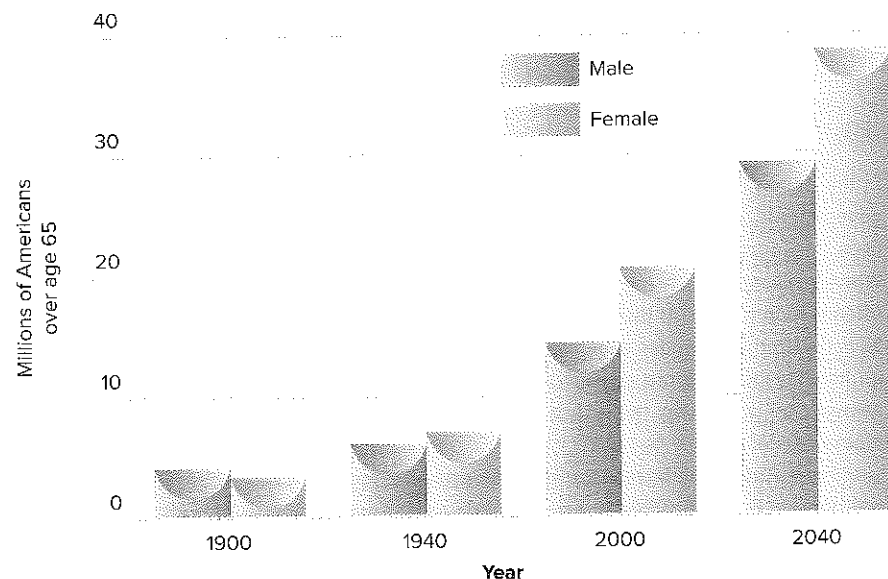
These concerns about the well-being of older adults are heightened by two facts. First, the number of older adults in the United States is growing dramatically, as Figure 5 shows. Second, many of these older Americans are likely to need society's help (Leung & others, 2015; Moon, 2016; Williamson & Beland, 2016). Compared with earlier decades, U.S. adults today are less likely to be married, more likely to be childless, and more likely to be living alone (Gerst-Emerson & Jayawardhana, 2015; Machielse, 2015). As the older population continues to expand during the twenty-first century, an increasing number of older adults will be without either a spouse or children—traditionally the main sources of support for older adults. These individuals will need social relationships, networks, and other forms of support (Antonucci & others, 2016; Fingerman & Tennant, 2015; LaMantia & others, 2015).

Source	Characteristic
Individual	Good intellectual functioning Appealing, sociable, easygoing disposition Self-confidence, high self-esteem Talents Faith
Family	Close relationship to caring parent figure Authoritative parenting: warmth, structure, high expectations Socioeconomic advantages Connections to extended supportive family networks
Extrafamilial Context	Bonds to caring adults outside the family Connections to positive organizations Attending effective schools

FIGURE 4
CHARACTERISTICS OF RESILIENT CHILDREN AND THEIR CONTEXTS

FIGURE 5

THE AGING OF AMERICA. The number of Americans over age 65 has grown dramatically since 1900 and is projected to increase further from the present to the year 2040. A significant increase will also occur in the number of individuals in the 85-and-over group. Centenarians—persons 100 years of age or older—are the fastest-growing age group in the United States, and their numbers are expected to swell in the coming decades.



Review Connect Reflect

LG1 Discuss the distinctive features of a life-span perspective on development.

Review

- What is meant by the concept of development? Why is the study of life-span development important?
- What are the main characteristics of the life-span perspective? What are three sources of contextual influences?
- What are some contemporary concerns in life-span development?

Connect

- Give your own example (not found in this chapter) of how biology, culture,

and individual experience interact to affect development.

Reflect Your Own Personal Journey of Life

- Imagine what your development would have been like in a culture that offered fewer or distinctly different choices. How might your development have been different if your family had been significantly richer or poorer?

2 The Nature of Development

LG2 Identify the most important processes, periods, and issues in development.

Biological, Cognitive, and Socioemotional Processes

Periods of Development

The Significance of Age

Developmental Issues

In this section, we will explore what is meant by developmental processes and periods, as well as variations in the way age is conceptualized. We will examine key developmental issues and strategies we can use to evaluate them.

If you wanted to describe how and why Alice Walker or Ted Kaczynski developed during their lifetimes, how would you go about it? A chronicle of the events in any person's life can quickly become a confusing and tedious array of details. Two concepts help provide a framework for describing and understanding an individual's development: developmental processes and periods.

BIOLOGICAL, COGNITIVE, AND SOCIOEMOTIONAL PROCESSES

At the beginning of this chapter, we defined development as the pattern of change that begins at conception and continues through the life span. The pattern is complex because it is the product of biological, cognitive, and socioemotional processes (see Figure 6).

Biological Processes Biological processes produce changes in an individual's physical nature. Genes inherited from parents, the development of the brain, height and weight gains, changes in motor skills, nutrition, exercise, the hormonal changes of puberty, and cardiovascular decline are all examples of biological processes that affect development.

Cognitive Processes Cognitive processes refer to changes in the individual's thought, intelligence, and language. Watching a colorful mobile swinging above the crib, putting together a two-word sentence, memorizing a poem, imagining what it would be like to be a movie star, and solving a crossword puzzle all involve cognitive processes.

Socioemotional Processes Socioemotional processes involve changes in the individual's relationships with other people, changes in emotions, and changes in personality. An infant's smile in response to a parent's touch, a toddler's aggressive attack on a playmate, a school-age child's development of assertiveness, an adolescent's joy at the senior prom, and the affection of an elderly couple all reflect the role of socioemotional processes in development.

Connecting Biological, Cognitive, and Socioemotional Processes Biological, cognitive, and socioemotional processes are inextricably intertwined (Diamond, 2013). Consider a baby smiling in response to a parent's touch. This response depends on biological processes (the physical nature of touch and responsiveness to it), cognitive processes (the ability to understand intentional acts), and socioemotional processes (the fact that smiling often reflects a positive emotional feeling and helps to connect us in positive ways with other human beings). Nowhere is the connection across biological, cognitive, and socioemotional processes more obvious than in two rapidly emerging fields:

- *developmental cognitive neuroscience*, which explores links between development, cognitive processes, and the brain (de Haan & Johnson, 2016; Johnson, 2016)
- *developmental social neuroscience*, which examines connections between socioemotional processes, development, and the brain (Casey, 2015; Decety & Cowell, 2016; Monahan & others, 2016)

In many instances, biological, cognitive, and socioemotional processes are bidirectional. For example, biological processes can influence cognitive processes and vice versa. Thus, although usually we will study the different processes of development (biological, cognitive, and socioemotional) separately, keep in mind that we are talking about the development of an integrated individual with a mind and body that are interdependent. In many places throughout the book, we will call attention to these connections.

PERIODS OF DEVELOPMENT

The interplay of biological, cognitive, and socioemotional processes produces the periods of the human life span (see Figure 7). A *developmental period* refers to a time frame in a person's life that is characterized by certain features. For the purposes of organization and understanding, we commonly describe development in terms of these periods. The most widely used classification of developmental periods involves the eight-period sequence shown in Figure 7. Approximate age ranges are listed for the periods to provide a general idea of when a period begins and ends.

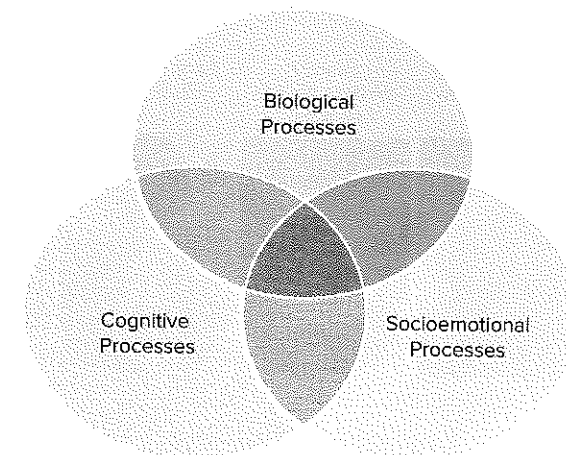


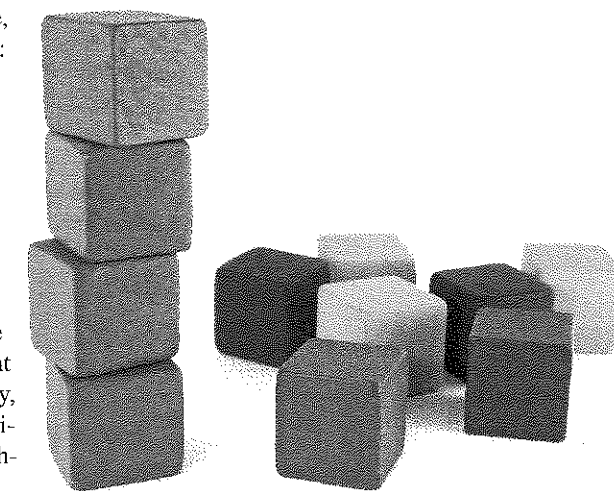
FIGURE 6

PROCESSES INVOLVED IN DEVELOPMENTAL CHANGES. Biological, cognitive, and socioemotional processes interact as individuals develop.

developmental connection

Brain Development

Is there a link between changes in the adolescent's brain and their mood swings and increased risk taking? Connect to "Physical and Cognitive Development in Adolescence."



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biological processes Changes in an individual's physical nature.

cognitive processes Changes in an individual's thought, intelligence, and language.

socioemotional processes Changes in an individual's interpersonal relationships, emotions, and personality.

Periods of Development

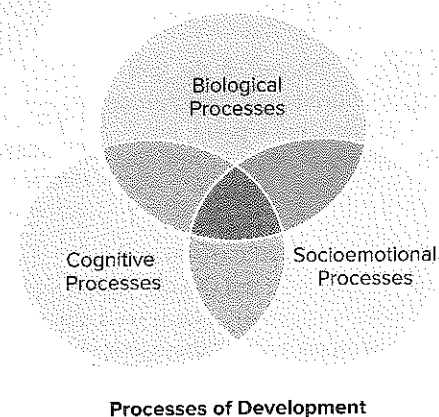
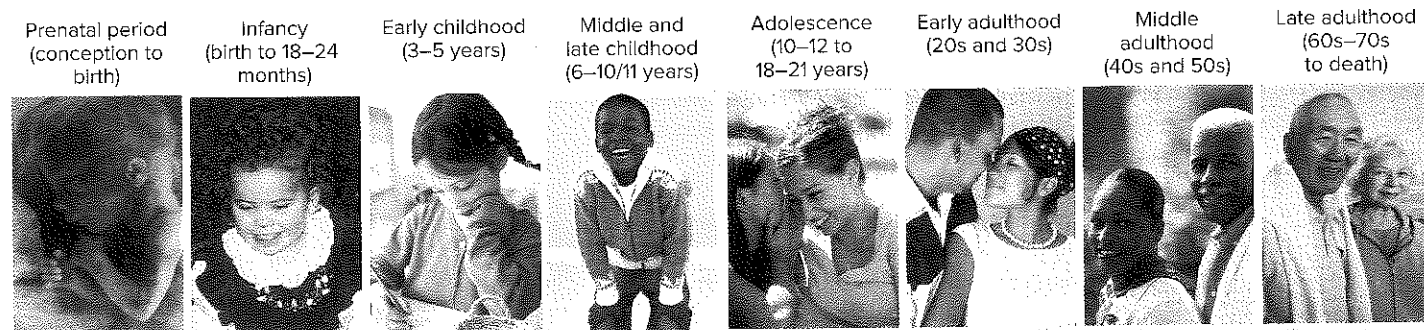


FIGURE 7
PROCESSES AND PERIODS OF DEVELOPMENT.

The unfolding of life's periods of development is influenced by the interaction of biological, cognitive, and socioemotional processes.

(Photo credit left to right) © Brand X Pictures/PunchStock RF; Courtesy of John Santrock; © Laurence Mouton/PhotoAlto/PictureQuest RF; © Digital Vision RF; © SW Productions/Getty Images RF; © Blue Moon Stock/Alamy Images RF; © Kristi J. Black/Corbis RF; © Ronnie Kaufman/Blend Images LLC RF

The prenatal period is the time from conception to birth. It involves tremendous growth—from a single cell to an organism complete with brain and behavioral capabilities—and takes place in approximately a 9-month period.

Infancy is the developmental period from birth to 18 or 24 months. Infancy is a time of extreme dependence upon adults. During this period, many psychological activities—language, symbolic thought, sensorimotor coordination, and social learning, for example—are just beginning.

The term *toddler* is often used to describe a child from about 1½ to 3 years of age. Toddlers are in a transitional period between infancy and the next period, *early childhood*.

Early childhood is the developmental period from 3 through 5 years of age. This period is sometimes called the “preschool years.” During this time, young children learn to become more self-sufficient and to care for themselves, develop school readiness skills (following instructions, identifying letters), and spend many hours playing with peers. First grade typically marks the end of early childhood.

Middle and late childhood is the developmental period from about 6 to 10 or 11 years of age, approximately corresponding to the elementary school years. During this period, children master the fundamental skills of reading, writing, and arithmetic, and they are formally exposed to the larger world and its culture. Achievement becomes a more central theme of the child's world, and self-control increases.

Adolescence is the developmental period of transition from childhood to early adulthood, entered at approximately 10 to 12 years of age and ending at 18 to 21 years of age. Adolescence begins with rapid physical changes—dramatic gains in height and weight, changes in body contour, and the development of sexual characteristics such as enlargement of the breasts, growth of pubic and facial hair, and deepening of the voice. At this point in development, the pursuit of independence and an identity are preeminent. Thought is more logical, abstract, and idealistic. More time is spent outside the family.

Early adulthood is the developmental period that begins in the early twenties and lasts through the thirties. It is a time of establishing personal and economic independence, advancing in a career, and for many, selecting a mate, learning to live with that person in an intimate way, starting a family, and rearing children.



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www.cartoonbank.com

Middle adulthood is the developmental period from approximately 40 to about 60 years of age. It is a time of expanding personal and social involvement and responsibility; of assisting the next generation in becoming competent, mature individuals; and of reaching and maintaining satisfaction in a career.

Late adulthood is the developmental period that begins during the sixties or seventies and lasts until death. It is a time of life review, retirement, and adjustment to new social roles and diminishing strength and health.

Late adulthood has the longest span of any period of development, and as noted earlier, the number of people in this age group has been increasing dramatically. As a result, life-span developmentalists have been paying more attention to differences within late adulthood (Exteberria & others, 2015; Shah & others, 2016). Paul Baltes and Jacqui Smith (2003) argue that a major change takes place in older adults' lives as they become the “oldest-old,” on average at about 85 years of age. For example, the “young-old” (classified as 65 through 84 in this analysis) have substantial potential for physical and cognitive fitness, retain much of their cognitive capacity, and can develop strategies to cope with the gains and losses of aging. In contrast, the oldest-old (85 and older) show considerable loss in cognitive skills, experience an increase in chronic stress, and become more frail.

Thus, Baltes and Smith concluded that considerable plasticity and adaptability characterize adults from their sixties until their mid-eighties but that the oldest-old have reached the limits of their functional capacity, which makes interventions to improve their lives difficult. Nonetheless, as will be described in later chapters, considerable variation exists in the degree to which the oldest-old retain their capabilities (Stevenson & others, 2015).

Four Ages Life-span developmentalists who focus on adult development and aging increasingly describe life-span development in terms of four “ages” (Baltes, 2006; Willis & Schaie, 2006):

First age: Childhood and adolescence

Second age: Prime adulthood, ages 20 through 59

Third age: Approximately 60 to 79 years of age

Fourth age: Approximately 80 years and older

The major emphasis in this conceptualization is on the third and fourth ages, especially the increasing evidence that individuals in the third age are healthier and can lead more active, productive lives than their predecessors in earlier generations. However, when older adults reach their eighties (fourth age), especially 85 and over, health and well-being decline for many individuals.

Three Developmental Patterns of Aging K. Warner Schaie (2016) recently described three different developmental patterns that provide a portrait of how aging can involve individual variations:

- *Normal aging* characterizes most individuals, for whom psychological functioning often peaks in early middle age, remains relatively stable until the late fifties to early sixties, and then shows a modest decline through the early eighties. However, marked decline can occur as individuals near death.
- *Pathological aging* characterizes individuals who show greater than average decline as they age through the adult years. In early old age, they may have mild cognitive impairment, develop Alzheimer disease later on, or have a chronic disease that impairs their daily functioning.
- *Successful aging* characterizes individuals whose positive physical, cognitive, and socioemotional development is maintained longer, declining later in old age than is the case for most people. For too long, only the declines that occur in late adulthood were highlighted, but recently there has been increased interest in the concept of successful aging (Araujo & others, 2016; Carstensen, Smith, & Jaworski, 2015; Rowe & Kahn, 2015).

Connections Across Periods of Development A final important point needs to be made about the periods of the human life span. Just as there are many connections between biological, cognitive, and socioemotional processes, so are there many connections between the

One's children's children's children. Look back to us as we look to you; we are related by our imaginations. If we are able to touch, it is because we have imagined each other's existence, our dreams running back and forth along a cable from age to age.

—ROGER ROSENBLATT
Contemporary American writer

periods of the human life span. A key element in the study of life-span development is how development in one period is connected to development in another period. For example, when individuals reach adolescence, many developments and experiences have already taken place in their lives. If an adolescent girl becomes depressed, might her depression be linked to development early in her life, as well as recent and current development? Throughout the text we will call attention to such connections across periods of development through *Developmental Connection* inserts that guide you to earlier or later connections with the material you are currently reading.

THE SIGNIFICANCE OF AGE

In our description of developmental periods, we linked an approximate age range with each period. But we also have noted that there are variations in the capabilities of individuals of the same age, and we have seen how age-related changes can be exaggerated. How important is age in understanding the characteristics of an individual?

Age and Happiness Is there a best age to be? An increasing number of studies indicate that in the United States adults are happier as they age. Consider also a U.S. study of approximately 28,000 individuals from 18 to 88 that revealed happiness increased with age (Yang, 2008). About 33 percent were very happy at 88 years of age compared with only about 24 percent in their late teens and early twenties. Why might older people report being happier and more satisfied with their lives than younger people? Despite facing higher incidences of physical problems and losses, older adults are more content with what they have in their lives, have better relationships with the people who matter to them, are less pressured to achieve, have more time for leisurely pursuits, and have many years of experience resulting in wisdom that may help them adapt better to their circumstances than younger adults do (Carstensen, 2015; Sims, Hogan, & Carstensen, 2015). Researchers have also found that baby boomers (those born between 1946 and 1964) tend to report being less happy than individuals born earlier—possibly because they are not lowering their aspirations and idealistic hopes as they age, as did earlier generations. Because growing older is a certain outcome of staying alive, it is good to know that we are likely to be happier as older adults than we were when we were younger.

Not all studies, though, have found an increase in life satisfaction with age (Stephoe, Deaton, & Stone, 2015). Some studies indicate that the lowest levels of life-satisfaction occur in middle age, especially from 45 to 54 years of age (OECD, 2014). Other studies have found that life satisfaction varies across some countries. For example, respondents in research studies conducted in the former Soviet Union and Eastern Europe, as well as in South American countries, reported a decrease in life satisfaction with advancing age (Deaton, 2008). Further, older adults in poor health, such as those with cardiovascular disease, chronic lung disease, and depression, tend to be less satisfied with their lives than their healthier older adult counterparts (Wikman, Wardle, & Steptoe, 2011).

Researchers also have distinguished between the evaluative and hedonic aspects of life course trajectories (Lachman, Teschale, & Agrigoroaei, 2015). In some studies, it is only the *evaluative* dimension (life satisfaction) that reaches a low point in middle adulthood (Stone & others, 2010). In contrast, the *hedonic* aspects (happiness and positive affect) take an upward trajectory from early adulthood through late adulthood, which is sometimes referred to as a *positivity effect* (Carstensen, 2015; Sims, Hogan, & Carstensen, 2015).

Now that you have read about age variations in life satisfaction, think about how satisfied you are with your life. To help you answer this question, complete the items in Figure 8, which presents the most widely used measure in research on life satisfaction (Diener, 2016).

Conceptions of Age According to some life-span experts, chronological age is not very relevant to understanding a person's psychological development (Botwinick, 1978). *Chronological age* is the number of years that have elapsed since birth. But time is a crude index of experience, and it does

not cause anything. Chronological age, moreover, is not the only way to measure age (MacDonald & Stawski, 2016). Just as there are different domains of development, there are different ways of thinking about age.

Age has been conceptualized not just as chronological age but also as biological age, psychological age, and social age (Hoyer & Roodin, 2009). *Biological age* is a person's age in terms of biological health. Determining biological age involves knowing the functional capacities of a person's vital organs. One person's vital capacities may be better or worse than those of other people of comparable age (Richards & others, 2015). The younger the person's biological age, the longer the person is expected to live, regardless of chronological age.

Psychological age is an individual's adaptive capacities compared with those of other individuals of the same chronological age. Thus, older adults who continue to learn, are flexible, are motivated, have positive personality traits, control their emotions, and think clearly are engaging in more adaptive behaviors than their chronological age-mates who do not continue to learn, are rigid, are unmotivated, do not control their emotions, and do not think clearly (Allen, Mejia, & Hooker, 2015; Perry & others, 2015). A longitudinal study of more than 1,200 individuals across seven decades revealed that the personality trait of conscientiousness (being organized, careful, and disciplined, for example) predicted lower mortality (frequency of death) risk from childhood through late adulthood (Martin, Friedman, & Schwartz, 2007). And a recent study found that a higher level of conscientiousness was protective of cognitive functioning in older adults (Wilson & others, 2015).

Social age refers to connectedness with others and the social roles individuals adopt. Individuals who have better social relationships with others are happier and more likely to live longer than individuals who are lonely (Carstensen & others, 2015; Reed & Carstensen, 2015).

Life-span expert Bernice Neugarten (1988) argues that in U.S. society chronological age is becoming irrelevant. The 28-year-old mayor, the 35-year-old grandmother, the 65-year-old father of a preschooler, the 55-year-old widow who starts a business, and the 70-year-old student illustrate that old assumptions about the proper timing of life events no longer govern our lives. We still have some

Below are five statements that you may agree or disagree with. Using the 1–7 scale below, indicate your agreement with each item by placing the appropriate number on the line preceding that item. Please be open and honest in your responding.

Response	Statement
Scale 7 Strongly agree 6 Agree 5 Slightly agree 4 Neither agree nor disagree 3 Slightly disagree 2 Disagree 1 Strongly disagree	In most ways my life is close to my ideal.
	The conditions of my life are excellent.
	I am satisfied with my life.
	So far I have gotten the important things I want in life.
	If I could live my life over, I would change almost nothing.
	Total score

Scoring	
31–35	Extremely satisfied
26–30	Satisfied
21–25	Slightly satisfied
20	Neutral
15–19	Slightly dissatisfied
10–14	Dissatisfied
5–9	Extremely dissatisfied

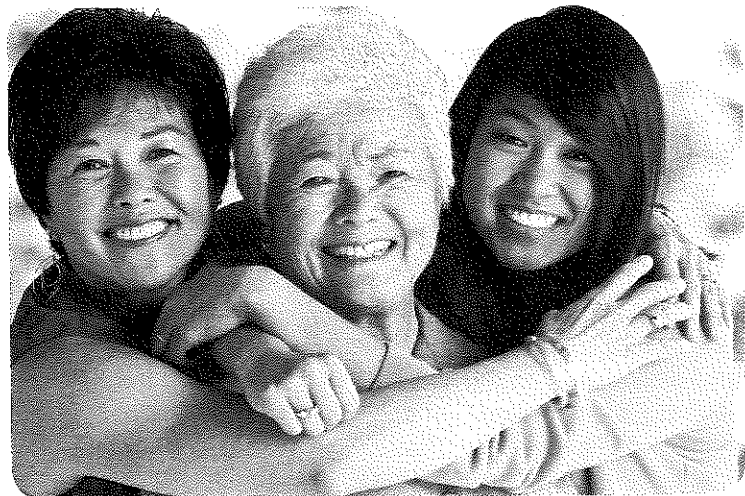
FIGURE 8
HOW SATISFIED AM I WITH MY LIFE?

Source: E. Diener, R.A. Emmons, R.J. Larson, & S. Griffin (1985). The Satisfaction with Life Scale. *Journal of Personality Assessment*, 48, 71–75.

How old would you be if you didn't know how old you were?

—SATCHEL PAIGE
American baseball pitcher, 20th century

(Left) Dawn Russel competes in the long jump in a Senior Olympics competition in Oregon; (right) a sedentary, overweight middle-aged man. Even though Dawn Russel's chronological age is older, might her biological age be younger than the middle-aged man's?



Which of these individuals is likely to be the happiest and to report the highest level of psychological well-being?
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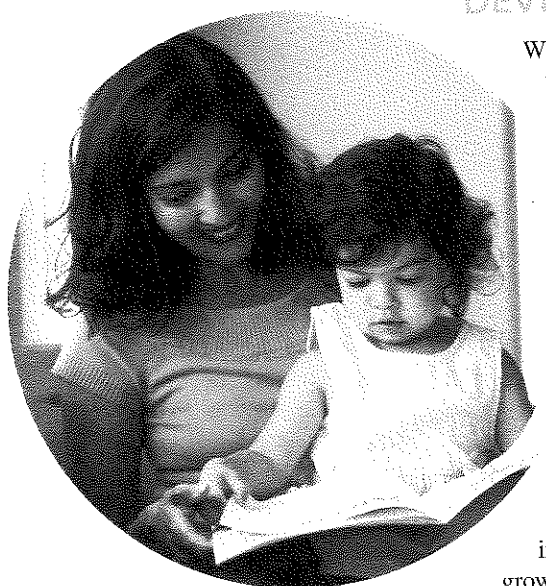


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developmental connection

Nature and Nurture

Can specific genes be linked to specific environmental experiences to influence development? Connect to “Biological Beginnings.”



What are some key developmental issues?
© Rubberball/PictureQuest RF

developmental connection

Personality

How much does personality change as people go through the adult years? Connect to “Socioemotional Development in Middle Adulthood.”

nature-nurture issue Debate about whether development is primarily influenced by nature or nurture. Nature refers to an organism's biological inheritance, nurture to its environmental experiences.

stability-change issue Debate about whether we become older renditions of our early experience (stability) or whether we develop into someone different from who we were at an earlier point in development (change).

continuity-discontinuity issue Debate about the extent to which development involves gradual, cumulative change (continuity) or distinct stages (discontinuity).

expectations for when certain life events—such as getting married, having children, and retiring—should occur. However, chronological age has become a less accurate predictor of these life events in our society. Moreover, issues such as how to deal with intimacy and how to cope with success and failure appear and reappear throughout the life span.

From a life-span perspective, an overall age profile of an individual involves not just chronological age but also biological age, psychological age, and social age. For example, a 70-year-old man (chronological age) might be in good physical health (biological age), be experiencing memory problems and not be coping well with the demands placed on him by his wife's recent hospitalization (psychological age), and have a number of friends with whom he regularly plays golf (social age).

DEVELOPMENTAL ISSUES

Was Ted Kaczynski born a killer, or did his life turn him into one? Kaczynski himself thought that his childhood was the root of his troubles, saying that he grew up as a genius in a boy's body and never fit in with other children. Did his early experiences determine his later life? Is your own journey through life marked out ahead of time, or can your experiences change your path? Are the experiences you have early in your journey more important than later ones? Is your journey more like taking an elevator up a skyscraper with distinct stops along the way or more like a cruise down a river with smoother ebbs and flows? These questions point to three issues about the nature of development: the roles played by nature and nurture, stability and change, and continuity and discontinuity.

Nature and Nurture The **nature-nurture issue** involves the extent to which development is influenced by nature and by nurture. Nature refers to an organism's biological inheritance, nurture to its environmental experiences.

According to those who emphasize the role of nature, just as a sunflower grows in an orderly way—unless flattened by an unfriendly environment—so too the human grows in an orderly way. An evolutionary and genetic foundation produces commonalities in growth and development (Belsky & Pluess, 2016; Buss, 2015; Del Giudice & Ellis, 2016; Sutphin & Korstanje, 2016). We walk before we talk, speak one word before two words, grow rapidly in infancy and less so in early childhood, experience a rush of sex hormones in puberty, reach the peak of our physical strength in late adolescence and early adulthood, and then physically decline. Proponents of the importance of nature acknowledge that extreme environments—those that are psychologically barren or hostile—can depress development. However, they believe that basic growth tendencies are genetically programmed into humans (Simon & others, 2016).

By contrast, other psychologists emphasize the importance of nurture, or environmental experiences, in development (Lamb & Lewis, 2016; Packer & Cole, 2016; Thompson, 2015). Experiences run the gamut from the individual's biological environment (nutrition, medical care, drugs, and physical accidents) to the social environment (family, peers, schools, community, media, and culture).

Stability and Change Is the shy child who hides behind the sofa when visitors arrive destined to become a wallflower at college dances, or might the child become a sociable, talkative individual? Is the fun-loving, carefree adolescent bound to have difficulty holding down a 9-to-5 job as an adult? These questions reflect the **stability-change issue**, which involves the degree to which early traits and characteristics persist through life or change.

Many developmentalists who emphasize stability in development argue that stability is the result of heredity and possibly early experiences in life. For example, many argue that if an individual is shy throughout life (as Ted Kaczynski was), this stability is due to heredity and possibly early experiences in which the infant or young child encountered considerable stress when interacting with people.

Developmentalists who emphasize change take the more optimistic view that later experiences can produce change. Recall that in the life-span perspective, plasticity, the potential

for change, exists throughout the life span, although possibly to different degrees (Kuhn & Lindenberger, 2016). Experts such as Paul Baltes (2003) argue that older adults often show less capacity for learning new things than younger adults do. However, many older adults continue to be good at practicing what they have learned earlier in life.

The roles of early and later experience are an aspect of the stability-change issue that has long been hotly debated (Fraley & Roisman, 2015; O'Connor, 2016). Some argue that warm, nurturant caregiving during infancy and toddlerhood predicts optimal development later in life (Easterbrooks & others, 2013). The later-experience advocates see children as malleable throughout development and believe later sensitive caregiving is just as important as earlier sensitive caregiving (Antonucci & others, 2016; Mikulincer & Shaver, 2015).

Continuity and Discontinuity When developmental change occurs, is it gradual or abrupt? Think about your own development for a moment. Did you gradually become the person you are today? Or did you experience sudden, distinct changes as you matured? For the most part, developmentalists who emphasize nurture describe development as a gradual, continuous process. Those who emphasize nature often describe development as a series of distinct stages.

The **continuity-discontinuity issue** focuses on the degree to which development involves either gradual, cumulative change (continuity) or distinct stages (discontinuity). In terms of continuity, as the oak grows from seedling to giant oak, it becomes more of an oak—its development is continuous (see Figure 9). Similarly, a child's first word, though seemingly an abrupt, discontinuous event, is actually the result of weeks and months of growth and practice. Puberty might seem abrupt, but it is a gradual process that occurs over several years.

In terms of discontinuity, as an insect grows from a caterpillar to a chrysalis to a butterfly, it passes through a sequence of stages in which change is qualitatively rather than quantitatively different. Similarly, at some point a child moves from not being able to think abstractly about the world to being able to do so. This is a qualitative, discontinuous change in development rather than a quantitative, continuous change.

Evaluating the Developmental Issues Most life-span developmentalists acknowledge that development is not all nature or all nurture, not all stability or all change, and not all continuity or all discontinuity. Nature and nurture, stability and change, continuity and discontinuity characterize development throughout the human life span.

Although most developmentalists do not take extreme positions on these three important issues, there is spirited debate regarding how strongly development is influenced by each of these factors (Grigorenko & others, 2016; Hill & Roth, 2016; Moore, 2015).

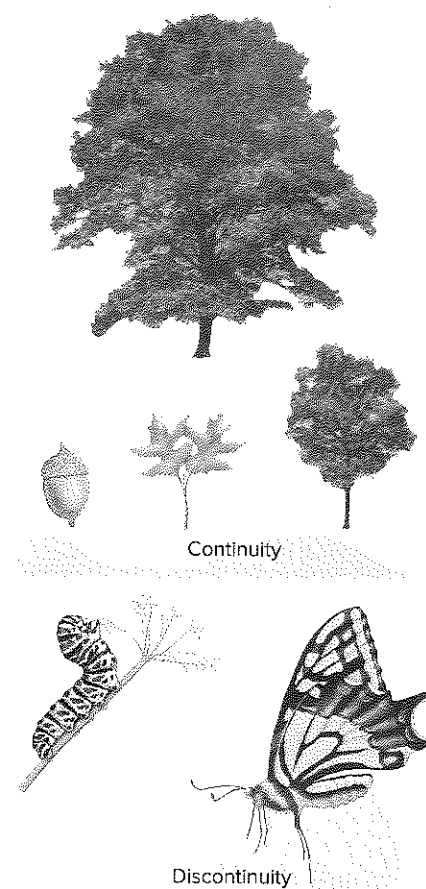


FIGURE 9
CONTINUITY AND DISCONTINUITY IN DEVELOPMENT. Is our development like that of a seedling gradually growing into a giant oak? Or is it more like that of a caterpillar suddenly becoming a butterfly?

Review Connect Reflect

LG2 Identify the most important processes, periods, and issues in development.

Review

- What are three key developmental processes?
- What are eight main developmental periods?
- How is age related to development?
- What are three main developmental issues?

Connect

- In the previous section, we discussed biological, cognitive, and socioemotional

processes. What concepts do these processes have in common with the issue of nature versus nurture, which was also discussed in this section?

Reflect Your Own Personal Journey of Life

- Do you think there was/is/will be a best age for you to be? If so, what is it? Why?

3 Theories of Development



Describe the main theories of human development.

Psychoanalytic
Theories

Cognitive
Theories

Behavioral and
Social Cognitive
Theories

Ethological
Theory

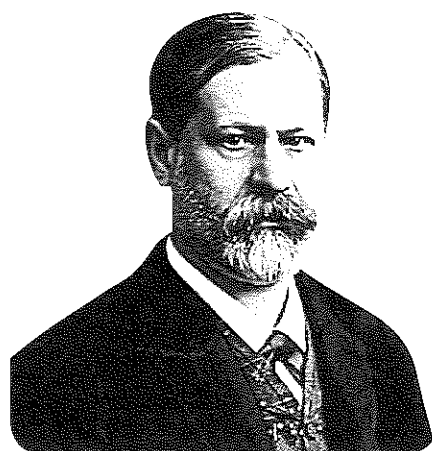
Ecological
Theory

An Eclectic
Theoretical
Orientation

There is nothing quite so
practical as a good theory.

—KURT LEWIN

American social psychologist, 20th century



Sigmund Freud, the pioneering architect of psychoanalytic theory. *How did Freud portray the organization of an individual's personality?*
© Bettmann/Corbis

scientific method An approach that can be used to obtain accurate information. It includes the following steps: (1) conceptualize the problem, (2) collect data, (3) draw conclusions, and (4) revise research conclusions and theory.

theory An interrelated, coherent set of ideas that helps to explain phenomena and facilitate predictions.

hypotheses Specific assumptions and predictions that can be tested to determine their accuracy.

psychoanalytic theories Theories that describe development as primarily unconscious and heavily colored by emotion. Behavior is merely a surface characteristic, and the symbolic workings of the mind have to be analyzed to understand behavior. Early experiences with parents are emphasized.

How can we answer questions about the roles of nature and nurture, stability and change, and continuity and discontinuity in development? How can we determine, for example, whether deterioration of memory in older adults can be prevented or whether special care can repair the harm inflicted by child neglect? The scientific method is the best tool we have to answer such questions (Smith & Davis, 2016).

The **scientific method** is essentially a four-step process: (1) conceptualize a process or problem to be studied, (2) collect research information (data), (3) analyze the data, and (4) draw conclusions.

In step 1, when researchers are formulating a problem to study, they often draw on theories and develop hypotheses. A **theory** is an interrelated, coherent set of ideas that helps to explain phenomena and facilitate predictions. It may suggest **hypotheses**, which are specific assertions and predictions that can be tested. For example, a theory on mentoring might state that sustained support and guidance from an adult makes a difference in the lives of children from impoverished backgrounds because the mentor gives the children opportunities to observe and imitate the behavior and strategies of the mentor.

This section outlines key aspects of five theoretical orientations to development: psychoanalytic, cognitive, behavioral and social cognitive, ethological, and ecological. Each contributes an important piece to the life-span development puzzle. Although the theories disagree about certain aspects of development, many of their ideas are complementary rather than contradictory. Together they let us see the total landscape of life-span development in all its richness.

PSYCHOANALYTIC THEORIES

Psychoanalytic theories describe development as primarily unconscious (beyond awareness) and heavily colored by emotion. Psychoanalytic theorists emphasize that behavior is merely a surface characteristic and that a true understanding of development requires analyzing the symbolic meanings of behavior and the deep inner workings of the mind. Psychoanalytic theorists also stress that early experiences with parents extensively shape development. These characteristics are highlighted in the main psychoanalytic theory, that of Sigmund Freud (1856–1939).

Freud's Theory As Freud listened to, probed, and analyzed his patients, he became convinced that their problems were the result of experiences early in life. He thought that as children grow up, their focus of pleasure and sexual impulses shifts from the mouth to the anus and eventually to the genitals. As a result, we go through five stages of psychosexual development: oral, anal, phallic, latency, and genital (see Figure 10). Our adult personality, Freud (1917) claimed, is determined by the way we resolve conflicts between sources of pleasure at each stage and the demands of reality.

Freud's theory has been significantly revised by a number of psychoanalytic theorists. Many of today's psychoanalytic theorists maintain that Freud overemphasized sexual instincts; they argue that more emphasis should be placed on cultural experiences as determinants of an individual's development. Unconscious thought remains a central theme, but conscious thought plays a greater role than Freud envisioned. One of the most influential revisionists of Freud's ideas was Erik Erikson.

Erikson's Psychosocial Theory Erik Erikson (1902–1994) recognized Freud's contributions but believed that Freud misjudged some important dimensions of human development. For one thing, Erikson (1950, 1968) said we develop in psychosocial stages, rather than in psychosexual stages as Freud maintained. According to Freud, the primary motivation for human behavior is sexual in nature; according to Erikson, it is social and reflects

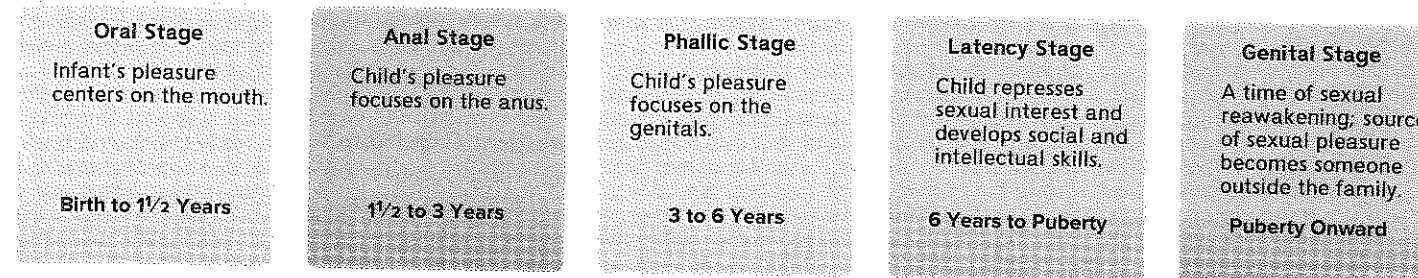


FIGURE 10

FREUDIAN STAGES. Because Freud emphasized sexual motivation, his stages of development are known as psychosexual stages. In his view, if the need for pleasure at any stage is either undergratified or overgratified, an individual may become fixated, or locked in, at that stage of development.

a desire to affiliate with other people. According to Freud, our basic personality is shaped during the first five years of life; according to Erikson, developmental change occurs throughout the life span. Thus, in terms of the early-versus-later-experience issue described earlier in the chapter, Freud viewed early experience as being far more important than later experiences, whereas Erikson emphasized the importance of both early and later experiences.

In **Erikson's theory**, eight stages of development unfold as we go through life (see Figure 11). At each stage, a unique developmental task confronts individuals with a crisis that must be resolved. According to Erikson, this crisis is not a catastrophe but a turning point marked by both increased vulnerability and enhanced potential. The more successfully an individual resolves each crisis, the healthier development will be.

Trust versus mistrust is Erikson's first psychosocial stage, which is experienced in the first year of life. The development of trust during infancy sets the stage for a lifelong expectation that the world will be a good and pleasant place to live.

Autonomy versus shame and doubt is Erikson's second stage. This stage occurs in late infancy and toddlerhood (1 to 3 years). After gaining trust in their caregivers, infants begin to discover that their behavior is their own. They start to assert their sense of independence or autonomy. They realize their will. If infants and toddlers are restrained too much or punished too harshly, they are likely to develop a sense of shame and doubt.

Initiative versus guilt, Erikson's third stage of development, occurs during the preschool years. As preschool children encounter a widening social world, they face new challenges that require active, purposeful, responsible behavior. Feelings of guilt may arise, though, if the child is irresponsible and is made to feel too anxious.

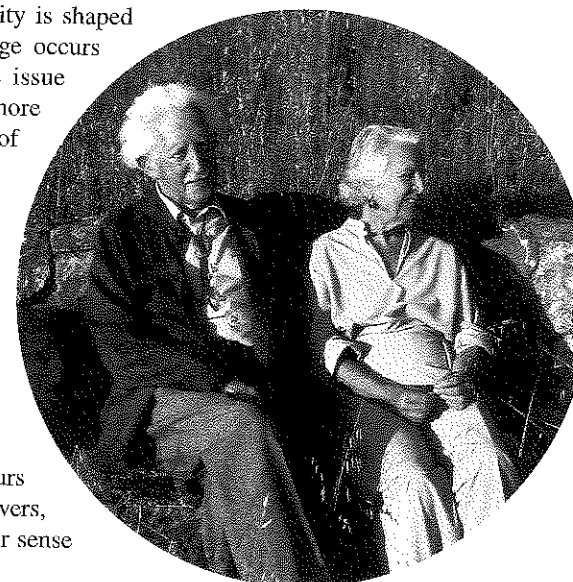
Industry versus inferiority is Erikson's fourth developmental stage, occurring approximately during the elementary school years. Children now need to direct their energy toward mastering knowledge and intellectual skills. The negative outcome is that the child may develop a sense of inferiority—feeling incompetent and unproductive.

During the adolescent years, individuals need to find out who they are, what they are all about, and where they are going in life. This is Erikson's fifth developmental stage, **identity versus identity confusion**. If adolescents explore roles in a healthy manner and arrive at a positive path to follow in life, then they achieve a positive identity; if they do not, identity confusion reigns.

Intimacy versus isolation is Erikson's sixth developmental stage, which individuals experience during early adulthood. At this time, individuals face the developmental task of forming intimate relationships. If young adults form healthy friendships and an intimate relationship with another, intimacy will be achieved; if not, isolation will result.

Generativity versus stagnation, Erikson's seventh developmental stage, occurs during middle adulthood. By generativity Erikson means primarily a concern for helping the younger generation to develop and lead useful lives. The feeling of having done nothing to help the next generation is stagnation.

Integrity versus despair is Erikson's eighth and final stage of development, which individuals experience in late adulthood. During this stage, a person reflects on the past. If the



Erik Erikson with his wife, Joan, an artist. Erikson generated one of the most important developmental theories of the twentieth century. *Which stage of Erikson's theory are you in? Does Erikson's description of this stage characterize you?*
© Jon Erikson/The Image Works

Erikson's theory includes eight stages of human development. Each stage consists of a unique developmental task that confronts individuals with a crisis that must be resolved.

Erikson's Stages	Developmental Period
Integrity versus despair	Late adulthood (60s onward)
Generativity versus stagnation	Middle adulthood (40s, 50s)
Intimacy versus isolation	Early adulthood (20s, 30s)
Identity versus identity confusion	Adolescence (10 to 20 years)
Industry versus inferiority	Middle and late childhood (elementary school years, 6 years to puberty)
Initiative versus guilt	Early childhood (preschool years, 3 to 5 years)
Autonomy versus shame and doubt	Infancy (1 to 3 years)
Trust versus mistrust	Infancy (first year)



Jean Piaget, the famous Swiss developmental psychologist, changed the way we think about the development of children's minds. What are some key ideas in Piaget's theory?
© Yves de Braine/Black Star/Stock Photo

person's life review reveals a life well spent, integrity will be achieved; if not, the retrospective glances likely will yield doubt or gloom—the despair Erikson described.

Evaluating Psychoanalytic Theories Contributions of psychoanalytic theories include an emphasis on a developmental framework, family relationships, and unconscious aspects of the mind. Criticisms include a lack of scientific support, too much emphasis on sexual underpinnings, and an image of people that is too negative.

COGNITIVE THEORIES

Whereas psychoanalytic theories stress the importance of the unconscious, cognitive theories emphasize conscious thoughts. Three important cognitive theories are Jean Piaget's cognitive developmental theory, Lev Vygotsky's sociocultural cognitive theory, and the information-processing theory.

Piaget's Cognitive Developmental Theory Piaget's theory states that children go through four stages of cognitive development as they actively construct their understanding of the world. Two processes underlie this cognitive construction of the world: organization and adaptation. To make sense of our world, we organize our experiences. For example, we separate important ideas from less important ideas, and we connect one idea to another. In addition to organizing our observations and experiences, we adapt, adjusting to new environmental demands (Miller, 2015).

Piaget (1954) identified four stages in understanding the world (see Figure 12). Each stage is age-related and consists of a distinct way of thinking, a different way of understanding the world. Thus, according to Piaget (1896–1980), the child's cognition is qualitatively different from one stage to another. What are Piaget's four stages of cognitive development?

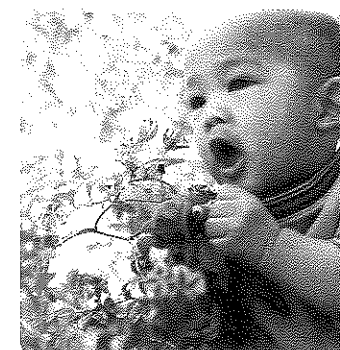
- The *sensorimotor stage*, which lasts from birth to about 2 years of age, is the first Piagetian stage. In this stage, infants construct an understanding of the world by coordinating sensory experiences (such as seeing and hearing) with physical, motoric actions—hence the term *sensorimotor*.
- The *preoperational stage*, which lasts from approximately 2 to 7 years of age, is Piaget's second stage. In this stage, children begin to go beyond simply connecting sensory information with physical action and represent the world with words, images, and drawings. However, according to Piaget, preschool children still lack the ability to perform what he calls operations, which are internalized mental actions that allow children to do mentally what they previously could only do physically. For example, if you imagine putting two sticks together to see whether they would be as long as another stick, without actually moving the sticks, you are performing a concrete operation.
- The *concrete operational stage*, which lasts from approximately 7 to 11 years of age, is the third Piagetian stage. In this stage, children can perform operations that involve objects, and they can reason logically when the reasoning can be applied to specific or concrete examples. For instance, concrete operational thinkers cannot imagine the steps necessary to complete an algebraic equation, a task that is too abstract for individuals at this stage of development.
- The *formal operational stage*, which appears between the ages of 11 and 15 and continues through adulthood, is Piaget's fourth and final stage. In this stage, individuals move beyond concrete experiences and begin to think in abstract and more

FIGURE 11 ERIKSON'S EIGHT LIFE-SPAN STAGES.

Like Freud, Erikson proposed that individuals go through distinct, universal stages of development. Thus, in terms of the continuity-discontinuity issue discussed in this chapter, both favor the discontinuity side of the debate. Notice that the timing of Erikson's first four stages is similar to that of Freud's stages. What are the implications of saying that people go through stages of development?

Piaget's theory Theory stating that children actively construct their understanding of the world and go through four stages of cognitive development.

Vygotsky's theory A sociocultural cognitive theory that emphasizes how culture and social interaction guide cognitive development.



Sensorimotor Stage

The infant constructs an understanding of the world by coordinating sensory experiences with physical actions. An infant progresses from reflexive, instinctual action at birth to the beginning of symbolic thought toward the end of the stage.

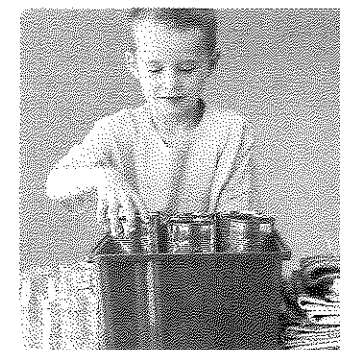
Birth to 2 Years of Age



Preoperational Stage

The child begins to represent the world with words and images. These words and images reflect increased symbolic thinking and go beyond the connection of sensory information and physical action.

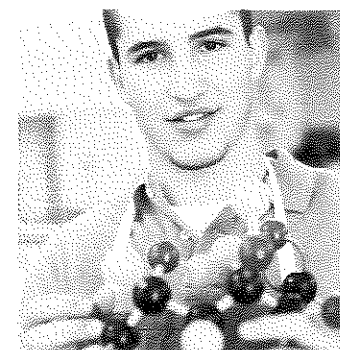
2 to 7 Years of Age



Concrete Operational Stage

The child can now reason logically about concrete events and classify objects into different sets.

7 to 11 Years of Age



Formal Operational Stage

The adolescent reasons in more abstract, idealistic, and logical ways.

11 Years of Age Through Adulthood

FIGURE 12

PIAGET'S FOUR STAGES OF COGNITIVE DEVELOPMENT. According to Piaget, how a child thinks—not how much the child knows—determines the child's stage of cognitive development.

(Photo credit left to right) © Stockbyte/Getty Images RF; © BananaStock/PunchStock RF; © Image100/Corbis RF; © Purestock/Getty Images RF

logical terms. As part of thinking more abstractly, adolescents develop images of ideal circumstances. They might think about what an ideal parent would be like and compare their parents to this ideal standard. They begin to entertain possibilities for the future and are fascinated with what they can be. In solving problems, they become more systematic, developing hypotheses about why something is happening the way it is and then testing these hypotheses. We will examine Piaget's cognitive developmental theory further in other chapters.

Vygotsky's Sociocultural Cognitive Theory Like Piaget, the Russian developmentalist Lev Vygotsky (1896–1934) argued that children actively construct their knowledge. However, Vygotsky (1962) gave social interaction and culture far more important roles in cognitive development than Piaget did. **Vygotsky's theory** is a sociocultural cognitive theory that emphasizes how culture and social interaction guide cognitive development.

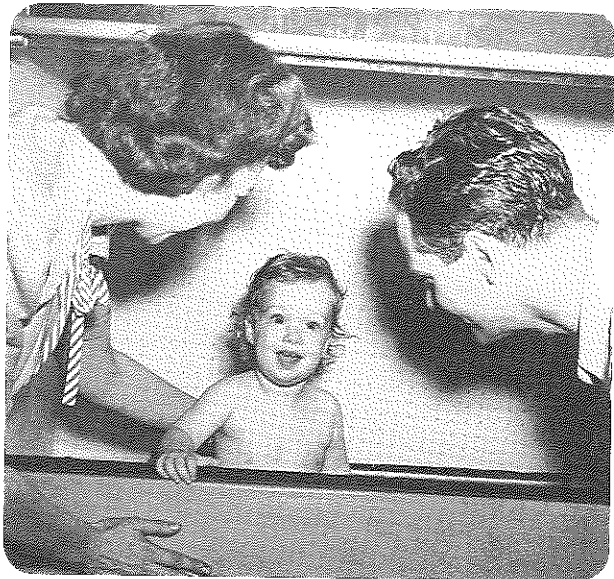
Vygotsky portrayed the child's development as inseparable from social and cultural activities (Gauvain & Perez, 2015). He maintained that cognitive development involves learning to use the inventions of society, such as language, mathematical systems, and memory strategies. Thus in one culture, children might learn to count with the help of a computer; in another, they might learn by using beads. According to Vygotsky, children's social interaction with more-skilled adults and peers is indispensable to their cognitive development. Through this interaction, they learn to use the tools that will help them adapt and be successful in their culture (Rogoff & others, 2015). In later chapters, we will examine ideas about learning and teaching that are based on Vygotsky's theory.

The Information-Processing Theory Information-processing theory emphasizes that individuals manipulate information, monitor it, and strategize about it. Unlike Piaget's theory, but like Vygotsky's theory, information-processing theory does not describe development as stage-like. Instead, according to this theory, individuals develop



Lev Vygotsky was born the same year as Piaget, but he died much earlier, at the age of 37. There is considerable interest today in Vygotsky's sociocultural cognitive theory of child development. What are some key characteristics of Vygotsky's theory?
A.R. Lauria/Dr. Michael Cole, Laboratory of Human Cognition, University of California, San Diego

information-processing theory Emphasizes that individuals manipulate information, monitor it, and strategize about it. Central to this theory are the processes of memory and thinking.



B. F. Skinner was a tinkerer who liked to make new gadgets. The younger of his two daughters, Deborah, was raised in Skinner's enclosed Air-Crib, which he invented because he wanted to control her environment completely. The Air-Crib was sound-proofed and temperature controlled. Debbie, shown here as a child with her parents, is currently a successful artist, is married, and lives in London. *What do you think about Skinner's Air-Crib?*

© AP Images



Albert Bandura has been one of the leading architects of social cognitive theory. *How does Bandura's theory differ from Skinner's?*

© Linda A Cicero/Stanford News Service

social cognitive theory The view of psychologists who emphasize behavior, environment, and cognition as the key factors in development.

a gradually increasing capacity for processing information, which allows them to acquire increasingly complex knowledge and skills (Muller & Kerns, 2015).

Robert Siegler (2006, 2013), a leading expert on children's information processing, states that thinking is information processing. In other words, when individuals perceive, encode, represent, store, and retrieve information, they are thinking. Siegler emphasizes that an important aspect of development is learning good strategies for processing information. For example, becoming a better reader might involve learning to monitor the key themes of the material being read.

Siegler (2006) also argues that the best way to understand how children learn is to observe them while they are learning. He emphasizes the importance of using the *microgenetic method* to obtain detailed information about processing mechanisms as they are occurring from moment to moment. Siegler concludes that most research methods indirectly assess cognitive change, being more like snapshots than movies. The microgenetic method seeks to discover not just what children know but the cognitive processes involved in how they acquired the knowledge. A typical microgenetic study will be conducted across a number of trials assessed at various times over weeks or months (Miller, 2015). A number of microgenetic studies have focused on a specific aspect of academic learning, such as how children learn whole number arithmetic, fractions, and other areas of math (Fazio, DeWolf, & Siegler, 2016; Siegler, 2016a, b; Siegler & others, 2015). Microgenetic studies also have been used to discover how children learn a particular concept in science or a key component of learning to read.

Evaluating Cognitive Theories Contributions of cognitive theories include a positive view of development and an emphasis on the active construction of understanding. Criticisms include skepticism about the pureness of Piaget's stages and too little attention to individual variations.

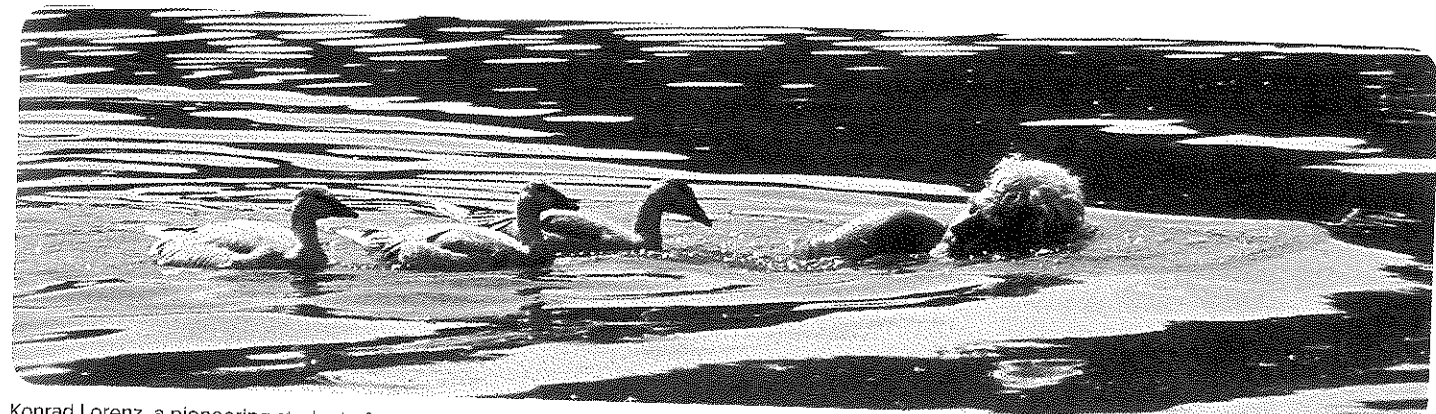
BEHAVIORAL AND SOCIAL COGNITIVE THEORIES

Behaviorism essentially holds that we can study scientifically only what can be directly observed and measured. Out of the behavioral tradition grew the belief that development is observable behavior that can be learned through experience with the environment (Spiegler, 2016). In terms of the continuity-discontinuity issue discussed earlier in this chapter, the behavioral and social cognitive theories emphasize continuity in development and argue that development does not occur in stage-like fashion. Let's explore two versions of behaviorism: Skinner's operant conditioning and Bandura's social cognitive theory.

Skinner's Operant Conditioning According to B. F. Skinner (1904–1990), through operant conditioning the consequences of a behavior produce changes in the probability of the behavior's occurrence. A behavior followed by a rewarding stimulus is more likely to recur, whereas a behavior followed by a punishing stimulus is less likely to recur. For example, when an adult smiles at a child after the child has done something, the child is more likely to engage in that behavior again than if the adult gives the child a disapproving look.

In Skinner's (1938) view, such rewards and punishments shape development. For Skinner the key aspect of development is behavior, not thoughts and feelings. He emphasized that development consists of the pattern of behavioral changes that are brought about by rewards and punishments. For example, Skinner would say that shy people learned to be shy as a result of experiences they had while growing up. It follows that modifications in an environment can help a shy person become more socially oriented.

Bandura's Social Cognitive Theory Some psychologists agree with the behaviorists' notion that development is learned and is influenced strongly by environmental interactions. However, unlike Skinner, they also see cognition as important in understanding development (Mischel, 2014). **Social cognitive theory** holds that behavior, environment, and cognition are the key factors in development.



Konrad Lorenz, a pioneering student of animal behavior, is followed through the water by three imprinted greylag geese. Describe Lorenz's experiment with the geese. *Do you think his experiment would have had the same results with human babies? Explain.*

© Nina Leen/Time Life Pictures/Getty Images

American psychologist Albert Bandura (1925–) is the leading architect of social cognitive theory. Bandura (1986, 2004, 2010a, b, 2012, 2015) emphasizes that cognitive processes have important links with the environment and behavior. His early research program focused heavily on observational learning (also called imitation or modeling), which is learning that occurs through observing what others do. For example, a young boy might observe his father acts very aggressively, showing the same characteristics as his father's behavior. Social cognitive theorists stress that people acquire a wide range of behaviors, thoughts, and feelings through observing others' behavior and that these observations play a central role in life-span development.

What is cognitive about observational learning in Bandura's view? He proposes that people cognitively represent the behavior of others and then sometimes adopt this behavior themselves.

Bandura's (2004, 2010a, b, 2012, 2015) most recent model of learning and development includes three elements: behavior, the person/cognition, and the environment. An individual's confidence that he or she can control his or her success is an example of a person factor; strategies are an example of a cognitive factor. As shown in Figure 13, behavior, person/cognitive, and environmental factors operate interactively.

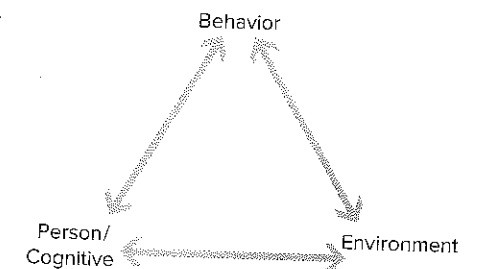


FIGURE 13

BANDURA'S SOCIAL COGNITIVE MODEL. The arrows illustrate how relations between behavior, person/cognitive, and environment are reciprocal rather than one-way. Person/cognitive refers to cognitive processes (for example, thinking and planning) and personal characteristics (for example, believing that you can control your experiences).

Evaluating Behavioral and Social Cognitive Theories Contributions of the behavioral and social cognitive theories include an emphasis on scientific research and environmental determinants of behavior. Criticisms include too little emphasis on cognition in Skinner's theory and inadequate attention paid to developmental changes.

ETHOLOGICAL THEORY

Ethology stresses that behavior is strongly influenced by biology, is tied to evolution, and is characterized by critical or sensitive periods. These are specific time frames during which, according to ethologists, the presence or absence of certain experiences has a long-lasting influence on individuals (Bateson, 2015).

European zoologist Konrad Lorenz (1903–1989) helped bring ethology to prominence. In his best-known research, Lorenz (1965) studied the behavior of greylag geese, which will follow their mothers as soon as they hatch. Lorenz separated the eggs laid by one goose into two groups. One group he returned to the goose to be hatched by her. The other group was hatched in an incubator. The goslings in the first group performed as predicted. They followed their mother as soon as they hatched. However, those in the second group, which saw Lorenz when they first hatched, followed him everywhere, as though he were their mother. Lorenz marked the goslings and then placed both groups under a box. Mother goose and "mother" Lorenz stood aside as the box was lifted. Each group of goslings went directly to its "mother." Lorenz called this process imprinting—the rapid, innate learning that involves attachment to the first moving object seen.

developmental connection
Achievement
Bandura emphasizes that self-efficacy is a key person/cognitive factor in children's achievement. Connect to "Socioemotional Development in Middle and Late Childhood."

ethology Stresses that behavior is strongly influenced by biology, is tied to evolution, and is characterized by critical or sensitive periods.

developmental connection

Attachment

Human babies go through a series of phases in developing an attachment to a caregiver. Connect to "Socioemotional Development in Infancy."

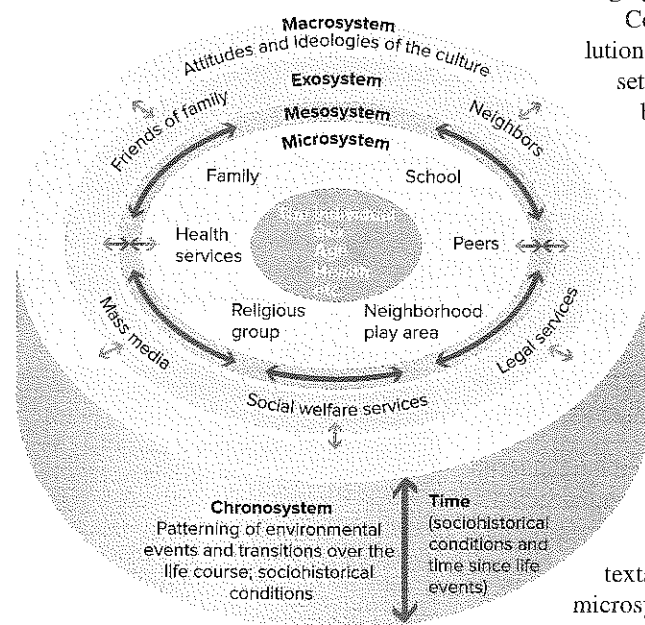


FIGURE 14
BRONFENBRENNER'S ECOLOGICAL THEORY OF DEVELOPMENT.

Bronfenbrenner's ecological theory consists of five environmental systems: microsystem, mesosystem, exosystem, macrosystem, and chronosystem.

developmental connection

Parenting

How are parent-child relationships and children's peer relations linked? Connect to "Socioemotional Development in Early Childhood."

Bronfenbrenner's ecological theory

Bronfenbrenner's environmental systems theory that focuses on five environmental systems: microsystem, mesosystem, exosystem, macrosystem, and chronosystem.

John Bowlby (1969, 1989) illustrated an important application of ethological theory to human development. Bowlby stressed that attachment to a caregiver over the first year of life has important consequences throughout the life span. In his view, if this attachment is positive and secure, the individual will likely develop positively in childhood and adulthood. If the attachment is negative and insecure, life-span development will likely not be optimal. We will explore the concept of infant attachment in much greater detail later in this edition.

In Lorenz's view, imprinting needs to take place at a certain, very early time in the life of the animal, or else it will not take place. This point in time is called a critical period. A related concept is that of a sensitive period, and an example of this is the time during infancy when, according to Bowlby, attachment should occur in order to promote optimal development of social relationships.

Another theory that emphasizes biological foundations of development—evolutionary psychology—will be presented in the chapter on "Biological Beginnings," along with views on the role of heredity in development. In addition, we will examine a number of biological theories of aging in later chapters.

Contributions of ethological theory include a focus on the biological and evolutionary basis of development, and the use of careful observations in naturalistic settings. Criticisms include too much emphasis on biological foundations and a belief that the critical and sensitive period concepts might be too rigid.

ECOLOGICAL THEORY

While ethological theory stresses biological factors, ecological theory emphasizes environmental factors. One ecological theory that has important implications for understanding life-span development was created by Urie Bronfenbrenner (1917–2005). **Bronfenbrenner's ecological theory** (Bronfenbrenner, 1986, 2004; Bronfenbrenner & Morris, 1998, 2006) holds that development reflects the influence of several environmental systems. The theory identifies five environmental systems: microsystem, mesosystem, exosystem, macrosystem, and chronosystem (see Figure 14).

The *microsystem* is the setting in which the individual lives. These contexts include the person's family, peers, school, and neighborhood. It is in the microsystem that the most direct interactions with social agents take place—with parents, peers, and teachers, for example. The individual is not a passive recipient of experiences in these settings, but someone who helps to construct the settings.

The *mesosystem* involves relations between microsystems or connections between contexts. Examples are the relation of family experiences to school experiences, school experiences to religious experiences, and family experiences to peer experiences. For example, children whose parents have rejected them may have difficulty developing positive relations with teachers.

The *exosystem* consists of links between a social setting in which the individual does not have an active role and the individual's immediate context. For example, a husband's or child's experience at home may be influenced by a mother's experiences at work. The mother might receive a promotion that requires more travel, which might increase conflict with the husband and change patterns of interaction with the child.

The *macrosystem* involves the culture in which individuals live. Remember from earlier in the chapter that culture refers to the behavior patterns, beliefs, and all other products of a group of people that are passed on from generation to generation. Remember also that cross-cultural studies—the comparison of one culture with one or more other cultures—provide information about the generality of development.

The *chronosystem* consists of the patterning of environmental events and transitions over the life course, as well as sociohistorical circumstances. For example, divorce is one transition. Researchers have found that the negative effects of divorce on children often peak in the first year after the divorce (Hetherington, 1993, 2006). By two years

after the divorce, family interaction has become more stable. As an example of socio-historical circumstances, consider how career opportunities for women have increased since the 1960s.

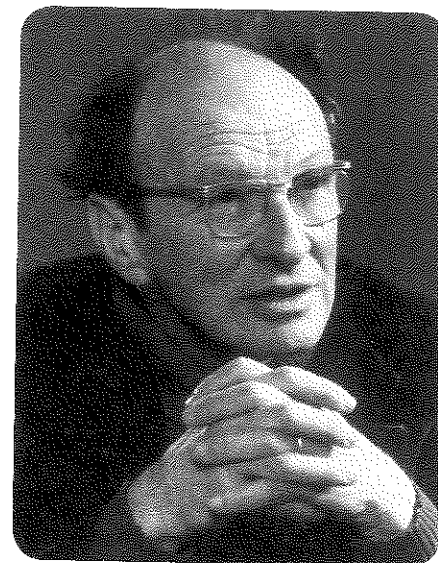
Bronfenbrenner (2004; Bronfenbrenner & Morris, 2006) subsequently added biological influences to his theory, describing it as a bioecological theory. Nonetheless, it is still dominated by ecological, environmental contexts.

Contributions of ecological theory include a systematic examination of macro and micro dimensions of environmental systems, and attention to connections between environmental systems. A further contribution of Bronfenbrenner's theory is an emphasis on a range of social contexts beyond the family, such as neighborhood, religion, school, and workplace, as influential in children's development (Gauvain & Perez, 2015). Criticisms include inadequate attention to biological factors, as well as too little emphasis on cognitive factors.

AN ECLECTIC THEORETICAL ORIENTATION

No single theory described in this chapter can explain entirely the rich complexity of life-span development, but each has contributed to our understanding of development. Psychoanalytic theory best explains the unconscious mind. Erikson's theory best describes the changes that occur during adult development. Piaget's, Vygotsky's, and the information-processing views provide the most complete description of cognitive development. The behavioral and social cognitive and ecological theories have been the most adept at examining the environmental determinants of development. The ethological theories have highlighted biology's role and the importance of sensitive periods in development.

In short, although theories are helpful guides, relying on a single theory to explain development is probably a mistake. This book instead takes an **eclectic theoretical orientation**, which does not follow any one theoretical approach but rather selects from each theory whatever is considered its best features. In this way, you can view the study of development as it actually exists—with different theorists making different assumptions, stressing different empirical problems, and using different strategies to discover information. Figure 15 compares the main theoretical perspectives in terms of how they view important issues in life-span development.



Urie Bronfenbrenner developed ecological theory, a perspective that is receiving increased attention today. His theory emphasizes the importance of both micro and macro dimensions of the environment in which the child lives.
Courtesy of Cornell University

eclectic theoretical orientation An orientation that does not follow any one theoretical approach but rather selects from each theory whatever is considered the best in it.

THEORY

ISSUES

	Continuity/discontinuity, early versus later experiences	Biological and environmental factors
Psychoanalytic	Discontinuity between stages—continuity between early experiences and later development; early experiences very important; later changes in development emphasized in Erikson's theory	Freud's biological determination interacting with early family experiences; Erikson's more balanced biological-cultural interaction perspective
Cognitive	Discontinuity between stages in Piaget's theory; continuity between early experiences and later development in Piaget's and Vygotsky's theories; no stages in Vygotsky's theory or information-processing theory	Piaget's emphasis on interaction and adaptation; environment provides the setting for cognitive structures to develop; information-processing view has not addressed this issue extensively but mainly emphasizes biological-environmental interaction
Behavioral and social cognitive	Continuity (no stages); experience at all points of development important	Environment viewed as the cause of behavior in both views
Ethological	Discontinuity but no stages; critical or sensitive periods emphasized; early experiences very important	Strong biological view
Ecological	Little attention to continuity/discontinuity; change emphasized more than stability	Strong environmental view

FIGURE 15
A COMPARISON OF THEORIES AND ISSUES IN LIFE-SPAN DEVELOPMENT

Review Connect Reflect

LG3 Describe the main theories of human development.

Review

- What are the four steps of the scientific method? How can theory and hypotheses be defined? What are two main psychoanalytic theories? What are some contributions and criticisms of the psychoanalytic theories?
- What are three main cognitive theories? What are some contributions and criticisms of the cognitive theories?
- What are two main behavioral and social cognitive theories? What are some contributions and criticisms of the behavioral and social cognitive theories?
- What is the nature of ethological theory? What are some contributions and criticisms of the theory?

- What characterizes ecological theory? What are some contributions and criticisms of the theory?
- What is an eclectic theoretical orientation?

Connect

- The beginning of this section started with a question about whether special care might be able to repair the harm inflicted by child neglect. How might this question be answered differently using the various theories outlined?

Reflect Your Own Personal Journey of Life

- Which of the life-span theories do you think best explains your own development? Why?

4 Research on Life-Span Development

LG4 Explain how research on life-span development is conducted.

Methods for
Collecting Data

Research Designs

Time Span of Research

Conducting
Ethical Research

Minimizing Bias

Science refines everyday
thinking.

—ALBERT EINSTEIN
German-born American physicist, 20th century

If they follow an eclectic orientation, how do scholars and researchers determine that one feature of a theory is somehow better than another? Through scientific research, the features of theories can be tested and refined (Smith & Davis, 2016).

Generally, research on life-span development is designed to test hypotheses, which in some cases are derived from the theories just described. Through research, theories are modified to reflect new data, and occasionally new theories arise. How are data about life-span development collected? What types of research designs are used to study life-span development? And what are some ethical considerations in conducting research on life-span development?

METHODS FOR COLLECTING DATA

Whether we are interested in studying attachment in infants, the cognitive skills of children, or social relationships in older adults, we can choose from several ways of collecting data (Salkind, 2017; Trochim, Donnelly, & Arora, 2016). Here we outline the measures most often used, beginning with observation.

Observation Scientific observation requires an important set of skills (Christensen, Johnson, & Turner, 2015). For observations to be effective, they have to be systematic. We have to have some idea of what we are looking for. We have to know whom we are observing, when and where we will observe, how the observations will be made, and how they will be recorded.

Where should we make our observations? We have two choices: the laboratory and the everyday world.

When we observe scientifically, we often need to control certain factors that determine behavior but are not the focus of our inquiry (Jackson, 2016; Stangor, 2015). For this reason, some research on life-span development is conducted in a **laboratory**, a controlled setting

laboratory A controlled setting in which many of the complex factors of the “real world” are removed.

where many of the complex factors of the “real world” are absent. For example, suppose you want to observe how children react when they see other people act aggressively. If you observe children in their homes or schools, you have no control over how much aggression the children observe, what kind of aggression they see, which people they see acting aggressively, or how other people treat the children. In contrast, if you observe the children in a laboratory, you can control these and other factors and therefore have more confidence about how to interpret your observations.

Laboratory research does have some drawbacks, however, including the following:

1. It is almost impossible to conduct research without the participants knowing they are being studied.
2. The laboratory setting is unnatural and therefore can cause the participants to behave unnaturally.
3. People who are willing to come to a university laboratory may not accurately represent groups from diverse cultural backgrounds.
4. People who are unfamiliar with university settings and with the idea of “helping science” may be intimidated by the laboratory setting.

Naturalistic observation provides insights that sometimes cannot be attained in the laboratory (Leedy & Ormrod, 2016). **Naturalistic observation** means observing behavior in real-world settings, making no effort to manipulate or control the situation. Life-span researchers conduct naturalistic observations at sporting events, child-care centers, work settings, malls, and other places people live in and frequent.

Naturalistic observation was used in one study that focused on conversations in a children’s science museum (Crowley & others, 2001). When visiting exhibits at the science museum, parents were far more likely to engage boys than girls in explanatory talk. This finding suggests a gender bias that encourages boys more than girls to be interested in science (see Figure 16).

Survey and Interview Sometimes the best and quickest way to get information about people is to ask them for it. One technique is to interview them directly. A related method is the survey (sometimes referred to as a questionnaire), which is especially useful when information from many people is needed. A standard set of questions is used to obtain peoples’ self-reported attitudes or beliefs about a particular topic. In a good survey, the questions are clear and unbiased, allowing respondents to answer unambiguously.

Surveys and interviews can be used to study topics ranging from religious beliefs to sexual habits to attitudes about gun control to beliefs about how to improve schools. Surveys and interviews may be conducted in person, over the telephone, and over the Internet.

One problem with surveys and interviews is the tendency of participants to answer questions in a way that they think is socially acceptable or desirable rather than to say what they truly think or feel (Madill, 2012). For example, on a survey or in an interview some individuals might say that they do not take drugs even though they do.

Standardized Test A **standardized test** has uniform procedures for administration and scoring. Many standardized tests allow a person’s performance to be compared with that of other individuals; thus they provide information about individual differences among people (Gregory, 2014). One example is the Stanford-Binet intelligence test, which will be discussed on more detail later. Your score on the Stanford-Binet test tells you how your performance compares with that of thousands of other people who have taken the test (Geisinger, 2012).

One criticism of standardized tests is that they assume a person’s behavior is consistent and stable, yet personality and intelligence—two primary targets of standardized testing—can

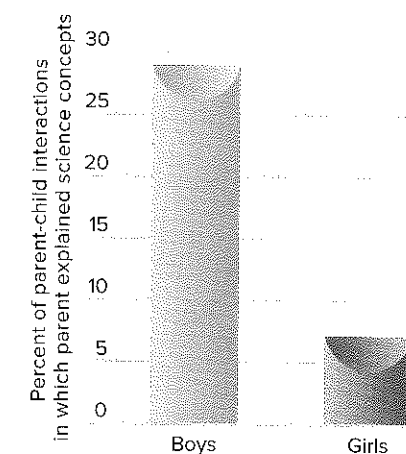


FIGURE 16
PARENTS’ EXPLANATIONS OF SCIENCE TO SONS AND DAUGHTERS AT A SCIENCE MUSEUM.

In a naturalistic observation study at a children’s science museum, parents were three times more likely to explain science to boys than to girls (Crowley & others, 2001). The gender difference occurred regardless of whether the father, the mother, or both parents were with the child, although the gender difference was greatest for fathers’ science explanations to sons and daughters.



What are some important strategies in conducting observational research with children?
© Philadelphia Inquirer/MCT/Landov Images

naturalistic observation Studies that involve observing behavior in real-world settings.

standardized test A test with uniform procedures for administration and scoring. Many standardized tests allow a person’s performance to be compared with the performance of other individuals.



Mahatma Gandhi was the spiritual leader of India in the middle of the twentieth century. Erik Erikson conducted an extensive case study of Gandhi's life to determine what contributed to his identity development. What are some limitations of the case study approach?
© Bettmann/Corbis

vary with the situation. For example, a person may perform poorly on a standardized intelligence test in an office setting but score much higher at home, where he or she is less anxious.

Case Study A case study is an in-depth look at a single individual. Case studies are performed mainly by mental health professionals when, for either practical or ethical reasons, the unique aspects of an individual's life cannot be duplicated and tested in other individuals. A case study provides information about one person's experiences; it may focus on nearly any aspect of the subject's life that helps the researcher understand the person's mind, behavior, or other attributes (Yin, 2012). A researcher may gather information for a case study from interviews and medical records. In later chapters, we discuss vivid case studies, such as that of Michael Rehbein, who had much of the left side of his brain removed at 7 years of age to end severe epileptic seizures.

A case study can provide a dramatic, in-depth portrayal of an individual's life, but we must be cau-

tious when generalizing from this information. The subject of a case study is unique, with a genetic makeup and personal history that no one else shares. In addition, case studies involve judgments of unknown reliability. Researchers who conduct case studies rarely check to see if other professionals agree with their observations or findings.

Physiological Measures Researchers are increasingly using physiological measures when they study development at different points in the life span (de Haan, 2015; Johnson, 2016; Kennedy & others, 2015; Zisner & Beauchaine, 2016). Hormone levels are increasingly used in developmental research.

Cortisol is a hormone produced by the adrenal gland that is linked to the body's stress level and has been measured in studies of temperament, emotional reactivity, and peer relations (Gunnar, Doom, & Esposito, 2015; Jacoby & others, 2016). Also, as puberty unfolds, the blood levels of certain hormones increase. To determine the nature of these hormonal changes, researchers analyze blood samples from adolescent volunteers (Susman & Dorn, 2013).

Another physiological measure that is increasingly being used is neuroimaging, especially *functional magnetic resonance imaging* (fMRI), in which electromagnetic waves are used to construct images of a person's brain tissue and biochemical activity (Casey, 2015; de Haan & Johnson, 2016; Galvan & Tottenham, 2016; Park & Farrell, 2016). Figure 17 compares the brain images of two adolescents—one a non-drinker and the other a heavy drinker—while they are engaged in a memory task.

Electroencephalography (EEG) is a physiological measure that has been used for many decades to monitor overall electrical activity in the brain (Reznick, 2013). Recent electroencephalograph research includes studies of infants' attention and memory (Rajan & Bell, 2015). In many chapters of this book, you will read about recent research on changes in the brain during prenatal development, infancy, childhood, adolescence, and aging.

Heart rate has been used as an indicator of infants' and children's development of perception, attention, and memory (Kim, Yang, & Lee, 2015). Further, heart rate has served as an index of different aspects of emotional development, such as inhibition and anxiety (Blood & others, 2015).

Researchers study eye movement to learn more about perceptual development and other developmental topics. Sophisticated eye-tracking equipment reveals detailed information about infants' perception, attention, and the development of autism (Johnson & Hannon, 2015).

Yet another dramatic change in physiological methods is the advancement in methods to assess the actual units of hereditary information—genes—in studies of biological influences

on development (Cho & Suh, 2016; Grigorenko & others, 2016; Moore, 2015). For example, in a later chapter you will read about the role of the ApoE4 gene in Alzheimer disease (Park & Farrell, 2016).

RESEARCH DESIGNS

When you are conducting research on life-span development, in addition to selecting a method for collecting data, you also need to choose a research design. There are three main types of research designs: descriptive, correlational, and experimental.

Descriptive Research All of the data-collection methods that we have discussed can be used in **descriptive research**, which aims to observe and record behavior. For example, a researcher might observe the extent to which people are altruistic or aggressive toward each other. By itself, descriptive research cannot prove what causes some phenomenon, but it can reveal important information about people's behavior (Leedy & Ormrod, 2016).

Correlational Research In contrast with descriptive research, correlational research goes beyond describing phenomena to provide information that will help us to predict how people will behave. In **correlational research**, the goal is to describe the strength of the relationship between two or more events or characteristics. The more strongly the two events are correlated (or related or associated), the more accurately we can predict one event from the other (Aron, Aron, & Coups, 2017).

For example, to find out whether children of permissive parents have less self-control than other children, you would need to carefully record observations of parents' permissiveness and their children's self-control. You might observe that the higher a parent was in permissiveness, the lower the child was in self-control. You would then analyze these data statistically to yield a numerical measure called a **correlation coefficient**, which is a number based on a statistical analysis that describes the degree of association between two variables. The correlation coefficient ranges from -1.00 to $+1.00$. A negative number means an inverse relation. In this example, you might find an inverse correlation between permissive parenting and children's self-control with a coefficient of, say, $-.30$. By contrast, you might find a positive correlation of $+.30$ between parental monitoring of children and children's self-control.

The higher the correlation coefficient (whether positive or negative), the stronger the association between the two variables. A correlation of 0 means that there is no association between the variables. A correlation of $-.40$ is stronger than a correlation of $+.20$ because we disregard whether the correlation is positive or negative in determining the strength of the correlation.

A caution is in order, however. Correlation does not equal causation (Heiman, 2014, 2015). The correlational finding just mentioned does not mean that permissive parenting necessarily causes low self-control in children. It could have that meaning, but it also could indicate that a child's lack of self-control caused the parents to throw up their arms in despair and give up trying to control the child. It also could mean that other factors, such as heredity or poverty, caused the correlation between permissive parenting and low self-control in children. Figure 18 illustrates these possible interpretations of correlational data.

Experimental Research To study causality, researchers turn to experimental research. An **experiment** is a carefully regulated procedure in which one or more factors believed to influence the behavior being studied are manipulated while all other factors are held constant. If the behavior under study changes when a factor is manipulated, we say that the manipulated factor has caused the behavior to change. In other words, the experiment has demonstrated cause and effect. The cause is the factor that was manipulated. The effect is the behavior that changed because of the manipulation. Nonexperimental research methods (descriptive and correlational research) cannot establish cause and effect because they do not involve manipulating factors in a controlled way.

Independent and Dependent Variables Experiments include two types of changeable factors, or variables: independent and dependent. An independent variable is a manipulated, influential, experimental factor. It is a potential cause. The label "independent"

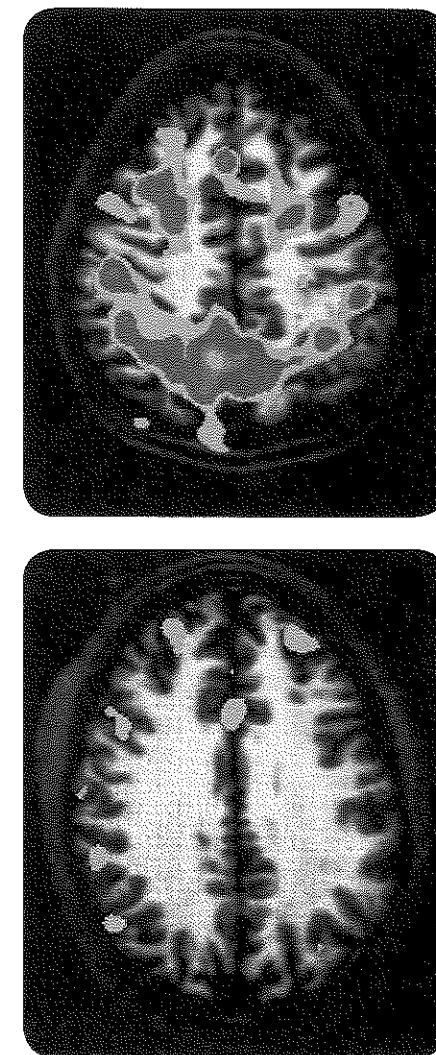


FIGURE 17
BRAIN IMAGING OF 15-YEAR-OLD ADOLESCENTS. These two brain images indicate how alcohol can influence the functioning of an adolescent's brain. Notice the pink and red coloring (which indicates effective brain functioning involving memory) in the brain of the 15-year-old non-drinker (top) while engaging in a memory task, and compare it with the lack of those colors in the brain of the 15-year-old heavy drinker (bottom) under the influence of alcohol.
Dr. Susan Tapert, University of California, San Diego

descriptive research Studies designed to observe and record behavior.

correlational research Research that attempts to determine the strength of the relationship between two or more events or characteristics.

correlation coefficient A number based on statistical analysis that is used to describe the degree of association between two variables.

developmental connection

Cognitive Neuroscience and Aging

The cognitive neuroscience of aging involves the study of links between the brain's development in older adults and changes in their cognitive skills. Connect to "Cognitive Development in Late Adulthood."

developmental connection

Gene $\times$ Environment (G $\times$ E) Interaction

Increasingly, researchers are exploring how the interaction of a specific gene and a specific aspect of the environment affects development. Connect to "Biological Beginnings."

case study An in-depth look at a single individual.

Observed Correlation: As permissive parenting increases, children's self-control decreases.

Possible explanations for this observed correlation

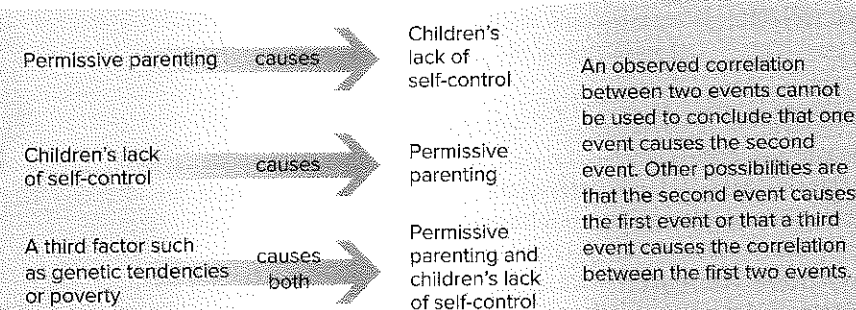


FIGURE 18
POSSIBLE EXPLANATIONS OF CORRELATIONAL DATA
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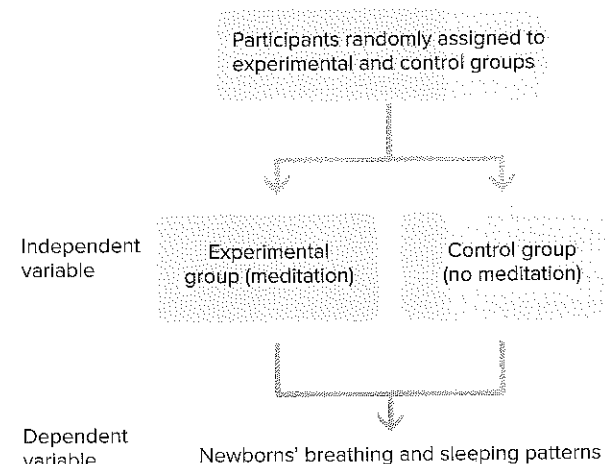


FIGURE 19
PRINCIPLES OF EXPERIMENTAL RESEARCH. Imagine that you decide to conduct an experimental study of the effects of meditation by pregnant women on their newborns' breathing and sleeping patterns. You would randomly assign pregnant women to experimental and control groups. The experimental-group women would engage in meditation over a specified number of sessions and weeks. The control group would not. Then, when the infants are born, you would assess their breathing and sleeping patterns. If the breathing and sleeping patterns of newborns whose mothers were in the experimental group are more positive than those of the control group, you would conclude that meditation caused the positive effects.

Experimental and Control Groups Experiments can involve one or more experimental groups and one or more control groups (Gravetter & Forzano, 2016). An experimental group is a group whose experience is manipulated. A control group is a comparison group that is as similar to the experimental group as possible and that is treated in every way like the experimental group except for the manipulated factor (independent variable). The control group serves as a baseline against which the effects of the manipulated condition can be compared.

Random assignment is an important principle for deciding whether each participant will be placed in the experimental group or in the control group. Random assignment means that researchers assign participants to experimental and control groups by chance. It reduces the likelihood that the experiment's results will be due to any preexisting differences between groups (Kantowitz, Roediger, & Elmes, 2015). In the example involving the effects of meditation by pregnant women on the breathing and sleeping patterns of their newborns, you would randomly assign half of the pregnant women to engage in meditation over a period of weeks (the experimental group) and the other half to not meditate over the same number of weeks (the control group). Figure 19 illustrates the nature of experimental research.

TIME SPAN OF RESEARCH

Researchers in life-span development have a special concern with studies that focus on the relation of age to some other variable. We have several options: Researchers can study different individuals of varying ages and compare them or they can study the same individuals as they age over time.

experiment A carefully regulated procedure in which one or more of the factors believed to influence the behavior being studied are manipulated while all other factors are held constant.

Cross-Sectional Approach The **cross-sectional approach** is a research strategy that simultaneously compares individuals of different ages. A typical cross-sectional study might include three groups of children: 5-year-olds, 8-year-olds, and 11-year-olds. Another study might include groups of 15-year-olds, 25-year-olds, and 45-year-olds. The groups can be compared with respect to a variety of dependent variables: IQ, memory, peer relations, attachment to parents, hormonal changes, and so on. All of this can be accomplished in a short time. In some studies, data are collected in a single day. Even in large-scale cross-sectional studies with hundreds of subjects, data collection does not usually take longer than several months to complete.

The main advantage of the cross-sectional study is that the researcher does not have to wait for the individuals to grow up or become older. Despite its efficiency, though, the cross-sectional approach has its drawbacks. It gives no information about how individuals change or about the stability of their characteristics. It can obscure the increases and decreases of development—the hills and valleys of growth and development. For example, a cross-sectional study of life satisfaction might reveal average increases and decreases, but it would not show how the life satisfaction of individual adults waxed and waned over the years. It also would not tell us whether the same adults who had positive or negative perceptions of life satisfaction in early adulthood maintained their relative degree of life satisfaction as they became middle-aged or older adults.

Longitudinal Approach The **longitudinal approach** is a research strategy in which the same individuals are studied over a period of time, usually several years or more. For example, in a longitudinal study of life satisfaction, the same adults might be assessed periodically over a 70-year time span—at the ages of 20, 35, 45, 65, and 90, for example.

Longitudinal studies provide a wealth of information about vital issues such as stability and change in development and the influence of early experience on later development, but they do have drawbacks (Cicchetti & Toth, 2015, 2016). They are expensive and time consuming. The longer the study lasts, the more participants drop out—they move, get sick, lose interest, and so forth. The participants who remain may be dissimilar to those who drop out, biasing the outcome of the study. Those individuals who remain in a longitudinal study over a number of years may be more responsible and conformity-oriented, for example, or they might lead more stable lives.

Cohort Effects A **cohort** is a group of people who are born at a similar point in history and share similar experiences as a result, such as living through the Vietnam War or growing up in the same city around the same time. These shared experiences may produce a range of differences among cohorts (Kadlecova & others, 2015; MacDonald & Stawski, 2016; Schaie, 2013, 2016). For example, people who were teenagers during the Great Depression are likely to differ from people who were teenagers during the booming 1990s in regard to their educational opportunities and economic status, how they were raised, and their attitudes toward sex and religion. In life-span development research, **cohort effects** are due to a person's time of birth, era, or generation but not to actual age.

Cohort effects are important because they can powerfully affect the dependent measures in a study ostensibly concerned with age (Carstensen & others, 2015; George & Ferraro, 2016; Karlsson & others, 2015; MacDonald & Stawski, 2016). Researchers have shown that it is especially important to be aware of cohort effects when assessing adult intelligence (Schaie, 2009, 2013, 2016). Individuals born at different points in time—such as 1920, 1940, and 1960—have had varying opportunities for education. Individuals born in earlier years had less access to education, and this fact may have a significant effect on how this cohort performs on intelligence tests. Some researchers have found that cross-sectional studies indicate more than 90 percent of cognitive decline in aging is due to a slowing of processing speed, whereas longitudinal studies reveal that 20 percent or less of cognitive decline is due to processing speed (MacDonald & others, 2003; MacDonald & Stawski, 2015, 2016; Stawski, Sliwinski, & Hofer, 2013).

A recent example of a cohort effect occurred in a study in which older adults assessed in 2013–2014 engaged in a higher level of abstract reasoning than their counterparts assessed two decades earlier in 1990–1993 (Gerstorf & others, 2015). Another study illustrated how even a 10-year difference in when people are born can produce differences in cognitive and health outcomes (Christensen & others, 2013). In this study, Danish cohorts born in 1905 and 1915 were compared when each cohort reached their nineties, with the 1915 cohort showing significantly better cognitive and health profiles.

developmental connection Intelligence

Cohort effects help to explain differences in the intelligence of people born at different points in time. Connect to “Physical and Cognitive Development in Middle Adulthood.”

cross-sectional approach A research strategy in which individuals of different ages are compared at one time.

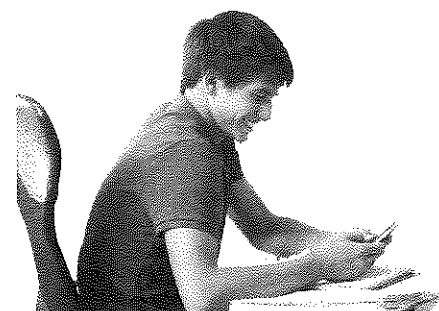
longitudinal approach A research strategy in which the same individuals are studied over a period of time, usually several years or more.

cohort effects Effects due to a person's time of birth, era, or generation rather than the person's actual age.



Cohort effects are due to a person's time of birth or generation but not actually to age. Think for a moment about growing up (a) during the Great Depression or (b) today. How might your development differ depending on which of these time frames has dominated your life? your parents' lives? your grandparents' lives?

(Left) George Grantham Bain Collection, Library of Congress, Reproduction Number #LC-USZ62-63966; (right) © Jamie Grill/Blend Images/Corbis RF



How are today's millennials experiencing youth differently from earlier generations? © Mark Bowden/E+/Getty Images RF



Cross-sectional studies can show how different cohorts respond, but they can confuse age changes and cohort effects. Longitudinal studies are effective in studying age changes but only within one cohort.

Various generations have been given labels by the popular culture. Figure 20 describes the labels given to various generations, their historical periods, and the reasons for these labels. Consider the following description of the current generation of youth and think about how they differ from earlier youth generations:

They are history's first "always connected" generation. Steeped in digital technology and social media, they treat their multi-tasking hand-held gadgets almost like a body part—for better or worse. More than 8 in 10 say they sleep with a cell phone glowing by the bed, poised to disgorge texts, phone calls, e-mails, songs, news, videos, games, and wake-up jingles. But sometimes convenience yields to temptation. Nearly two-thirds admit to texting while driving (Pew Research Center, 2010, p. 1).

So far we have discussed many aspects of research on life-span development, but where can you read about this research firsthand? Read *Connecting Through Research* to find out.

Generation	Historical Period	Reasons for Label
Millennials	Individuals born in 1980 and later	First generation to come of age and enter emerging adulthood (18 to 25 years of age) in the twenty-first century (the new millennium). Two main characteristics: (1) connection to technology, and (2) ethnic diversity.
Generation X	Individuals born between 1965 and 1980	Described as lacking an identity and savvy loners.
Baby Boomers	Individuals born between 1946 and 1964	Label used because this generation represents the spike in the number of babies born after World War II; the largest generation ever to enter late adulthood in the United States.
Silent Generation	Individuals born between 1928 and 1945	Children of the Great Depression and World War II; described as conformists and civic minded.

FIGURE 20
GENERATIONS, THEIR HISTORICAL PERIODS, AND CHARACTERISTICS

connecting through research

Where Is Life-Span Research Published?

Regardless of whether you pursue a career in life-span development, psychology, or some related scientific field, you can benefit by learning about the journal process. As a student, you might be required to look up original research in journals. As a parent, teacher, or nurse you might want to consult journals to obtain information that will help you understand and work more effectively with people. And, as an inquiring person, you might look up information in journals after you have heard or read something that piqued your curiosity.

A journal publishes scholarly and academic information, usually in a specific domain—like physics, math, sociology, or our current interest, life-span development. Scholars in these fields publish most of their research in journals, which are the source of core information in virtually every academic discipline.

An increasing number of journals publish information about life-span development. Among the leading journals in life-span development are *Developmental Psychology*, *Child Development*,

Pediatrics, *Pediatric Nursing*, *The Journals of Gerontology*, *Infant Behavior and Development*, *Journal of Research on Adolescence*, *Journal of Adult Development*, *Journal of Gerontological Nursing*, *Psychology and Aging*, *Human Development*, and many others. Also, a number of journals that do not focus solely on development publish articles on various aspects of human development. These journals include *Journal of Educational Psychology*, *Sex Roles*, *Journal of Cross-Cultural Research*, *Journal of Marriage and the Family*, and *Journal of Consulting and Clinical Psychology*.

Every journal has a board of experts who evaluate articles submitted for publication. Each submitted paper is accepted or rejected on the basis of such factors as its contribution to the field, methodological excellence, and clarity of writing. Some of the most prestigious journals reject as many as 80 to 90 percent of the articles submitted.

Journal articles are usually written by professionals in the specialized field of the journal's focus; therefore, they often contain technical language and terms specific to the discipline that are difficult for nonprofessionals to understand. Their structure often takes this format: abstract, introduction, method, results, discussion, and references.

The abstract is a brief summary that appears at the beginning of the article. The abstract lets readers quickly determine whether the

article is relevant to their interests. The introduction introduces the problem or issue that is being studied. It includes a concise review of research relevant to the topic, theoretical ties, and one or more hypotheses to be tested. The method section consists of a clear description of the subjects evaluated in the study, the measures used, and the procedures that were followed. The method section should be sufficiently clear and detailed so that by reading it another researcher could repeat or replicate the study. The results section reports the analysis of the data collected. In most cases, the results section includes statistical analyses that are difficult for nonprofessionals to understand. The discussion section describes the author's conclusions, inferences, and interpretation of what was found. Statements are usually made about whether the hypotheses presented in the introduction were supported, limitations of the study, and suggestions for future research. The last part of the journal article,

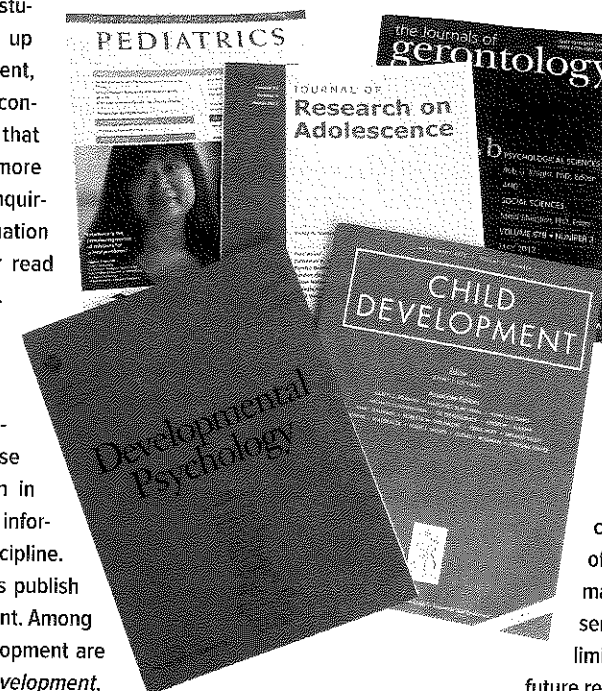
called references, includes bibliographic information for each source cited in the article. The references section is often a good resource for finding other articles relevant to a topic that interests you.

Where do you find journals such as those described above? Your college or university library likely has some of them, and some public libraries also carry journals. Online resources such as PsycINFO and PubMed, which can facilitate the search for journal articles, are available to students on many campuses.

The research published in the journals mentioned above shapes our lives. It not only informs the research of other life-span development researchers, but it also informs the practices of law and policy makers, physicians, educators, parents, and many others. In fact, much of what you will find that is new in this edition of this textbook comes directly from the research that can be found in the journals mentioned above.

Research journals are the core of information in virtually every academic discipline. Those shown here are among the increasing number of research journals that publish information about life-span development.

What are the main parts of a research article that presents findings from original research?



Research journals are the core of information in virtually every academic discipline. Those shown here are among the increasing number of research journals that publish information about life-span development. What are the main parts of a research article that presents findings from original research? © The McGraw-Hill Companies, Inc./Mark Dierker, photographer

CONDUCTING ETHICAL RESEARCH

Ethics in research may affect you personally if you ever serve as a participant in a study. In that event, you need to know your rights as a participant and the responsibilities of researchers to assure that these rights are safeguarded.

If you ever become a researcher in life-span development yourself, you will need an even deeper understanding of ethics. Even if you only carry out experimental projects in psychology courses, you must consider the rights of the participants in those projects (Jackson, 2016). A student might think, “I volunteer in a home for people with intellectual disabilities several hours per week. I can use the residents of the home in my study to see if a particular treatment helps improve their memory for everyday tasks.” But without proper permissions, the most well-meaning, kind, and considerate studies still violate the rights of the participants.

Today, proposed research at colleges and universities must pass the scrutiny of a research ethics committee before the research can be initiated (Leary, 2017). In addition, the American Psychological Association (APA) has developed ethics guidelines for its members. The code of ethics instructs psychologists to protect their participants from mental and physical harm. The participants’ best interests need to be kept foremost in the researcher’s mind. APA’s guidelines address four important issues:

1. **Informed consent.** All participants must know what their research participation will involve and what risks might develop. Even after informed consent is given, participants must retain the right to withdraw from the study at any time and for any reason.
2. **Confidentiality.** Researchers are responsible for keeping all of the data they gather on individuals completely confidential and, when possible, completely anonymous.
3. **Debriefing.** After the study has been completed, participants should be informed of its purpose and the methods that were used. In most cases, the experimenter also can inform participants in a general manner beforehand about the purpose of the research without leading participants to behave in a way they think that the experimenter is expecting.
4. **Deception.** In some circumstances, telling the participants beforehand what the research study is about substantially alters the participants’ behavior and invalidates the researcher’s data. In all cases of deception, however, the psychologist must ensure that the deception will not harm the participants and that the participants will be debriefed (told the complete nature of the study) as soon as possible after the study is completed.

MINIMIZING BIAS

Studies of life-span development are most useful when they are conducted without bias or prejudice toward any particular group of people. Of special concern is bias based on gender and bias based on culture or ethnicity.

Gender Bias For most of its existence, our society has had a strong gender bias, a preconceived notion about the abilities of women and men that prevented individuals from pursuing their own interests and achieving their potential (Hyde, 2014). Gender bias also has had a less obvious effect within the field of life-span development. For example, it is not unusual for conclusions to be drawn about females’ attitudes and behaviors from research conducted with males as the only participants.

Furthermore, when researchers find gender differences, their reports sometimes magnify those differences (Denmark & others, 1988). For example, a researcher might report that 74 percent of the men in a study had high achievement expectations versus only 67 percent of the women and go on to talk about the differences in some detail. In reality, this might be a rather small difference. It also might disappear if the study were repeated, or the study might have methodological problems that don’t allow such strong interpretations.

Pam Reid is a leading researcher who studies the effects of gender and ethnic bias on development. You can read about Dr. Reid’s interests in *Connecting with Careers*.

connecting with careers

Pam Reid, Educational and Developmental Psychologist

When she was a child, Pam Reid liked to play with chemistry sets. Reid majored in chemistry during college and wanted to become a doctor. However, when some of her friends signed up for a psychology class as an elective, she decided to take the course. She was intrigued by learning about how people think, behave, and develop—so much so that she changed her major to psychology. Reid went on to obtain her Ph.D. in psychology (American Psychological Association, 2003, p. 16).

For a number of years, Reid was a professor of education and psychology at the University of Michigan, where she also was a research scientist at the Institute for Research on Women and Gender. Her main focus has been on how children and adolescents develop social skills, with a special interest in the development of African American girls (Reid & Zalk, 2001). She has been involved in numerous community activities, including the creation of a math and technology enrichment program for middle-school girls. In 2004, Reid became provost and executive vice-president at Roosevelt University



Pam Reid (center), with students at the University of Saint Joseph. Courtesy of Dr. Pam Reid

in Chicago. From 2008 to 2015, she was president of the University of Saint Joseph in Hartford, Connecticut, before retiring to pursue other interests.

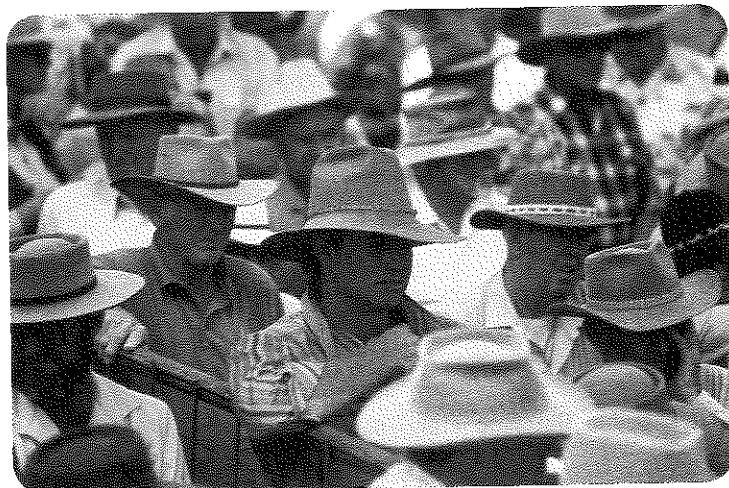
For more information about what educational psychologists do, see the *Careers in Life-Span Development* appendix.

Cultural and Ethnic Bias Today there is a growing realization that research on life-span development needs to include more people from diverse ethnic groups. Historically, people from ethnic minority groups (African American, Latino, Asian American, and Native American) were excluded from most research in the United States and simply thought of as variations from the norm or average. If minority individuals were included in samples and their scores didn’t fit the norm, they were viewed as confounds or “noise” in data and discounted. Given the fact that individuals from diverse ethnic groups were excluded from research on life-span development for so long, we might reasonably conclude that people’s real lives are perhaps more varied than research data have indicated in the past.

Researchers also have tended to overgeneralize about ethnic groups (Schaefer, 2015). **Ethnic gloss** is using an ethnic label such as *African American* or *Latino* in a superficial way that portrays an ethnic group as being more homogeneous than it really is (Trimble, 1988). For example, a researcher might describe a research sample like this: “The participants were 60 Latinos.” A more complete description of the group might be something like this: “The 60 Latino participants were Mexican Americans from low-income neighborhoods in the southwestern area of Los Angeles. Thirty-six were from homes in which Spanish is the dominant language spoken, 24 from homes in which English is the main language spoken. Thirty were born in the United States, 30 in Mexico. Twenty-eight described themselves as Mexican American, 14 as Mexican, 9 as American, 6 as Chicano, and 3 as Latino.” Ethnic gloss can cause researchers to obtain samples of ethnic groups that are not representative of the group’s diversity, which can lead to overgeneralization and stereotyping.

Ross Parke and Raymond Buriel (2006) described how research on ethnic minority children and their families has not been given adequate attention, especially in light of their significant rates of growth. Until recently, ethnic minority families were combined in the category “minority,” which masks important differences among ethnic groups as well as diversity within an ethnic group. When research has been conducted on ethnic groups, most often they are compared to non-Latino Whites to identify group differences. An assumption in two-group studies is that ethnic minority children have not advanced far enough to be the

ethnic gloss Using an ethnic label such as *African American* or *Latino* in a superficial way that portrays an ethnic group as being more homogeneous than it really is.



Look at these two photographs, one of all non-Latino White males, the other of a diverse group of females and males from different ethnic groups, including some non-Latino White males. Consider a topic in life-span development, such as parenting, love, or cultural values. If you were conducting research on this topic, might the results of the study differ depending on whether the participants in your study were the individuals in the photograph on the left or on the right?

(Left) © Anthony Cassidy/The Image Bank/Getty Images; (right) © Punchstock/Digital Vision RF

same as non-Latino White children and that this developmental lag contributes to ethnic minority children's problems. Recently, some researchers have replaced two-group studies with more in-depth examination of variations within a single ethnic group. For example, a researcher might study how parents in an ethnic group adapt to the challenges they face as a minority in U.S. society and how these experiences contribute to the goals they have for their children.

The continued growth of minority families in the United States in approaching decades will mainly be due to the immigration of Latino and Asian families. Researchers need "to take into account their acculturation level and generational status of parents and children," and consider how these factors might influence family processes and child outcomes (Parke & Buriel, 2006, p. 487). More attention also needs to be given to biculturalism because the complexity of diversity means that some children of color identify with two or more ethnic groups (Schwartz & others, 2015a, b). And language development research needs to focus more on second-language acquisition (usually English) and bilingualism and how they are linked to school achievement (Echevarria, Richards-Tutor, & Vogt, 2015; Herrera & Murry, 2015).

Review Connect Reflect

LG4 Explain how research on life-span development is conducted.

Review

- What methods do researchers use to collect data on life-span development?
- What research designs are used to study human development?
- How is research conducted on the time span of people's lives?
- What are researchers' ethical responsibilities to the people they study?
- How can gender, cultural, and ethnic bias affect the outcome of a research study?

Connect

- Earlier in the chapter, you read about normative age-graded influences,

normative history-graded influences, and nonnormative life events. Describe how these influences relate to what you just read about cohort effects.

Reflect Your Own Personal Journey of Life

- You and your parents grew up at different points in time. Consider some ways that you are different from your parents. Do you think some of your differences might be due to cohort effects? Explain.

topical connections *looking forward*

In the chapter on "Biological Beginnings," you will continue to learn about theory and research as you explore the biological underpinnings of life-span development. The influence of human evolution on development will be covered, including a discussion of natural selection and adaptive behavior. You will examine how the human genome works, the collaborative nature of genes, and how DNA plays a role in the person each of us becomes. You also will explore the challenges and choices people encounter when deciding to reproduce, including infertility treatments and adoption. And you will read in greater depth about the many sides of the age-old nature-nurture debate, focusing on the way heredity and environment interact.

reach your learning goals

Introduction

1 The Life-Span Perspective

LG1 Discuss the distinctive features of a life-span perspective on development.

The Importance of Studying Life-Span Development

Characteristics of the Life-Span Perspective

Some Contemporary Concerns

- Development is the pattern of change that begins at conception and continues through the human life span. It includes both growth and decline. Studying life-span development helps prepare us to take responsibility for children, gives us insight about our own lives, and gives us knowledge about what our lives will be like as we age.
- Life expectancy has increased dramatically in the last century but life span has remained virtually the same. The life-span perspective includes these basic conceptions: development is lifelong, multidimensional, multidirectional, and plastic; its study is multidisciplinary; it is contextual; it involves growth, maintenance, and regulation of loss; and it is a co-construction of biological, cultural, and individual factors. Three important sources of contextual influences are (1) normative age-graded influences, (2) normative history-graded influences, and (3) nonnormative life events.
- Health and well-being, parenting, education, sociocultural contexts and diversity, and social policy are all areas of contemporary concern that are closely tied to life-span development. Important dimensions of the sociocultural context include culture, ethnicity, socioeconomic status, and gender. There is increasing interest in social policy issues related to children and to older adults.

2 The Nature of Development

LG2 Identify the most important processes, periods, and issues in development.

Biological, Cognitive, and Socioemotional Processes

Periods of Development

- Three key categories of developmental processes are biological, cognitive, and socioemotional. Throughout development, there are extensive connections between these types of processes.
- The life span is commonly divided into the following development periods: prenatal, infancy, early childhood, middle and late childhood, adolescence, early adulthood, middle adulthood, and late adulthood. Recently, life-span developmentalists have described the human life span in terms of four ages, with a special focus on the third and fourth ages, as well as a distinction between the young-old and oldest-old. An important aspect of life-span development involves connections across periods of development.

The Significance of Age

- According to some experts on life-span development, too much emphasis is placed on chronological age. In studies covering adolescence through late adulthood, older people report the highest level of happiness. We often think of age only in terms of chronological age, but a full evaluation of age requires consideration of chronological, biological, psychological, and social age. Neugarten emphasizes that we are moving toward a society in which chronological age is only a weak predictor of development in adulthood.

Developmental Issues

- The nature-nurture issue focuses on the extent to which development is mainly influenced by nature (biological inheritance) or nurture (experience). The stability-change issue focuses on the degree to which we become older renditions of our early experience or develop into someone different from who we were earlier in development. A special aspect of the stability-change issue is the extent to which development is determined by early versus later experiences. Developmentalists describe development as continuous (gradual, or cumulative change) or as discontinuous (abrupt, or a sequence of stages). Most developmentalists recognize that extreme positions on the nature-nurture, stability-change, and continuity-discontinuity issues are unwise. Despite this consensus, there is still spirited debate on these issues.

3 Theories of Development

LG3 Describe the main theories of human development.

Psychoanalytic Theories

- The scientific method involves four main steps: (1) conceptualize a problem, (2) collect data, (3) analyze data, and (4) draw conclusions. Theory is often involved in conceptualizing a problem. A theory is a coherent set of interrelated ideas that helps to explain phenomena and to facilitate predictions. Hypotheses are specific assertions and predictions, often derived from theory, that can be tested. According to psychoanalytic theories, development primarily depends on the unconscious mind and is heavily couched in emotion. Freud argued that individuals go through five psychosexual stages. Erikson's theory emphasizes eight psychosocial stages of development: trust versus mistrust, autonomy versus shame and doubt, initiative versus guilt, industry versus inferiority, identity versus identity confusion, intimacy versus isolation, generativity versus stagnation, and integrity versus despair. Contributions of psychoanalytic theories include an emphasis on a developmental framework, family relationships, and unconscious aspects of the mind. Criticisms include a lack of scientific support, too much emphasis on sexual underpinnings, and an image of people that is too negative.

Cognitive Theories

- Three main cognitive theories are Piaget's, Vygotsky's, and information-processing. Cognitive theories emphasize thinking, reasoning, language, and other cognitive processes. Piaget proposed a cognitive developmental theory in which children use their cognition to adapt to their world. In Piaget's theory, children go through four cognitive stages: sensorimotor, preoperational, concrete operational, and formal operational. Vygotsky's sociocultural cognitive theory emphasizes how culture and social interaction guide cognitive development. The information-processing approach emphasizes that individuals manipulate information, monitor it, and strategize about it. Contributions of cognitive theories include an emphasis on the active construction of understanding and a positive view of development. Criticisms include giving too little attention to individual variations and skepticism about the pureness of Piaget's stages.

Behavioral and Social Cognitive Theories

- Two main behavioral and social cognitive theories are Skinner's operant conditioning and Bandura's social cognitive theory. In Skinner's operant conditioning, the consequences of a behavior produce changes in the probability of the behavior's occurrence. In Bandura's social cognitive theory, observational learning is a key aspect of life-span development. Bandura emphasizes reciprocal interactions among person/cognition, behavior, and environment. Contributions of the behavioral and social cognitive theories include an emphasis on scientific research and a focus on environmental factors. Criticisms include inadequate attention to developmental changes and, in Skinner's theory, too little attention to cognition.

Ethological Theory

- Ethology stresses that behavior is strongly influenced by biology, is tied to evolution, and is characterized by critical or sensitive periods. Contributions of ethological theory include a focus on the biological and evolutionary basis of development. Criticisms include rigidity of the concepts of critical and sensitive periods.

Ecological Theory

- Ecological theory emphasizes environmental contexts. Bronfenbrenner's environmental systems view of development proposes five environmental systems: microsystem, mesosystem, exosystem, macrosystem, and chronosystem. Contributions of the theory include a systematic examination of macro and micro dimensions of environmental systems and attention to

An Eclectic Theoretical Orientation

4 Research on Life-Span Development

Methods for Collecting Data

Research Designs

Time Span of Research

Conducting Ethical Research

Minimizing Bias

connections between them. Criticisms include inadequate attention to biological factors, as well as a lack of emphasis on cognitive factors.

- An eclectic theoretical orientation does not follow any one theoretical approach but rather selects from each theory whatever is considered the best in it.

LG4 Explain how research on life-span development is conducted.

- Methods for collecting data about life-span development include observation (in a laboratory or a naturalistic setting), survey (questionnaire) or interview, standardized test, case study, and physiological measures.
- Three main research designs are descriptive, correlational, and experimental. Descriptive research aims to observe and record behavior. In correlational research, the goal is to describe the strength of the relationship between two or more events or characteristics. Experimental research involves conducting an experiment, which can determine cause and effect. An independent variable is the manipulated, influential, experimental factor. A dependent variable is a factor that can change in an experiment, in response to changes in the independent variable. Experiments can involve one or more experimental groups and control groups. In random assignment, researchers assign participants to experimental and control groups by chance.
- When researchers decide about the time span of their research, they can conduct cross-sectional or longitudinal studies. Life-span researchers are especially concerned about cohort effects.
- Researchers' ethical responsibilities include seeking participants' informed consent, ensuring their confidentiality, debriefing them about the purpose and potential personal consequences of participating, and avoiding unnecessary deception of participants.
- Researchers need to guard against gender, cultural, and ethnic bias in research. Every effort should be made to make research equitable for both females and males. Individuals from varied ethnic backgrounds need to be included as participants in life-span research, and overgeneralization about diverse members within a group must be avoided.

key terms

biological processes
Bronfenbrenner's ecological theory
case study
cognitive processes
cohort effects
continuity-discontinuity issue
correlation coefficient
correlational research
cross-cultural studies
cross-sectional approach

culture
descriptive research
development
eclectic theoretical orientation
Erikson's theory
ethnic gloss
ethnicity
ethology
experiment
gender
hypotheses

information-processing theory
laboratory
life-span perspective
longitudinal approach
naturalistic observation
nature-nurture issue
nonnormative life events
normative age-graded influences
normative history-graded influences

Piaget's theory
psychoanalytic theories
scientific method
social cognitive theory
social policy
socioeconomic status (SES)
socioemotional processes
stability-change issue
standardized test
theory
Vygotsky's theory

key people

Paul Baltes
Albert Bandura
John Bowlby
Urie Bronfenbrenner

Raymond Buriel
Laura Carstensen
Marian Wright Edelman
Erik Erikson

Konrad Lorenz
Bernice Neugarten
Ross Parke
Jean Piaget

Robert Siegler
B. F. Skinner
Lev Vygotsky

appendix

Careers in Life-Span Development

The field of life-span development offers an amazing breadth of careers that can provide extremely satisfying work. College and university professors teach courses in many areas of life-span development. Teachers impart knowledge, understanding, and skills to children and adolescents. Counselors, clinical psychologists, nurses, and physicians help people of different ages to cope more effectively with their lives and improve their well-being.

These and many other careers related to life-span development offer many rewards. By working in the field of life-span development, you can help people to improve their lives, understand yourself and others better, possibly advance the state of knowledge in the field, and have an enjoyable time while you are doing these things. Many careers in life-span development pay reasonably well. For example, psychologists earn well above the median salary in the United States.

If you are considering a career in life-span development, would you prefer to work with infants? children? adolescents? older adults? As you go through this term, try to spend some time with people of different ages. Observe their behavior. Talk with them about their lives. Think about whether you would like to work with people of this age in your life's work.

In addition, to find out about careers in life-span development you might talk with people who work in various jobs. For example, if you have some interest in becoming a school counselor, call a school, ask to speak with a counselor, and set up an appointment to discuss the counselor's career and work. If you have an interest in becoming a nurse, call the nursing department at a hospital and set up an appointment to speak with the nursing coordinator about a nursing career.

Another way of exploring careers in life-span development is to work in a related job while you are in college. Many colleges and universities offer internships or other work experiences for students who major in specific fields. Course credit or pay is given for some of these jobs. Take advantage of these opportunities. They can help you decide if this is the right career for you, and they can help you get into graduate school, if you decide you want to go.

An advanced degree is not absolutely necessary for some careers in life-span development, but usually you can considerably expand your opportunities (and income) by obtaining a graduate degree. If you think you might want to go to graduate school, talk with one or more professors about your interests, keep a high grade-point

average, take appropriate courses, and realize that you likely will need to take the Graduate Record Examination at some point.

In the upcoming sections, we will profile a number of careers in four areas: education/research; clinical/counseling; medical/nursing/physical development; and families/relationships. These are not the only career options in life-span development, but the profiles should give you an idea of the range of opportunities available. For each career, we will describe the work and address the amount of education required and the nature of the training. We have provided chapter titles after some entries to help you find *Connecting with Careers*, the career profiles of people who hold some of these positions. The Web site for this book gives more detailed information about these careers in life-span development.

Education/Research

Numerous careers in life-span development involve education or research. The opportunities range from college professor to preschool teacher to school psychologist.

College/University Professor

Professors teach courses in life-span development at many types of institutions, including research universities with master's or Ph.D. programs in life-span development, four-year colleges with no graduate programs, and community colleges. The courses in life-span development are offered in many different programs and schools, including psychology, education, nursing, child and family studies, social work, and medicine. In addition to teaching at the undergraduate or graduate level (or both), professors may conduct research, advise students or direct their research, and serve on college or university committees. Research is part of a professor's job description at most universities with master's and Ph.D. programs, but some college professors do not conduct research and focus instead on teaching.

Teaching life-span development at a college or university almost always requires a Ph.D. or master's degree. Obtaining a Ph.D. usually takes four to six years of graduate work; a master's degree requires approximately two years. The training involves taking graduate courses, learning to conduct research, and attending and presenting papers at professional meetings. Many graduate students work as teaching or research assistants for professors in an apprenticeship relationship that helps them to become competent teachers and

researchers. **Read the profiles of professors in the "Socioemotional Development in Middle Adulthood" and "Socioemotional Development in Late Adulthood" chapters.**

Researcher

Some individuals in the field of life-span development work in research positions. They might work for a university, a government agency such as the National Institute of Mental Health, or private industry. They generate research ideas, plan studies, carry out the research, and usually attempt to publish the research in a scientific journal. A researcher often works in collaboration with other researchers. One researcher might spend much of his or her time in a laboratory; another researcher might work in the field, such as in schools, hospitals, and so on. Most researchers in life-span development have either a master's or a Ph.D.

Elementary or Secondary School Teacher

Elementary and secondary school teachers teach one or more subject areas, preparing the curriculum, giving tests, assigning grades, monitoring students' progress, conducting parent-teacher conferences, and attending workshops. Becoming an elementary or secondary school teacher requires a minimum of an undergraduate degree. The training involves taking a wide range of courses with a major or concentration in education as well as completing supervised practice teaching.

Exceptional Children (Special Education) Teacher

Teachers of exceptional children spend concentrated time with children who have a disability such as ADHD, intellectual disabilities, or cerebral palsy, or with children who are gifted. Usually some of their work occurs outside of the students' regular classroom and some of it inside the students' regular classroom. A teacher of exceptional children works closely with the student's regular classroom teacher and parents to create the best educational program for the student. Teachers of exceptional children often continue their education after obtaining their undergraduate degree and attain a master's degree.

Early Childhood Educator

Early childhood educators work on college faculties and usually teach in community colleges that award an associate degree in early childhood education. They have a minimum of a master's degree in

their field. In graduate school, they take courses in early childhood education and receive supervisory training in child-care or early childhood programs.

Preschool/Kindergarten Teacher

Preschool teachers teach mainly 4-year-old children, and kindergarten teachers primarily teach 5-year-old children. They usually have an undergraduate degree in education, specializing in early childhood education. State certification to become a preschool or kindergarten teacher usually is required.

Family and Consumer Science Educator

Family and consumer science educators may specialize in early childhood education or instruct middle and high school students about such matters as nutrition, interpersonal relationships, human sexuality, parenting, and human development. Hundreds of colleges and universities throughout the United States offer two- and four-year degree programs in family and consumer science. These programs usually require an internship. Additional education courses may be needed to obtain a teaching certificate. Some family and consumer science educators go on to graduate school for further training, which provides a background for possible jobs in college teaching or research. **Read a profile of a family and consumer science educator in the "Physical and Cognitive Development in Adolescence" chapter.**

Educational Psychologist

Educational psychologists most often teach in a college or university and conduct research in various areas of educational psychology such as learning, motivation, classroom management, and assessment. They help train students for positions in educational psychology, school psychology, and teaching. Most educational psychologists have a doctorate in education, which takes four to six years of graduate work. **Read a profile of an educational psychologist in the "Introduction" chapter.**

School Psychologist

School psychologists focus on improving the psychological and intellectual well-being of elementary, middle/junior, and high school students. They give psychological tests, interview students and their parents, consult with teachers, and may provide counseling to students and their families. They may work in a centralized office in a school district or in one or more schools.

School psychologists usually have a master's or doctoral degree in school psychology. In graduate school, they take courses in counseling, assessment, learning, and other areas of education and psychology.

Gerontologist

Gerontologists usually work in research in some branch of the federal or state government. They specialize in the study of aging with a particular

focus on government programs for older adults, social policy, and delivery of services to older adults. In their research, gerontologists define problems to be studied, collect data, interpret the results, and make recommendations for social policy. Most gerontologists have a master's or doctoral degree and have taken a concentration of coursework in adult development and aging.

Clinical/Counseling

A wide variety of clinical and counseling jobs are linked with life-span development. These range from child clinical psychologist to adolescent drug counselor to geriatric psychiatrist.

Clinical Psychologist

Clinical psychologists seek to help people with psychological problems. They work in a variety of settings, including colleges and universities, clinics, medical schools, and private practice. Some clinical psychologists only conduct psychotherapy; others do psychological assessment and psychotherapy; some also do research. Clinical psychologists may specialize in a particular age group, such as children (child clinical psychologist) or older adults (often referred to as a geropsychologist).

Clinical psychologists have either a Ph.D. (which involves clinical and research training) or a Psy.D. degree (which only involves clinical training). This graduate training usually takes five to seven years and includes courses in clinical psychology and a one-year supervised internship in an accredited setting toward the end of the training. Many geropsychologists pursue a year or two of postdoctoral training. Most states require clinical psychologists to pass a test in order to become licensed in the state and to call themselves clinical psychologists. **Read a profile of a clinical psychologist in the "Prenatal Development and Birth" chapter.**

Psychiatrist

Psychiatrists obtain a medical degree and then do a residency in psychiatry. Medical school takes approximately four years and the psychiatry residency another three to four years. Unlike most psychologists (who do not go to medical school), psychiatrists can administer drugs to clients. (Recently, several states gave clinical psychologists the right to prescribe drugs.)

Like clinical psychologists, psychiatrists might specialize in working with children (child psychiatry) or with older adults (geriatric psychiatry). Psychiatrists might work in medical schools in teaching and research roles, in a medical clinic or hospital, or in private practice. In addition to administering drugs to help improve the lives of people with psychological problems, psychiatrists also may conduct psychotherapy. **Read a profile of a child psychiatrist in the "Socioemotional Development in Middle and Late Childhood" chapter.**

Counseling Psychologist

Counseling psychologists work in the same settings as clinical psychologists and may do psychotherapy, teach, or conduct research. Many counseling psychologists do not do therapy with individuals who have severe mental disorders, such as schizophrenia.

Counseling psychologists go through much the same training as clinical psychologists, although in a graduate program in counseling rather than clinical psychology. Counseling psychologists have either a master's degree or a doctoral degree. They also must go through a licensing procedure. One type of master's degree in counseling leads to the designation of licensed professional counselor.

School Counselor

School counselors help students cope with adjustment problems, identify their abilities and interests, develop academic plans, and explore career options. The focus of the job depends on the age of the children. High school counselors advise students about vocational and technical training and admissions requirements for college, as well as about taking entrance exams, applying for financial aid, and choosing a major. Elementary school counselors mainly counsel students about social and personal problems. They may observe children in the classroom and at play as part of their work. School counselors may work with students individually, in small groups, or even in a classroom. They often consult with parents, teachers, and school administrators when trying to help students. School counselors usually have a master's degree in counseling.

Career Counselor

Career counselors help individuals to identify their best career options and guide them in applying for jobs. They may work in private industry or at a college or university. They usually interview individuals and give them vocational and/or psychological tests to identify appropriate careers that fit their interests and abilities. Sometimes they help individuals to create résumés or conduct mock interviews to help them feel comfortable in a job interview. They might arrange and promote job fairs or other recruiting events to help individuals obtain jobs.

Rehabilitation Counselor

Rehabilitation counselors work with individuals to identify career options, develop adjustment and coping skills to maximize independence, and resolve problems created by a disability. A master's degree in rehabilitation counseling or guidance or counseling psychology is generally considered the minimum educational requirement.

Social Worker

Many social workers are involved in helping people with social or economic problems. They may

investigate, evaluate, and attempt to rectify reported cases of abuse, neglect, endangerment, or domestic disputes. They may intervene in families and provide counseling and referral services to individuals and families. Some social workers specialize in a certain area. For example, a medical social worker might coordinate support services to people with a long-term disability; family-care social workers often work with families with children or an older adult who needs support services. Social workers often work for publicly funded agencies at the city, state, or national level, although increasingly they work in the private sector in areas such as drug rehabilitation and family counseling.

Social workers have a minimum of an undergraduate degree from a school of social work that includes coursework in sociology and psychology. Some social workers also have a master's or doctoral degree. For example, medical social workers have a master's degree in social work (M.S.W.) and complete graduate coursework and supervised clinical experiences in medical settings.

Drug Counselor

Drug counselors provide counseling to individuals with drug-abuse problems. Some drug counselors specialize in working with adolescents or older adults. They may work on an individual basis with a substance abuser or conduct group therapy. They may work in private practice, with a state or federal government agency, for a company, or in a hospital.

At a minimum, drug counselors complete an associate's or certificate program. Many have an undergraduate degree in substance-abuse counseling, and some have master's and doctoral degrees. Most states provide a certification procedure for obtaining a license to practice drug counseling.

Medical/Nursing/Physical Development

This third main area of careers in life-span development includes a wide range of choices in the medical and nursing areas, as well as jobs pertaining to improving some aspect of a person's physical development.

Obstetrician/Gynecologist

An obstetrician/gynecologist prescribes prenatal and postnatal care, performs deliveries in maternity cases, and treats diseases and injuries of the female reproductive system. Becoming an obstetrician/gynecologist requires a medical degree plus three to five years of residency in obstetrics/gynecology. Obstetricians may work in private practice, a medical clinic, a hospital, or a medical school.

Pediatrician

A pediatrician monitors infants' and children's health, works to prevent disease or injury, helps children attain optimal health, and treats children

with health problems. Pediatricians have earned a medical degree and completed a three- to five-year residency in pediatrics.

Pediatricians may work in private practice or at a medical clinic, a hospital, or a medical school. Many pediatricians on the faculties of medical schools also teach and conduct research on children's health and diseases. **Read the profile of a pediatrician in the "Physical Development in Infancy" chapter.**

Geriatric Physician

Geriatric physicians diagnose medical problems of older adults, evaluate treatment options, and make recommendations for nursing care or other arrangements. They have a medical degree and have specialized in geriatric medicine by doing a three- to five-year residency. Like other doctors, geriatric physicians may work in private practice or at a medical clinic, a hospital, or a medical school. Those in medical school settings may not only treat older adults but also teach future physicians and conduct research.

Neonatal Nurse

Neonatal nurses deliver care to newborn infants. They may work with infants born under normal circumstances or premature and critically ill neonates. A minimum of an undergraduate degree in nursing with a specialization in the newborn is required. This training involves coursework in nursing and the biological sciences, as well as supervised clinical experiences.

Nurse-Midwife

A nurse-midwife formulates and provides comprehensive care to expectant mothers as they prepare to give birth, guides them through the birth process, and cares for them after the birth. The nurse-midwife also may provide care to the newborn, counsel parents on the infant's development and parenting, and provide guidance about health practices. Becoming a nurse-midwife generally requires an undergraduate degree from a school of nursing. A nurse-midwife most often works in a hospital setting. **Read the profile of a perinatal nurse in the "Prenatal Development and Birth" chapter.**

Pediatric Nurse

Pediatric nurses monitor infants' and children's health, work to prevent disease or injury, and help children attain optimal health. They may work in hospitals, schools of nursing, or with pediatricians in private practice or at a medical clinic.

Pediatric nurses have a degree in nursing that takes two to five years to complete. They take courses in biological sciences, nursing care, and pediatrics, usually in a school of nursing. They also undergo supervised clinical experiences in medical settings. Some pediatric nurses go on to earn a master's or doctoral degree in pediatric nursing.

Geriatric Nurse

Geriatric nurses seek to prevent or intervene in the chronic or acute health problems of older adults. They may work in hospitals, nursing homes, schools of nursing, or with geriatric medical specialists or psychiatrists in a medical clinic or in private practice. Like pediatric nurses, geriatric nurses take courses in a school of nursing and obtain a degree in nursing, which takes from two to five years. They complete courses in biological sciences, nursing care, and mental health as well as supervised clinical training in geriatric settings. They also may obtain a master's or doctoral degree in their specialty. **Read a profile of a geriatric nurse in the "Physical Development in Late Adulthood" chapter.**

Physical Therapist

Physical therapists work with individuals who have a physical problem due to disease or injury to help them function as competently as possible. They may consult with other professionals and coordinate services for the individual. Many physical therapists work with people of all ages, although some specialize in working with a specific age group, such as children or older adults.

Physical therapists usually have an undergraduate degree in physical therapy and are licensed by a state. They take courses and experience supervised training in physical therapy.

Occupational Therapist

Occupational therapists initiate the evaluation of clients with various impairments and manage their treatment. They help people regain, develop, and build skills that are important for independent functioning, health, well-being, security, and happiness. An "Occupational Therapist Registered" (OTR) must have a master's and/or doctoral degree with education ranging from two to six years. Training includes occupational therapy courses in a specialized program. National certification is required, and licensing/registration is required in some states.

Therapeutic/Recreation Therapist

Therapeutic/recreation therapists maintain or improve the quality of life for people with special needs through intervention, leisure education, and recreation. They work in hospitals, rehabilitation centers, local government agencies, at-risk youth programs, and other settings. Becoming a therapeutic/recreation therapist requires an undergraduate degree with coursework in leisure studies and a concentration in therapeutic recreation. National certification is usually required. Coursework in anatomy, special education, and psychology is beneficial.

Audiologist

Audiologists assess and identify the presence and severity of hearing loss, as well as problems in balance. They may work in a medical clinic, with a physician in private practice, in a hospital, or in a medical school.

An audiologist completes coursework and supervised training to earn a minimum of an undergraduate degree in hearing science. Some audiologists also go on to obtain a master's or doctoral degree.

Speech Therapist

Speech therapists identify, assess, and treat speech and language problems. They may work with physicians, psychologists, social workers, and other health care professionals in a team approach to help individuals with physical or psychological problems that involve speech and language. Some speech therapists specialize in working with individuals of a particular age or people with a particular type of speech disorder. Speech therapists have a minimum of an undergraduate degree in speech and hearing science or in a type of communication disorder. They may work in private practice, hospitals and medical schools, and government agencies.

Genetic Counselor

Genetic counselors identify and counsel families at risk for genetic disorders. They work as members of a health care team, providing information and support to families with members who have genetic defects or disorders or are at risk for a variety of inherited conditions. They also serve as educators and resource people for other health care professionals and the public. Nearly half of genetic counselors work in university medical centers; one-fourth work in private hospital settings.

Genetic counselors have specialized graduate degrees and experience in medical genetics and counseling. Most enter the field after majoring in undergraduate school in such disciplines as biology,

genetics, psychology, nursing, public health, or social work. **Read a profile of a genetic counselor in the "Biological Beginnings" chapter.**

Families/Relationships

A number of careers and jobs related to life-span development focus on working with families and addressing relationship problems. These range from home health aide to marriage and family therapist.

Home Health Aide

A home health aide provides services to older adults in the older adults' homes, helping them with basic self-care tasks. No higher education is required for this position. There is brief training by an agency.

Child Welfare Worker

Child protective services in each state employ child welfare workers. They protect children's rights, evaluate any maltreatment, and may have children removed from their homes if necessary. A child social worker has a minimum of an undergraduate degree in social work.

Child Life Specialist

Child life specialists work with children and their families when the child needs to be hospitalized. They monitor the child's activities, seek to reduce the child's stress, and help the child to cope and to enjoy the hospital experience as much as possible. Child life specialists may provide parent education and develop individualized treatment plans based on an assessment of the child's development, temperament, medical plan, and available social supports. Child life specialists have an undergraduate degree. They have taken courses in child development and

education and usually completed additional courses in a child life program. **Read a profile of a child life specialist in the "Physical and Cognitive Development in Middle and Late Childhood" chapter.**

Marriage and Family Therapist

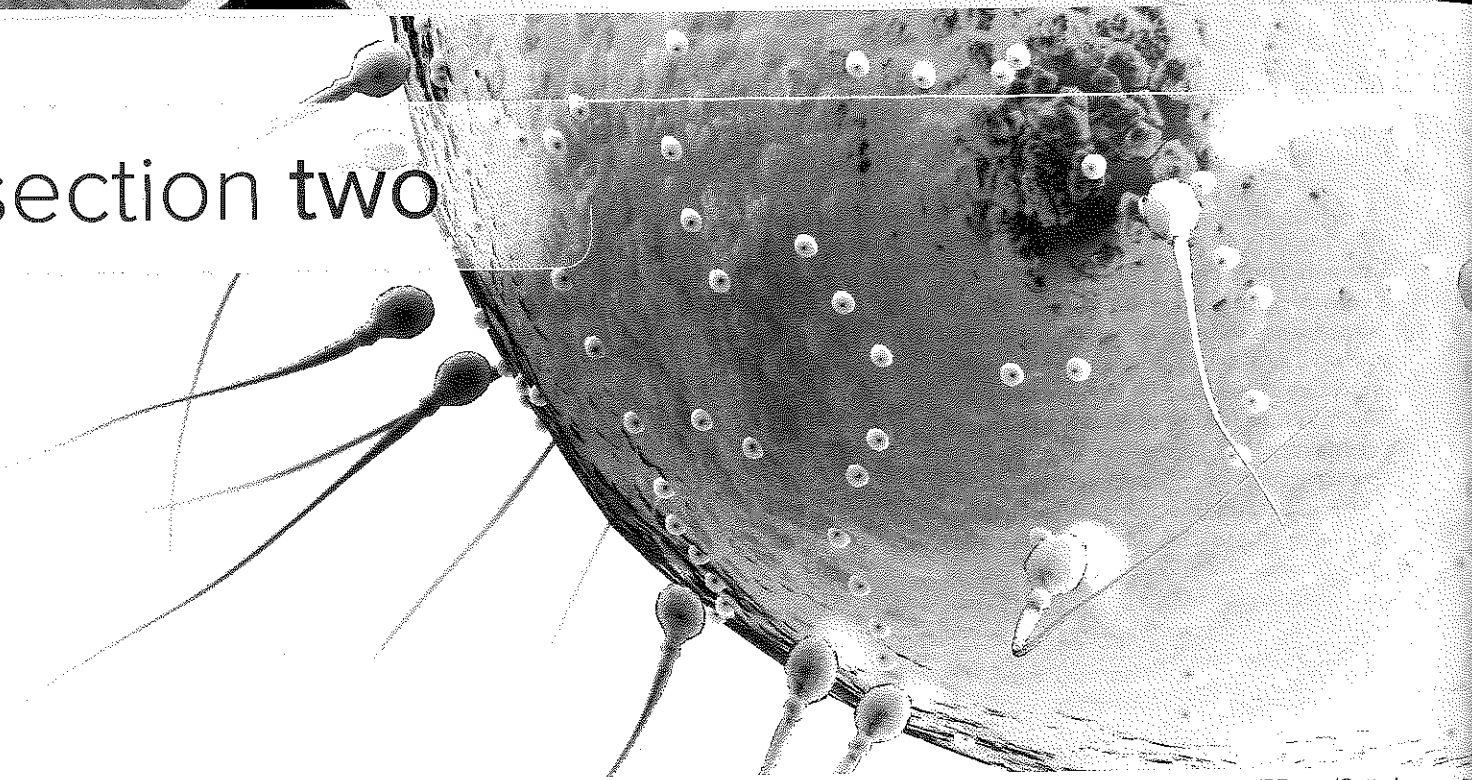
Marriage and family therapists work on the principle that many individuals who have psychological problems benefit when psychotherapy is provided in the context of a marital or family relationship. Marriage and family therapists may provide marital therapy, couple therapy to individuals in a relationship who are not married, and family therapy to two or more members of a family.

Marriage and family therapists have a master's or a doctoral degree. They complete a training program in graduate school similar to a clinical psychologist's but with the focus on marital and family relationships. In most states, it is necessary to go through a licensing procedure to practice marital and family therapy. **Read the profile of a marriage and family therapist in the "Socioemotional Development in Early Childhood" chapter.**

Further Careers

These are only a handful of careers that knowledge of developmental psychology can prepare you for. The *Connecting with Careers* profiles highlight additional careers, including an infant assessment specialist, child-care director, toy designer, health psychologist, college/career counselor, parent counselor, pastoral counselor, association director, and home hospice nurse. *What other careers can you think of that require a knowledge of human development?*

section two



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*There are one hundred and ninety-three living species of monkeys and apes. One hundred and ninety-two of them are covered with hair. The exception is the naked ape, self-named *Homo sapiens*.*

—**DESMOND MORRIS**
British zoologist, 20th century

Beginnings

The rhythm and meaning of life involve beginnings. Questions are raised about how, from so simple a beginning, endless forms develop, grow, and mature. What was this organism, what is this organism, and what will this organism be? In this section, you will read two chapters: “Biological Beginnings” and “Prenatal Development and Birth.”

chapter 2

BIOLOGICAL BEGINNINGS

chapter outline

1 The Evolutionary Perspective

Learning Goal 1 Discuss the evolutionary perspective on life-span development.

Natural Selection and Adaptive Behavior
Evolutionary Psychology

2 Genetic Foundations of Development

Learning Goal 2 Describe what genes are and how they influence human development.

The Collaborative Gene
Genes and Chromosomes
Genetic Principles
Chromosomal and Gene-Linked Abnormalities

3 Reproductive Challenges and Choices

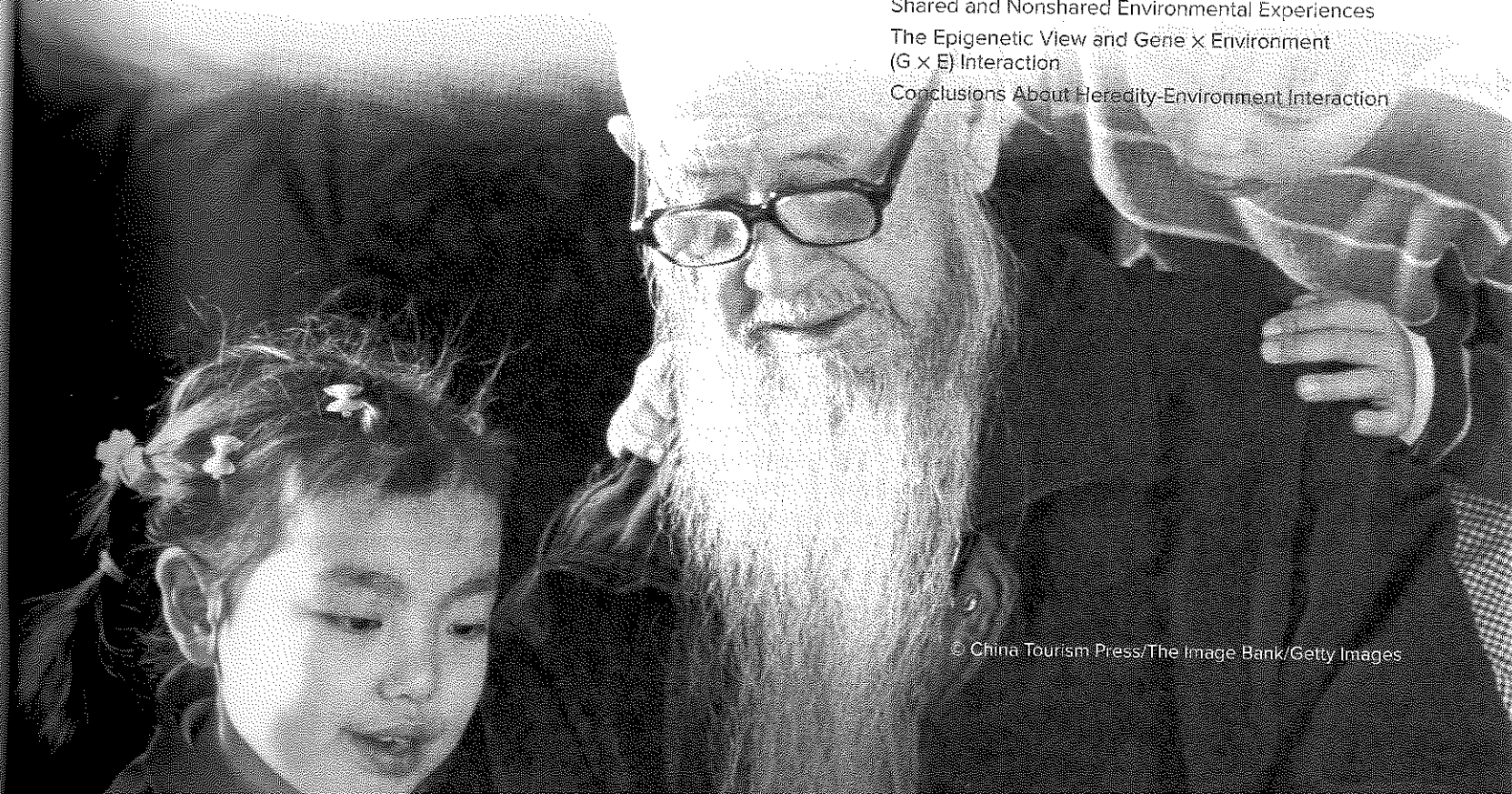
Learning Goal 3 Identify some important reproductive challenges and choices.

Prenatal Diagnostic Tests
Infertility and Reproductive Technology
Adoption

4 Heredity-Environment Interaction: The Nature-Nurture Debate

Learning Goal 4 Explain some of the ways that heredity and environment interact to produce individual differences in development.

Behavior Genetics
Heredity-Environment Correlations
Shared and Nonshared Environmental Experiences
The Epigenetic View and Gene x Environment (G x E) Interaction
Conclusions About Heredity-Environment Interaction



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Jim Springer and Jim Lewis are identical twins. They were separated at 4 weeks of age and did not see each other again until they were 39 years old. Both worked as part-time deputy sheriffs, vacationed in Florida, drove Chevrolets, had dogs named Toy, and married and divorced women named Betty. One twin named his son James Allan, and the other named his son James Alan. Both liked math but not spelling, enjoyed carpentry and mechanical drawing, chewed their fingernails down to the nubs, had almost identical drinking and smoking habits, had hemorrhoids, put on 10 pounds at about the same point in development, first suffered headaches at the age of 18, and had similar sleep patterns.

Jim and Jim do have some differences. One wears his hair over his forehead, the other slicks it back and has sideburns. One expresses himself best orally; the other is more proficient in writing. But, for the most part, their profiles are remarkably similar.

Another pair of identical twins, Daphne and Barbara, are called the “giggle sisters” because after being reunited they were always making each other laugh. A thorough search of their adoptive families’ histories revealed no gigglers. The giggle sisters ignored stress, avoided conflict and controversy whenever possible, and showed no interest in politics.

Jim and Jim and the giggle sisters were part of the Minnesota Study of Twins Reared Apart, directed by Thomas Bouchard and his colleagues. The study brings identical twins (identical genetically because they come from the same fertilized egg) and fraternal twins (who come from different fertilized eggs) from all over the world to Minneapolis to investigate their lives. There the twins complete personality and intelligence tests, and they provide detailed medical histories, including information about diet and smoking, exercise habits, chest X-rays, heart stress tests, and EEGs. The twins are asked more than 15,000 questions about their family and childhood, personal interests, vocational orientation, values, and aesthetic judgments (Bouchard & others, 1990).

topical connections *looking back*

The “Introduction” chapter introduced the field of life-span development, including discussion of three key categories of developmental processes: biological, cognitive, and socio-emotional. In this chapter, we lay the foundation of the biological aspects of development. Biological processes, guided by genes, influence an individual’s development in every period of the human life span. The forthcoming discussion of genetics and the previous discussion of theories (psychoanalytic, cognitive, behavioral and social cognitive, ethological, and ecological) provide a knowledge base from which to examine one of life-span development’s major issues and debates—how strongly development is influenced by heredity (nature) and the environment (nurture).

When genetically identical twins who were separated as infants show such striking similarities in their tastes and habits and choices, can we conclude that their genes must have caused the development of those tastes and habits and choices? Other possible causes need to be considered. The twins shared not only the same genes but also some experiences. Some of the separated twins lived together for several months prior to their adoption; some of the twins had been reunited prior to testing (in some cases, many years earlier); adoption agencies often place twins in similar homes; and even strangers who spend several hours together and start comparing their lives are likely to come up with some coincidental similarities (Joseph, 2006). The Minnesota study of identical twins points to both the importance of the genetic basis of human development and the need for further research on genetic and environmental factors (Lykken, 2001). We will discuss twin studies in more detail in the section on behavior genetics later in this chapter.

preview

The examples of Jim and Jim and the giggle sisters stimulate us to think about our genetic heritage and the biological foundations of our existence. However, organisms are not like billiard balls, moved by simple external forces to predictable positions on life’s table. Environmental experiences and biological foundations work together to make us who we are. Our coverage of life’s biological beginnings focuses on evolution, genetic foundations, challenges and choices regarding reproduction, and the interaction of heredity and environment.

1 The Evolutionary Perspective

LE1 Discuss the evolutionary perspective on life-span development.

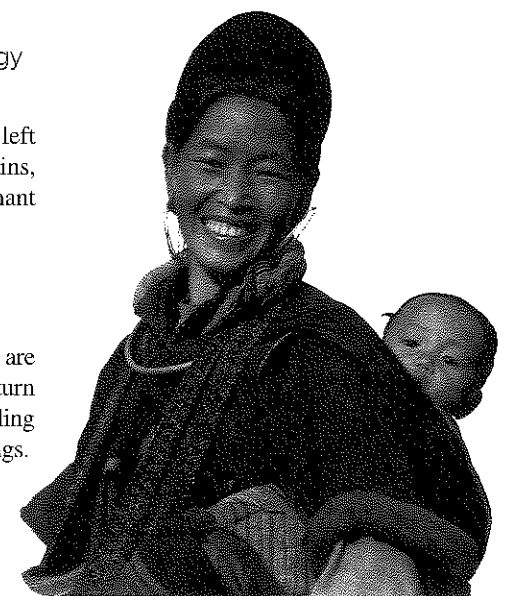
Natural Selection and Adaptive Behavior

Evolutionary Psychology

In evolutionary time, humans are relative newcomers to Earth. As our earliest ancestors left the forest to feed on the savannahs and then to form hunting societies on the open plains, their minds and behaviors changed, and they eventually established humans as the dominant species on Earth. How did this evolution come about?

NATURAL SELECTION AND ADAPTIVE BEHAVIOR

Natural selection is the evolutionary process by which those individuals of a species that are best adapted are the ones that survive and reproduce. To understand what this means, let’s return to the middle of the nineteenth century, when British naturalist Charles Darwin was traveling around the world, observing many different species of animals in their natural surroundings. Darwin, who published his observations and thoughts in *On the Origin of Species* (1859), noted that most organisms reproduce at rates that would cause enormous increases in the population of most species and yet populations remain nearly constant. He reasoned that an intense, constant struggle for food, water, and resources must occur among the many young born each generation, because many of the young do not survive. Those that do survive and reproduce pass on some of their characteristics to the next generation. Darwin argued that these survivors are better *adapted* to their world than are the nonsurvivors (Audesirk, Audesirk, & Byers, 2017; Hoefnagels, 2015). The best-adapted individuals survive to leave



How does the attachment of this Vietnamese baby to its mother reflect the evolutionary process of adaptive behavior?

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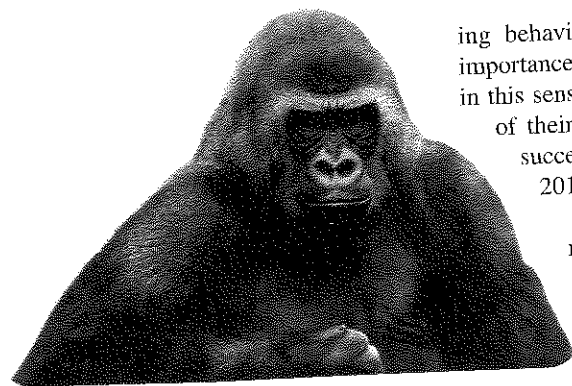
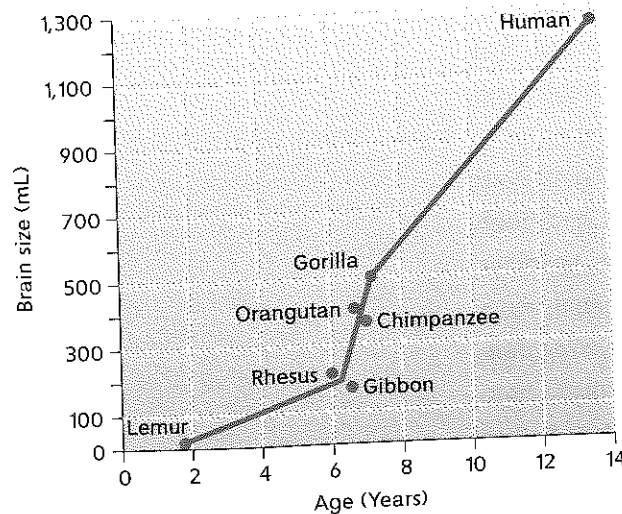


FIGURE 1
THE BRAIN SIZES OF VARIOUS PRIMATES AND HUMANS IN RELATION TO THE LENGTH OF THE CHILDHOOD PERIOD. Compared with other primates, humans have both a larger brain and a longer childhood period. What conclusions can you draw from the relationship indicated by this graph?
© Alan and Sandy Carey/Photodisc/Getty Images RF

What endless questions vex the thought, of whence and whither, when and how.

—**SIR RICHARD BURTON**
British explorer, 19th century

evolutionary psychology Emphasizes the importance of adaptation, reproduction, and “survival of the fittest” in shaping behavior.

the most offspring. Over the course of many generations, organisms with the characteristics needed for survival make up an increasing percentage of the population. Over many, many generations, this could produce a gradual modification of the whole population. If environmental conditions change, however, other characteristics might become favored by natural selection, moving the species in a different direction (Mader & Windelspecht, 2016).

All organisms must adapt to particular places, climates, food sources, and ways of life (Johnson, 2015; Simon, 2017). An eagle’s claws are a physical adaptation that facilitates predation. *Adaptive behavior* is behavior that promotes an organism’s survival in its natural habitat (Brooker & others, 2015). For example, attachment between a caregiver and a baby ensures the infant’s closeness to a caregiver for feeding and protection from danger, thus increasing the infant’s chances of survival.

EVOLUTIONARY PSYCHOLOGY

Although Darwin introduced the theory of evolution by natural selection in 1859, his ideas only recently have become a popular framework for explaining behavior. Psychology’s newest approach, **evolutionary psychology**, emphasizes the importance of adaptation, reproduction, and “survival of the fittest” in shaping behavior. “Fit” in this sense refers to the ability to bear offspring that survive long enough to bear offspring of their own. In this view, natural selection favors behaviors that increase reproductive success—the ability to pass your genes to the next generation (Bateson, 2015; Grinde, 2016; Hooper & others, 2015).

David Buss (2008, 2012, 2015) has been especially influential in stimulating new interest in how evolution can explain human behavior. He reasons that just as evolution has contributed to our physical features such as body shape and height, it also pervasively influences our psychological makeup, such as how we make decisions, how aggressive we are, our fears, and our mating patterns. For example, assume that our ancestors were hunters and gatherers on the plains and that men did most of the hunting and women stayed close to home gathering seeds and plants for food. If you have to travel some distance from your home to find and slay a fleeing animal, you need certain physical traits along with the capacity for certain types of spatial thinking. Men with these traits would be more likely than men without them to survive, to bring home lots of food, and to be considered attractive mates—and thus to reproduce and pass on these characteristics to their children. In other words, if Buss’ assumptions are correct, potentially these traits provide a reproductive advantage for males—over many generations, men with good spatial thinking skills might become more numerous in the population. Critics point out that these assumptions are not necessarily accurate and that this scenario might or might not have actually happened.

Evolutionary Developmental Psychology Recently, interest has grown in using the concepts of evolutionary psychology to understand human development (Bugental, Corpuz, & Beaulieu, 2015; Del Giudice & Ellis, 2016). Here we discuss some ideas proposed by evolutionary developmental psychologists (Bjorklund & Pellegrini, 2002).

An extended childhood period might have evolved because humans require time to develop a large brain and learn the complexity of human societies. Humans take longer to become reproductively mature than any other mammal (see Figure 1). During this extended childhood period, they develop a large brain and have the experiences needed to become competent adults in a complex society.

Many of our evolved psychological mechanisms are domain-specific. That is, the mechanisms apply only to a specific aspect of a person’s psychological makeup. According to evolutionary psychology, the mind is not a general-purpose device that can be applied equally to a vast array of problems. Instead, as our ancestors dealt with certain recurring problems such as hunting and finding shelter, specialized modules evolved to process information related to those problems. For example, such specialized modules might include a module for physical knowledge for tracking animals, a module for mathematical knowledge for trading, and a module for language.

Evolved mechanisms are not always adaptive in contemporary society. Some behaviors that were adaptive for our prehistoric ancestors may not serve us well today. For example, the food-scarce environment of our ancestors likely led to humans’ propensity to gorge when food is available and to crave high-caloric foods, a trait that might lead to an epidemic of obesity when food is plentiful.

Connecting Evolution and Life-Span Development In evolutionary theory, what matters is that individuals live long enough to reproduce and pass on their characteristics (Starr, Evers, & Starr, 2016). So why do humans live so long after reproduction? Perhaps evolution favored longevity because having older people around improves the survival rates of babies. Possibly having grandparents alive to care for the young while parents were out hunting and gathering food created an evolutionary advantage.

According to life-span developmentalist Paul Baltes (2003), the benefits conferred by evolutionary selection decrease with age. Natural selection has not weeded out many harmful conditions and nonadaptive characteristics that appear among older adults. Why? Natural selection operates primarily on characteristics that are tied to reproductive fitness, which extends through the earlier part of adulthood. Thus, says Baltes, selection primarily operates during the first half of life.

As an example, consider Alzheimer disease, an irreversible brain disorder characterized by gradual deterioration in thinking capacity. This disease typically does not appear until age 70 or later. If it were a disease that struck 20-year-olds, perhaps natural selection would have eliminated it eons ago.

Thus, unaided by evolutionary pressures against nonadaptive conditions, we suffer the aches, pains, and infirmities of aging. And as the benefits of evolutionary selection decrease with age, argues Baltes, the need for culture increases (see Figure 2). That is, as older adults weaken biologically, they need culture-based resources such as cognitive skills, literacy, medical technology, and social support. For example, older adults may need help and training from other people to maintain their cognitive skills (Rebok & others, 2014).

Evaluating Evolutionary Psychology Although the popular press gives a lot of attention to the ideas of evolutionary psychology, it remains just one theoretical approach among many. Like the theories described earlier, it has limitations, weaknesses, and critics (Hyde, 2014). Among the criticisms of evolutionary psychology are that it is one-sided, not adequately valuing social/environmental factors; that it relies on after-the-fact explanations; and that it cannot be tested scientifically.

Albert Bandura (1998), whose social cognitive theory was described earlier, acknowledges the important influence of evolution on human adaptation. However, he rejects what he calls “one-sided evolutionism,” which sees social behavior as strictly the product of evolved biology. An alternative is a bidirectional view in which environmental and biological conditions influence each other. In this view, evolutionary pressures created changes in biological structures that allowed the use of tools, which enabled our ancestors to manipulate their environment, constructing new environmental conditions. In turn, environmental innovations produced new selection pressures that led to the evolution of specialized biological systems for consciousness, thought, and language.

In other words, evolution does not dictate behavior. People have used their biological capacities to produce diverse cultures—aggressive and peace-loving, egalitarian and autocratic. As American scientist Stephen Jay Gould (1981) concluded, in most domains of human functioning, biology allows a broad range of cultural possibilities.

The “big picture” idea of natural selection leading to the development of human traits and behaviors is difficult to refute or test because evolution occurs on a time scale that does not lend itself to empirical study. Thus, studying specific genes in humans and other species—and their links to traits and behaviors—may be the best approach for testing ideas coming out of evolutionary psychology.

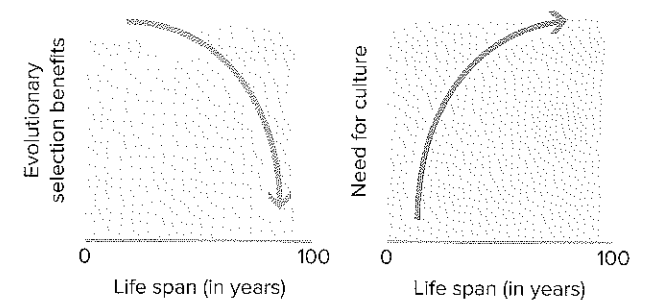
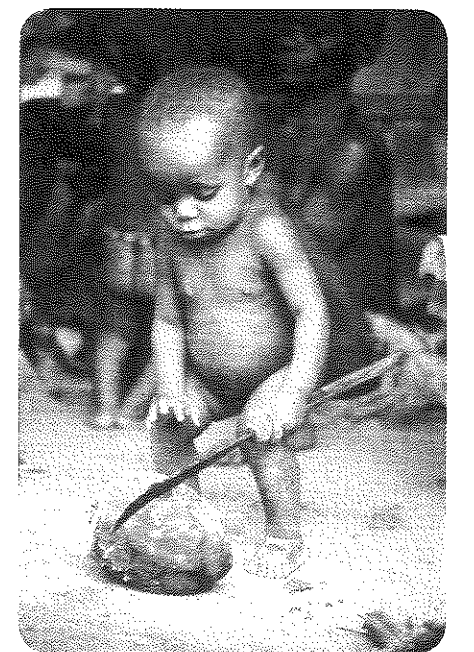


FIGURE 2
BALTES’ VIEW OF EVOLUTION AND CULTURE ACROSS THE LIFE SPAN. Benefits derived from evolutionary selection decrease as we age, whereas the need for culture increases with age.

developmental connection
Life-Span Perspective
Baltes described eight main characteristics of the life-span perspective. Connect to “Introduction.”



Children in all cultures are interested in the tools that adults in their cultures use. For example, this 11-month-old boy from the Efe culture in the Democratic Republic of the Congo in Africa is trying to cut a papaya with an apopau (a smaller version of a machete). Might the infant’s behavior be evolutionarily based or due to both biological and environmental conditions?
Courtesy of Dr. Gilda Morelli

Review Connect Reflect

LG1 Discuss the evolutionary perspective on life-span development.

Review

- How can natural selection and adaptive behavior be defined?
- What is evolutionary psychology? What are some basic ideas about human development proposed by evolutionary psychologists? How might evolutionary influences have different effects at different points in the life span? How can evolutionary psychology be evaluated?

Connect

- In the section on ethological theory in the previous chapter, you learned

about critical time periods. How does the concept of critical period relate to what you learned about older adults and aging in this section?

Reflect Your Own Personal Journey of Life

- Which do you think is more persuasive in explaining your development: the views of evolutionary psychologists or their critics? Why?

2 Genetic Foundations of Development

LG2 Describe what genes are and how they influence human development.

The Collaborative Gene

Genes and Chromosomes

Genetic Principles

Chromosomal and Gene-Linked Abnormalities

Genetic influences on behavior evolved over time and across many species. The many traits and characteristics that are genetically influenced have a long evolutionary history that is retained in our DNA. Our DNA is not just inherited from our parents; it includes what we inherited as a species from other species that were our ancestors.

How are characteristics that suit a species for survival transmitted from one generation to the next? Darwin did not know the answer because genes and the principles of genetics had not yet been discovered. Each of us carries a “genetic code” that we inherited from our parents. Because a fertilized egg carries this human code, a fertilized human egg cannot grow into an egret, eagle, or elephant.

developmental connection Biological Processes

A current biological theory of aging emphasizes that changes in the tips of chromosomes play a key role in aging. Connect to “Physical Development in Late Adulthood.”

chromosomes Threadlike structures that come in 23 pairs, with one member of each pair coming from each parent. Chromosomes contain the genetic substance DNA.

DNA A complex molecule that contains genetic information.

genes Units of hereditary information composed of DNA. Genes help cells to reproduce themselves and help manufacture the proteins that maintain life.

THE COLLABORATIVE GENE

Each of us began life as a single cell weighing about one twenty-millionth of an ounce! This tiny piece of matter housed our entire genetic code—information that helps us grow from that single cell to a person made of trillions of cells, each containing a replica of the original code. That code is carried by DNA, which includes our genes. What are genes and what do they do? For the answer, we need to look into our cells.

The nucleus of each human cell contains **chromosomes**, which are threadlike structures made up of deoxyribonucleic acid (DNA). DNA is a complex molecule that has a double helix shape, like a spiral staircase (shown in Figure 3) and contains genetic information. **Genes**, the units of hereditary information, are short segments of DNA. They help cells to reproduce themselves and to assemble proteins. Proteins, in turn, are the building blocks of cells as well as the regulators that direct the body’s processes (Cowan, 2015; Goodenough & McGuire, 2017).

Each gene has its own location—its own designated place on a particular chromosome. Today, there is a great deal of enthusiasm about efforts to discover the specific locations of genes that are linked to certain functions and developmental outcomes (Johnson, 2017; Mason & others, 2015). An important step in this direction is the Human Genome Project’s efforts to map the human genome—the complete genetic content of our cells, which includes developmental information used for creating proteins that contribute to the making of a human organism (Brooker, 2016; Sutphin & Korstanje, 2016).

Among the major approaches to gene identification and discovery that are being used today are the genome-wide association method, linkage analysis, next-generation sequencing, and the Thousand Genomes Project:

- Completion of the Human Genome Project has led to use of the *genome-wide association method* to identify genetic variations linked to a particular disease, such as obesity, cancer, cardiovascular disease, or Alzheimer disease (Brown & others, 2014; Cho & Suh, 2016; Hou & others, 2016; Locke & others, 2015). To conduct a genome-wide association study, researchers obtain DNA from individuals who have the disease and others who don’t have it. Then, each participant’s complete set of DNA, or genome, is purified from the blood or other cells and scanned on machines to determine markers of genetic variation. If the genetic variations occur more frequently in people who have the disease, the variations point to the region in the human genome with the disease. Genome-wide association studies have recently been conducted for cancer (Johnson & others, 2016; Stegeman & others, 2015), obesity (Apalasy & Mohamed, 2015; Wang & others, 2016), cardiovascular disease (Schick & others, 2016; Smith, Humphries, & Talmud, 2015), depression (Knowles & others, 2016; Nho & others, 2015), suicide (Sokolowski, Wasserman, & Wasserman, 2016), glaucoma (Bailey & others, 2016), and Alzheimer disease (Chauhan & others, 2015; Guerreiro & others, 2016).
- *Linkage analysis*, in which the goal is to discover the location of gene (or genes) in relation to a marker gene (whose position is already known), is often used to search for disease-related genes (Cho & Suh, 2016). Genes transmitted to offspring tend to be in close proximity to each other so that the gene(s) involved in the disease are usually located near the marker gene. Gene linkage studies are now being conducted on a wide variety of disorders, including attention deficit hyperactivity disorder (Hawi & others, 2015; Mastronardi & others, 2016), autism (Muller, Anacker, & Veenstra-VanderWeele, 2016; Pan & others, 2015), depression (Mathias & others, 2016), and Alzheimer disease (D’Aoust & others, 2015).
- *Next-generation sequencing* is a term used to describe the vast increase in genetic data generated at a much reduced cost and in a much shorter period of time than in the past. Using recently developed next-generation sequencing, an entire human genome can be sequenced in one day. Prior to recent improvements, deciphering the human genome took longer than ten years! The new technology sequences millions of small DNA fragments. Next-generation sequencing has considerably increased knowledge about genetic influences on development in recent years (Au & others, 2016; Hegele & others, 2015; Hou & others, 2016; Keller & others, 2016; Talseth-Palmer & others, 2016; Steinhilber & others, 2015).
- The human genome varies between individuals in small but very important ways. Understanding these variations will require examining the whole genomes of many individuals. A current project that began in 2008, the *Thousand Genomes Project*, is the most detailed study of human genetic variation to date. This project has the goal of determining the genomic sequences of at least 1,000 individuals from different ethnic groups around the world (Abyzov & others, 2013; Fukushima & others, 2015; Shibata & others, 2012). Gaining access to complete descriptions of the genetic variations of many people will allow researchers to conduct more detailed studies of genetic variations in disease.

One of the big surprises of the Human Genome Project was an early report indicating that humans have only about 30,000 genes (U.S. Department of Energy, 2001). More recently, the number of human genes has been revised further downward to approximately 20,700 (Ensembl Human, 2010; Flicek & others, 2013; Science Daily, 2008). Further recent analysis proposes that humans may actually have less than 20,000 protein-producing genes (Ezkurdia & others, 2014). Scientists had thought that humans had as many as 100,000 or more genes. They had also maintained that each gene programmed just one protein. In fact, humans have far more proteins than they have genes, so there cannot be a one-to-one correspondence between genes and proteins (Commoner, 2002). Each gene is not translated, in automaton-like fashion, into one and only one protein (Moore, 2015). A gene does not act independently, as developmental psychologist David Moore (2001) emphasized by titling his book *The Dependent Gene*.

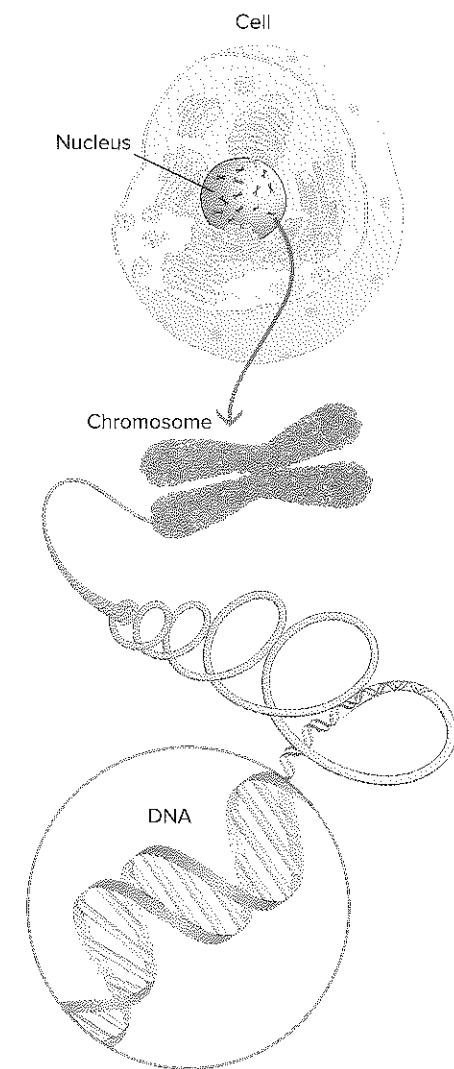


FIGURE 3
CELLS, CHROMOSOMES, DNA, AND GENES. (Top) The body contains trillions of cells. Each cell contains a central structure, the nucleus. (Middle) Chromosomes are threadlike structures located in the nucleus of the cell. Chromosomes are composed of DNA. (Bottom) DNA has the structure of a spiral staircase. A gene is a segment of DNA.

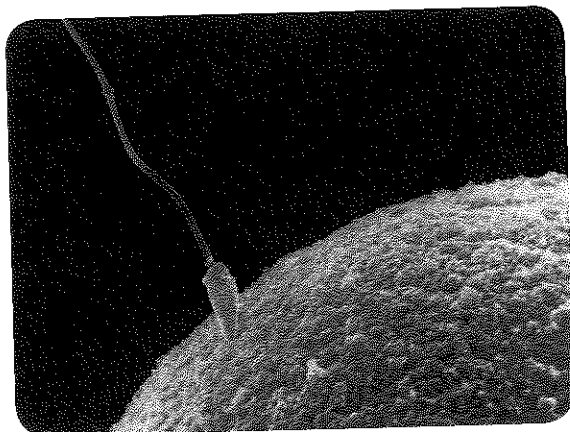


FIGURE 4
A SINGLE SPERM PENETRATING AN EGG AT THE
POINT OF FERTILIZATION
© Don W. Fawcett/Science Source

Rather than being a group of independent genes, the human genome consists of many genes that collaborate both with each other and with nongenetic factors inside and outside the body (Moore, 2013, 2015). The collaboration operates at many points. For example, the cellular machinery mixes, matches, and links small pieces of DNA to reproduce the genes—and that machinery is influenced by what is going on around it.

Whether a gene is turned “on”—working to assemble proteins—is also a matter of collaboration. The activity of genes (genetic expression) is affected by their environment (Gottlieb, 2007; Moore, 2015). For example, hormones that circulate in the blood make their way into the cell where they can turn genes “on” and “off.” And the flow of hormones can be affected by environmental conditions such as light, day length, nutrition, and behavior. Numerous studies have shown that external events outside of the original cell and the person, as well as events inside the cell, can excite or inhibit gene expression (Lickliter & Honeycutt, 2015; Moore, 2015). Recent research has documented that factors such as stress, exercise, nutrition, respiration, radiation, temperature, and sleep can influence gene expression (Craft & others, 2014; Dedon & Begley, 2014; Donnelly & Storchova, 2015; McInnis & others, 2015). For example, one study revealed that an increase in the concentration of stress hormones such as cortisol produced a fivefold increase in DNA damage (Flint & others, 2007). Another study also found that exposure to radiation changed the rate of DNA synthesis in cells (Lee & others, 2011). And recent research indicates that sleep deprivation can affect gene expression in negative ways such as increased inflammation, expression of stress-related genes, and impairment of protein functioning (da Costa Souza & Ribeiro, 2015).

Scientists have found that certain genes become turned on or off as a result of exercise mainly through a process called *methylation*, in which tiny atoms attached themselves to the outside of a gene (Lindholm & others, 2014). This process makes the gene more or less capable of receiving and responding to biochemical signals from the body (Reynolds, 2014). In this way the behavior of the gene, but not its structure, is changed. Researchers also have found that diet may affect gene behavior through the process of methylation (Das & others, 2016; Ma & others, 2015; Taylor, Jones, & Henagan, 2014).

GENES AND CHROMOSOMES

Genes are not only collaborative, they are enduring. How do the genes manage to get passed from generation to generation and end up in all of the trillion cells in the body? Three processes are at the heart of the story: mitosis, meiosis, and fertilization.

Mitosis, Meiosis, and Fertilization All of the cells in your body, except the sperm and egg, have 46 chromosomes arranged in 23 pairs. These cells reproduce through a process called **mitosis**. During mitosis, the cell’s nucleus—including the chromosomes—duplicates itself and the cell divides. Two new cells are formed, each containing the same DNA as the original cell, arranged in the same 23 pairs of chromosomes.

However, a different type of cell division—**meiosis**—forms eggs and sperm (which also are called gametes). During meiosis, a cell of the testes (in men) or ovaries (in women) duplicates its chromosomes but then divides twice, thus forming four cells, each of which has only half of the genetic material of the parent cell. By the end of meiosis, each egg or sperm has 23 unpaired chromosomes.

During **fertilization**, an egg and a sperm fuse to create a single cell called a **zygote** (see Figure 4). In the zygote, the 23 unpaired chromosomes from the egg and the 23 unpaired chromosomes from the sperm combine to form one set of 23 paired chromosomes—one chromosome of each pair coming from the mother’s egg and the other from the father’s sperm. In this manner, each parent contributes half of the offspring’s genetic material.

Figure 5 shows 23 paired chromosomes of a male and a female. The members of each pair of chromosomes are both similar and different: Each chromosome in the pair contains varying forms of the same genes, at the same location on the chromosome. A gene that influences hair color, for example, is located on both members of one pair of chromosomes, in the same location on each. However, one of those chromosomes might carry a gene associated with blond hair; the other chromosome in the pair might carry a gene associated with brown hair.

mitosis Cellular reproduction in which the cell’s nucleus duplicates itself with two new cells being formed, each containing the same DNA as the parent cell, arranged in the same 23 pairs of chromosomes.

meiosis A specialized form of cell division that occurs to form eggs and sperm (also known as gametes).

fertilization A stage in reproduction when an egg and a sperm fuse to create a single cell, called a zygote.

zygote A single cell formed through fertilization.

Do you notice any obvious differences between the chromosomes of the male and the chromosomes of the female in Figure 5? The difference lies in the 23rd pair. Ordinarily, in females this pair consists of two chromosomes called X chromosomes; in males, the 23rd pair consists of an X and a Y chromosome. The presence of a Y chromosome is one factor that makes a person male rather than female.

Sources of Variability Combining the genes of two parents in offspring increases genetic variability in the population, which is valuable for a species because it provides more characteristics for natural selection to operate on (Simon, 2015, 2017). In fact, the human genetic process creates several important sources of *variability* (Belk & Borden Maier, 2016).

First, the chromosomes in the zygote are not exact copies of those in the mother’s ovaries or the father’s testes. During the formation of the sperm and egg in meiosis, the members of each pair of chromosomes are separated, but which chromosome in the pair goes to the gamete is a matter of chance. In addition, before the pairs separate, pieces of the two chromosomes in each pair are exchanged, creating a new combination of genes on each chromosome (Mader & Windelspecht, 2016). Thus, when chromosomes from the mother’s egg and the father’s sperm are brought together in the zygote, the result is a truly unique combination of genes (Lewis, 2015).

If each zygote is unique, how do identical twins like those discussed in the opening of the chapter exist? *Identical twins* (also called monozygotic twins) develop from a single zygote that splits into two genetically identical replicas, each of which becomes a person. *Fraternal twins* (called dizygotic twins) develop when two eggs are fertilized by different sperm, creating two zygotes that are genetically no more similar than ordinary siblings.

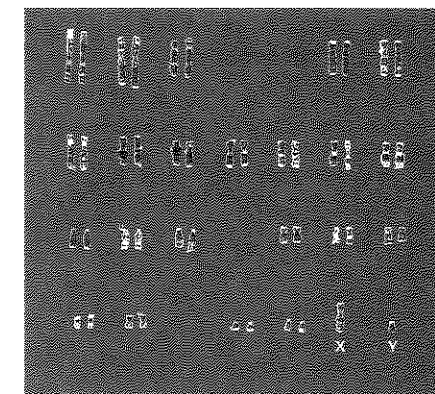
Another source of variability comes from DNA. Chance events, a mistake by cellular machinery, or damage from an environmental agent such as radiation may produce a *mutated gene*, which is a permanently altered segment of DNA (Bauman, 2015; Freeman & others, 2017).

There is increasing interest in studying *susceptibility genes*, those that make the individual more vulnerable to specific diseases or accelerated aging, and *longevity genes*, those that make the individual less vulnerable to certain diseases and more likely to live to an older age (Cho & Suh, 2016; Dong & others, 2015; Howard & Rogers, 2014; Sutphin & Korstanje, 2016). These are aspects of the individual’s genotype.

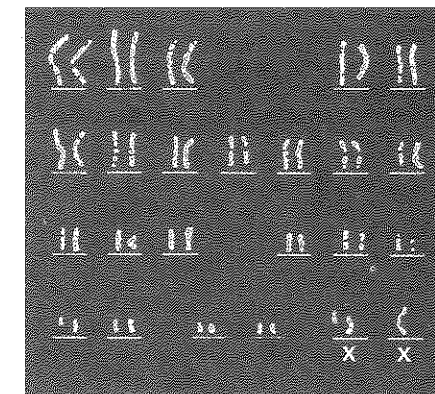
In the search for longevity genes, Cynthia Kenyon (2010) has extensively studied *C. elegans*, a roundworm, the first animal to have its entire genome sequenced. In early research, she found that modifying a single gene, *daf-2*, which is linked to hormones, slows aging in the roundworm. She also discovered that another gene, *daf-16*, is necessary for the roundworm to live longer. *Daf-16* encodes a gene switch that turns on a number of genes related to stress resistance, immunity, and metabolism (Mendler & others, 2015). These genes possibly can extend life by protecting and repairing body tissues (Patti & others, 2014). Other researchers have revealed that genetic variants in a human *daf-16* version labeled *FOXO3A* are linked to greater longevity in a wide range of people, including Americans, Europeans, and Chinese (Bao & others, 2014; Soerensen & others, 2010). Further, *daf-2*-type mutations extend life and slow aging not only in roundworms but also in flies and mice, resulting in delayed onset and severity of many aging diseases, including cancer, cardiovascular disease, and Alzheimer disease (Kenyon, 2010). Recently, Cynthia Kenyon has joined a think tank of scientists at Google’s Calico (short for California Life Company) division, which seeks to understand the aging process and uncover ways to modify it. Kenyon believes that interventions to extend the human life span might include drugs that mimic the action of gene mutations linked to greater longevity.

Even when their genes are identical, however, people vary. The difference between genotypes and phenotypes helps us to understand this source of variability. All of a person’s genetic material makes up his or her **genotype**. However, our observed and measurable characteristics reflect more than just genetic material. A **phenotype** consists of observable characteristics. Phenotypes include physical characteristics (such as height, weight, and hair color) and psychological characteristics (such as personality and intelligence).

How does the process from genotype to phenotype work? It’s highly complex, but at a very basic level in a cell, DNA information is transcribed to RNA (ribonucleic acid), which in turn is translated into amino acids that will become proteins (Brooker, 2016). Once proteins have been assembled, they become capable of producing phenotype traits and characteristics. Also, environments interact with genotypes to produce phenotypes.



(a)



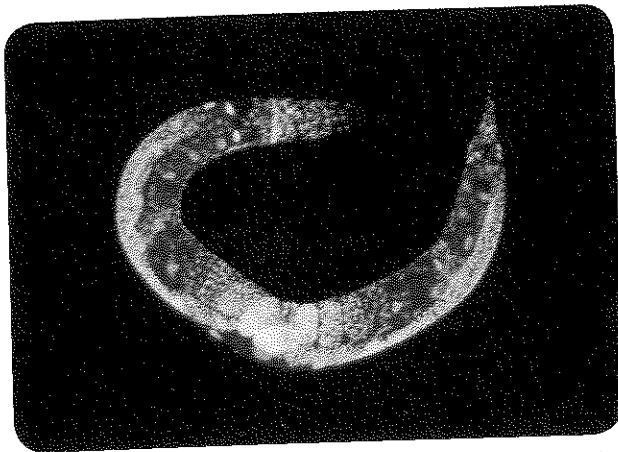
(b)

FIGURE 5
THE GENETIC DIFFERENCE BETWEEN MALES AND FEMALES. Set (a) shows the chromosome structure of a male, and set (b) shows the chromosome structure of a female. The last pair of 23 pairs of chromosomes is in the bottom right box of each set. Notice that the Y chromosome of the male is smaller than the X chromosome of the female. To obtain this kind of chromosomal picture, a cell is removed from a person’s body (an easy way to obtain a cell from a body is to swab the inside of the mouth with a Q-tip). The chromosomes are stained by chemical treatment, magnified extensively, and then photographed.

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genotype A person’s genetic heritage; the actual genetic material.

phenotype The way an individual’s genotype is expressed in observed and measurable characteristics.



Researcher Cynthia Kenyon found that modifying a gene called *daf-16* slows the aging process in *C. elegans* (shown above). This type of roundworm was the first animal to have its entire genome sequenced.
© Washington University, St. Louis/ KRT/Newscom

Thus, for each genotype, a range of phenotypes can be expressed, providing another source of variability (Klug & others, 2017; Solomon & others, 2015). An individual can inherit the genetic potential to grow very large, for example, but environmental influences involving good nutrition, among other things, will be essential for achieving that potential.

GENETIC PRINCIPLES

What determines how a genotype is expressed to create a particular phenotype? Much is unknown about the answer to this question (Moore, 2013, 2015). However, a number of genetic principles have been discovered, among them those of dominant-recessive genes, sex-linked genes, genetic imprinting, and polygenically determined characteristics.

Dominant-Recessive Genes In some cases, one gene of a pair always exerts its effects; it is *dominant* and overrides the potential influence of the other gene, called the recessive gene. This is the *dominant-recessive genes principle*. A recessive gene exerts its influence only if the two genes of a pair are both recessive. If you inherit a recessive gene for a trait from each of your parents, you will show the trait. If you inherit a recessive gene from only one parent, you may never know you carry the gene. Brown hair, farsightedness, and dimples are dominant genes; blond hair, nearsightedness, and freckles are recessive genes.

Can two brown-haired parents have a blond-haired child? Yes, they can. Suppose that each parent has a dominant gene for brown hair and a recessive gene for blond hair. Since dominant genes override recessive genes, the parents have brown hair, but both are carriers of genes that can contribute to blondness and pass on their recessive genes for producing blond hair. With no dominant gene to override them, the recessive genes can make the child's hair blond.

Sex-Linked Genes Most mutated genes are recessive. When a mutated gene is carried on the X chromosome, the result is called *X-linked inheritance*. The implications for males may be very different from those for females (Simon & others, 2016). Remember that males have only one X chromosome. Thus, if there is an absent or altered disease-relevant gene on the X chromosome, males have no "backup" copy to counter the harmful gene and therefore may develop an X-linked disease. However, females have a second X chromosome, which is likely to be unchanged. As a result, they are not likely to have the X-linked disease. Thus, most individuals who have X-linked diseases are males. Females who have one abnormal copy of the gene on the X chromosome are known as "carriers," and they usually do not show any signs of the X-linked disease. Hemophilia and fragile X syndrome, which we will discuss later in the chapter, are examples of X-linked inheritance diseases (Bartel, Weinstein, & Schaffer, 2012; Karmiloff-Smith & others, 2016).

Genetic Imprinting Genetic imprinting occurs when the expression of a gene has different effects depending on whether the mother or the father passed on the gene (Moore & others, 2015; Schneider & others, 2014). A chemical process "silences" one member of the gene pair. For example, as a result of imprinting, only the maternally derived copy of the expressed gene might be active, while the paternally derived copy of the same expressed gene is silenced—or vice versa (Court & others, 2014). Only a small percentage of human genes appear to undergo imprinting, but it is a normal and important aspect of development. When imprinting goes awry, development is disturbed, as in the case of Beckwith-Wiedemann syndrome (a growth disorder) and Wilms tumor (a type of cancer) (Okun & others, 2014).

Polygenic Inheritance Genetic transmission is usually more complex than the simple examples we have examined thus far (Moore, 2013, 2015). Few characteristics reflect the influence of only a single gene or pair of genes. The term *polygenic inheritance* means that many different genes determine a characteristic (Lu, Yu, & Deng, 2012). Even a simple characteristic such as height, for example, reflects the interaction of many genes as well as the influence of the environment. Most diseases, such as cancer and diabetes, develop as a consequence of complex gene interactions and environmental factors (Dastani & others, 2012).

Name	Description	Treatment	Incidence
Down syndrome	An extra chromosome causes mild to severe intellectual disability and physical abnormalities.	Surgery, early intervention, infant stimulation, and special learning programs	1 in 1,900 births at age 20 1 in 300 births at age 35 1 in 30 births at age 45
Klinefelter syndrome (XXY)	An extra X chromosome causes physical abnormalities.	Hormone therapy can be effective	1 in 1,000 male births
Fragile X syndrome	An abnormality in the X chromosome can cause intellectual disability, learning disabilities, or short attention span.	Special education, speech and language therapy	More common in males than in females
Turner syndrome (XO)	A missing X chromosome in females can cause intellectual disability and sexual underdevelopment.	Hormone therapy in childhood and puberty	1 in 2,500 female births
XYY syndrome	An extra Y chromosome can cause above-average height.	No special treatment required	1 in 1,000 male births

FIGURE 6

SOME CHROMOSOMAL ABNORMALITIES. The treatments for these abnormalities do not necessarily erase the problem but may improve the individual's adaptive behavior and quality of life.

The term *gene-gene interaction* is increasingly used to describe studies that focus on the interdependent process by which two or more genes influence characteristics, behavior, diseases, and development (Cho & Suh, 2016; Hodge & others, 2016). For example, recent studies have documented gene-gene interaction in immune system functioning (Heinonen & others, 2015), asthma (Lee & others, 2014), alcoholism (Yokoyama & others, 2013), cancer (Wu & others, 2016), cardiovascular disease (Musameh & others, 2015; Zhang & others, 2016), arthritis (Freytag & others, 2014), and Alzheimer disease (Koran & others, 2014).

CHROMOSOMAL AND GENE-LINKED ABNORMALITIES

Abnormalities characterize the genetic process in some individuals. Some of these abnormalities involve whole chromosomes that do not separate properly during meiosis. Other abnormalities are produced by harmful genes.

Chromosomal Abnormalities Sometimes a gamete is formed in which the male's sperm and/or the female's ovum do not have their normal set of 23 chromosomes. The most notable examples involve Down syndrome and abnormalities of the sex chromosomes (see Figure 6).

Down Syndrome Down syndrome is a form of intellectual disability caused by the presence of an extra copy of chromosome 21 (Lewanda & others, 2016). It is not known why the extra chromosome is present, but the health of the male sperm or the female ovum may be involved. An individual with Down syndrome has a round face, a flattened skull, an extra fold of skin over the eyelids, a protruding tongue, short limbs, and retardation of motor and mental abilities.

Down syndrome appears approximately once in every 700 live births. Women between the ages of 16 and 34 are less likely to give birth to a child with Down syndrome than are younger or older women. African American children are rarely born with Down syndrome.

Sex-Linked Chromosomal Abnormalities Recall that a newborn normally has either an X and a Y chromosome, or two X chromosomes. Human embryos must possess at least one X chromosome to be viable. The most common sex-linked chromosomal abnormalities involve the presence of an extra chromosome (either an X or Y) or the absence of one X chromosome in females.

Klinefelter syndrome is a chromosomal disorder in which males have an extra X chromosome, making them XXY instead of XY. Males with this disorder have undeveloped testes, and they usually have enlarged breasts and become tall (Lunenfeld & others, 2015).



These athletes, several of whom have Down syndrome, are participating in a Special Olympics competition. Notice the distinctive facial features of the individuals with Down syndrome, such as a round face and a flattened skull. *What causes Down syndrome?*
© James Shaffer/PhotoEdit

Down syndrome A form of intellectual disability that is caused by the presence of an extra copy of chromosome 21.

Klinefelter syndrome A chromosomal disorder in which males have an extra X chromosome, making them XXY instead of XY.

Klinefelter syndrome occurs approximately once in every 1,000 live male births. Only 10 percent of individuals with Klinefelter syndrome are diagnosed before puberty, with the majority not identified until adulthood (Aksela & others, 2013).

Fragile X syndrome is a genetic disorder that results from an abnormality in the X chromosome, which becomes constricted and often breaks (Karmiloff-Smith & others, 2016; Yudkin & others, 2014). An intellectual difficulty frequently is an outcome, which may take the form of an intellectual disability, autism, a learning disability, or a short attention span (Hall & others, 2014). This disorder occurs more frequently in males than in females, possibly because the second X chromosome in females negates the effects of the abnormal X chromosome (Bonaccorso & others, 2015; McDuffie & others, 2015; Rocca & others, 2016).

Turner syndrome is a chromosomal disorder in females in which either an X chromosome is missing, making the person XO instead of XX, or part of one X chromosome is deleted (Miguel-Neto & others, 2016; Vlatkovic & others, 2014). Females with Turner syndrome are short in stature and have a webbed neck (Kaur & Phadke, 2012). They might be infertile and have difficulty in mathematics, but their verbal ability is often quite good (Lleo & others, 2012). Turner syndrome occurs in approximately 1 of every 2,500 live female births (Pinsker, 2012).

The **XXY syndrome** is a chromosomal disorder in which a male has an extra Y chromosome (Lepage & others, 2014). Early interest in this syndrome focused on the belief that the extra Y chromosome found in some males contributed to aggression and violence. However, researchers subsequently found that XYY males are no more likely to commit crimes than are normal XY males (Witkin & others, 1976).

Gene-Linked Abnormalities Abnormalities can be produced not only by an abnormal number of chromosomes but also by harmful genes. More than 7,000 such genetic disorders have been identified, although most of them are rare. Two widely studied *gene-linked abnormalities* are phenylketonuria and sickle-cell anemia.

Phenylketonuria (PKU) is a genetic disorder in which the individual cannot properly metabolize phenylalanine, an amino acid. It results from a recessive gene and occurs about once in every 10,000 to 20,000 live births. Today, phenylketonuria is easily detected during infancy, and it is treated by a diet that prevents an excess accumulation of phenylalanine (Rohde & others, 2014). If phenylketonuria is left untreated, however, excess phenylalanine builds up in the child, producing intellectual disability and hyperactivity. Phenylketonuria accounts for approximately 1 percent of institutionalized individuals with intellectual disabilities, and it occurs primarily in non-Latino Whites.

The story of phenylketonuria has important implications for the nature-nurture issue. Although phenylketonuria is often described as a genetic disorder (nature), how or whether a gene's influence in phenylketonuria is played out depends on environmental influences since the disorder can be treated (nurture) using an environmental manipulation (Di Cionno, Forcella, & Cotugno, 2012). That is, the presence of a genetic defect does not inevitably lead to the development of the disorder if the individual develops in the right environment (one free of phenylalanine). This is one example of the important principle of heredity-environment interaction. Under one environmental condition (phenylalanine in the diet), intellectual disability results, but when other nutrients replace phenylalanine, intelligence develops in the normal range. The same genotype has different outcomes depending on the environment (in this case, the nutritional environment).

Sickle-cell anemia, which occurs most often in African Americans, is a genetic disorder that impairs the functioning of the body's red blood cells. Red blood cells carry oxygen to the body's other cells and are usually disk-shaped. In sickle-cell anemia, a recessive gene causes the red blood cell to become a hook-shaped "sickle" that cannot carry oxygen properly and dies quickly (Derebail & others, 2014). As a result, the body's cells do not receive adequate oxygen, causing anemia and early death (Mehari & others, 2012). About 1 in 400 African American babies is affected by sickle-cell anemia. One in 10 African Americans is a carrier, as is 1 in 20 Latin Americans. A National Institutes of Health (2008) panel concluded that the only FDA-approved drug (hydroxyurea) to treat sickle-cell anemia in adolescents and adults has been underutilized. Recent research strongly supports the use of hydroxyurea therapy for infants with sickle-cell anemia beginning at 9 months of age (Yawn & John-Sowah, 2015).

Other diseases that result from genetic abnormalities include cystic fibrosis, some forms of diabetes, hemophilia, Huntington disease, spina bifida, and Tay-Sachs disease. Figure 7 provides further information about these diseases. Someday scientists may be able to identify

Name	Description	Treatment	Incidence
Cystic fibrosis	Glandular dysfunction that interferes with mucus production; breathing and digestion are hampered, resulting in a shortened life span.	Physical and oxygen therapy, synthetic enzymes, and antibiotics; most individuals live to middle age.	1 in 2,000 births
Diabetes	Body does not produce enough insulin, which causes abnormal metabolism of sugar.	Early onset can be fatal unless treated with insulin.	1 in 2,500 births
Hemophilia	Delayed blood clotting causes internal and external bleeding.	Blood transfusions/injections can reduce or prevent damage due to internal bleeding.	1 in 10,000 males
Huntington's disease	Central nervous system deteriorates, producing problems in muscle coordination and mental deterioration.	Does not usually appear until age 35 or older; death likely 10 to 20 years after symptoms appear.	1 in 20,000 births
Phenylketonuria (PKU)	Metabolic disorder that, left untreated, causes intellectual disability and hyperactivity.	Special diet can result in average intelligence and normal life span.	1 in 10,000 to 1 in 20,000 births
Sickle-cell anemia	Blood disorder that limits the body's oxygen supply; it can cause joint swelling, as well as heart and kidney failure.	Penicillin, medication for pain, antibiotics, blood transfusions, and hydroxyurea.	1 in 400 African American children (lower among other groups)
Spina bifida	Neural tube disorder that causes brain and spine abnormalities.	Corrective surgery at birth, orthopedic devices, and physical/medical therapy.	2 in 1,000 births
Tay-Sachs disease	Deceleration of mental and physical development caused by an accumulation of lipids in the nervous system.	Medication and special diet are used, but death is likely by 5 years of age.	1 in 30 American Jews is a carrier.

FIGURE 7
SOME GENE-LINKED ABNORMALITIES

why these and other genetic abnormalities occur and discover how to cure them. The Human Genome Project has already linked specific DNA variations with increased risk of a number of diseases and conditions, including Huntington disease (in which the central nervous system deteriorates), some forms of cancer, asthma, diabetes, hypertension, and Alzheimer disease (Capurro & others, 2015; Tai & others, 2015; Wang & others, 2016; Williams & others, 2016).

Dealing with Genetic Abnormalities Every individual carries DNA variations that might predispose the person to serious physical disease or mental disorder. But not all individuals who carry an abnormal genetic variation develop the disorder. Other genes or developmental events sometimes compensate for genetic abnormalities (Russell, Hertz, & McMillan, 2017). For example, recall the earlier example of phenylketonuria: Even though individuals might carry the abnormal genetic variation associated with phenylketonuria, the abnormal phenotype does not develop when phenylalanine is replaced by other nutrients in their diet.

Thus, genes are not destiny, but genes that are missing, nonfunctional, or mutated can contribute to disorders (Cagini & others, 2016; Fleck, Pavel, & Cassandras, 2016; Moore, 2015). Identifying such genetic flaws could enable doctors to predict an individual's risks, recommend healthy practices, and prescribe the safest and most effective drugs (Paneque, Sequeiros, & Skirton, 2015). A decade or two from now, parents of a newborn baby may be able to leave the hospital with a full genome analysis of their offspring that identifies disease risks.

However, this knowledge might bring important costs as well as benefits. Who would have access to a person's genetic profile? An individual's ability to land and hold jobs or obtain insurance might be threatened if she or he is known to be at risk for some disease. For example, should an airline pilot or a neurosurgeon who is predisposed to develop a disorder that makes one's hands shake be required to leave that job early, before showing any symptoms of the disorder?

Genetic counselors, usually physicians or biologists who are well-versed in the field of medical genetics, understand the kinds of problems just described, the odds of encountering them, and helpful strategies for offsetting some of their effects (Mollee, 2014). To read about the career and work of a genetic counselor, see *Connecting with Careers*.

fragile X syndrome A genetic disorder involving an abnormality in the X chromosome, which becomes constricted and often breaks.

Turner syndrome A chromosome disorder in females in which either an X chromosome is missing, making the person XO instead of XX, or the second X chromosome is partially deleted.

XXY syndrome A chromosomal disorder in which males have an extra Y chromosome.

phenylketonuria (PKU) A genetic disorder in which an individual cannot properly metabolize an amino acid called phenylalanine. PKU is now easily detected but, if left untreated, results in intellectual disability and hyperactivity.

sickle-cell anemia A genetic disorder that affects the red blood cells and occurs most often in people of African descent.

Holly Ishmael, Genetic Counselor

Holly Ishmael is a genetic counselor at Children's Mercy Hospital in Kansas City. She obtained an undergraduate degree in psychology and a master's degree in genetic counseling from Sarah Lawrence College.

Genetic counselors like Ishmael work as members of a health care team, providing information and support to families with birth defects or genetic disorders. They identify families at risk by analyzing inheritance patterns and then explore options with the family. Some genetic counselors, like Ishmael, specialize in prenatal and pediatric genetics while others focus on cancer genetics or psychiatric genetic disorders.

Ishmael says, "Genetic counseling is a perfect combination for people who want to do something science-oriented, but need human contact and don't want to spend all of their time in a lab or have their nose in a book" (Rizzo, 1999, p. 3).

Genetic counselors have specialized graduate degrees in medical genetics and counseling. They enter graduate school from undergraduate programs in a variety of disciplines, including biology, genetics, psychology, public health, and social work. There are



Holly Ishmael (left) in a genetic counseling session. Courtesy of Holly Ishmael Welsh

approximately 30 graduate genetic counseling programs in the United States. If you are interested in this profession, you can obtain further information from the National Society of Genetic Counselors at www.nsgc.org.

For more information about what genetic counselors do, see the *Careers in Life-Span Development* appendix.

Review Connect Reflect

LG2 Describe what genes are and how they influence human development.

Review

- What are genes?
- How are genes passed on?
- What basic principles describe how genes interact?
- What are some chromosomal and gene-linked abnormalities?

Connect

- Would you want to be able to access a full genome analysis of your offspring? Why or why not?

Reflect Your Own Personal Journey of Life

- Can you identify in yourself or a friend the likelihood of the influence of dominant and/or recessive genes? Explain.

3 Reproductive Challenges and Choices

LG3 Identify some important reproductive challenges and choices.

Prenatal Diagnostic Tests

Infertility and Reproductive Technology

Adoption

The facts and principles we have discussed regarding meiosis, genetics, and genetic abnormalities are a small part of the recent explosion of knowledge about human biology. This knowledge not only helps us understand human development but also opens up many new choices to prospective parents—choices that can also raise ethical questions.

PRENATAL DIAGNOSTIC TESTS

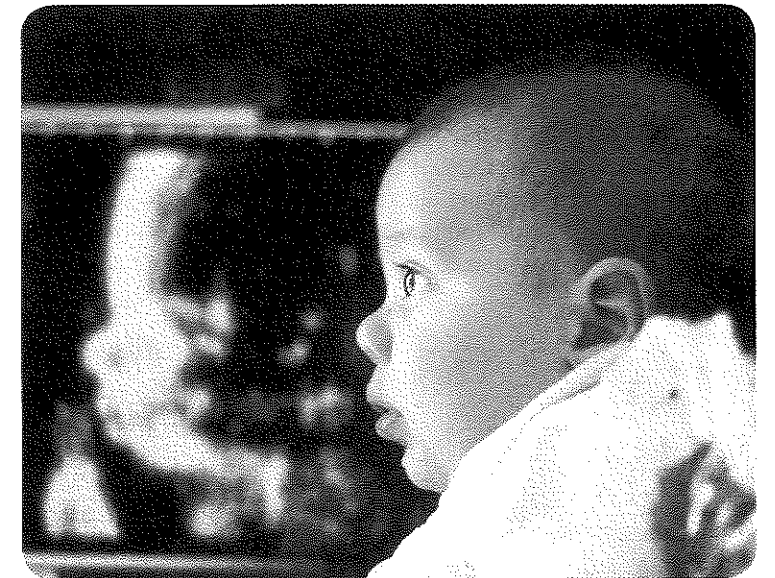
One choice open to prospective mothers is the extent to which they will undergo prenatal testing. A number of tests can indicate whether a fetus is developing normally, including ultrasound sonography, fetal MRI, chorionic villus sampling, amniocentesis, maternal blood screening, and noninvasive prenatal diagnosis.

Ultrasound Sonography An ultrasound test is often conducted seven weeks into a pregnancy and at various times later in pregnancy. *Ultrasound sonography* is a prenatal medical procedure in which high-frequency sound waves are directed into the pregnant woman's abdomen (X. Li & others, 2015). The echo from the sounds is transformed into a visual representation of the fetus's inner structures. This technique can detect many abnormalities in the fetus, including microencephaly, in which an abnormally small brain can produce intellectual disability (C. P. Chen & others, 2014); it can also determine the number of fetuses (that is, detect whether a woman is carrying twins or triplets) and give clues to the baby's sex (Masselli & others, 2011). A recent research review concluded that many aspects of the developing prenatal brain can be detected by ultrasound in the first trimester and that about 50 percent of spina bifida cases can be identified at this time, most of these being severe cases (Engels & others, 2016). There is virtually no risk to the woman or fetus in using ultrasound.

Brain-Imaging Techniques The development of brain-imaging techniques has led to increasing use of *fetal MRI* to diagnose fetal malformations (Sanz-Cortes & others, 2015) (see Figure 8). MRI, which stands for magnetic resonance imaging, uses a powerful magnet and radio images to generate detailed images of the body's organs and structures. Currently, ultrasound is still the first choice in fetal screening, but fetal MRI can provide more detailed images than ultrasound. In many instances, ultrasound will indicate a possible abnormality and then fetal MRI will be used to obtain a clearer, more detailed image (Milani & others, 2015). Among the fetal malformations that fetal MRI may be able to detect better than ultrasound sonography are certain abnormalities of the central nervous system, chest, gastrointestinal tract, genital/urinary organs, and placenta (Malinge & Lerman-Sagie, 2015; Milesi & others, 2014).

Chorionic Villus Sampling At some point between the 10th and 12th weeks of pregnancy, chorionic villus sampling may be used to detect genetic defects and chromosomal abnormalities such as those discussed in the previous section. *Chorionic villus sampling (CVS)* is a prenatal medical procedure in which a small sample of the placenta (the vascular organ that links the fetus to the mother's uterus) is removed (Gimovsky, Khodak-Gelman, & Larsen, 2014; Lankford & others, 2015). Diagnosis takes about 10 days. There is a small risk of limb deformity when CVS is used.

Amniocentesis Between the 15th and 18th weeks of pregnancy, amniocentesis may be performed. *Amniocentesis* is a prenatal medical procedure in which a sample of amniotic fluid is withdrawn by syringe and tested for chromosomal or metabolic disorders (Ekblad & others, 2015; Menon & others, 2014). The amniotic fluid is found within the amnion, a thin sac in which the embryo is suspended. Ultrasound sonography is often used during amniocentesis so that the syringe can be placed precisely.



A 6-month-old infant poses with the ultrasound sonography record taken four months into the baby's prenatal development. What is ultrasound sonography? © Jacques Pavlovsky/Sygma/Corbis



FIGURE 8
A FETAL MRI, WHICH IS INCREASINGLY BEING USED IN PRENATAL DIAGNOSIS OF FETAL MALFORMATIONS
© Du Cane Medical Imaging Ltd./Science Source

developmental connection

Biological Processes

Discover what the development of the fetus is like at the stages when chorionic villus sampling and amniocentesis can be used. Connect to “Prenatal Development and Birth.”

The later amniocentesis is performed, the better its diagnostic potential. The earlier it is performed, the more useful it is in deciding how to handle a pregnancy. It may take two weeks for enough cells to grow to allow amniocentesis test results to be obtained. Amniocentesis brings a small risk of miscarriage: About 1 woman in every 200 to 300 miscarries after amniocentesis.

Both amniocentesis and chorionic villus sampling provide valuable information about the presence of birth defects, but they also raise difficult issues for parents about whether an abortion should be obtained if birth defects are present (Zhang & others, 2010). Chorionic villus sampling allows a decision to be made earlier, near the end of the first 12 weeks of pregnancy, when abortion is safer and less traumatic.

Maternal Blood Screening During the 15th to 19th weeks of pregnancy, maternal blood screening may be performed. *Maternal blood screening* identifies pregnancies that have an elevated risk for birth defects such as spina bifida (a defect in the spinal cord) and Down syndrome (Byeon, Ki, & Han, 2016). The current blood test is called the *triple screen* because it measures three substances in the mother’s blood. After an abnormal triple screen result, the next step is usually an ultrasound examination. If an ultrasound does not explain the abnormal triple screen results, amniocentesis is typically used.

Noninvasive Prenatal Diagnosis (NIPD) *Noninvasive prenatal diagnosis (NIPD)* is increasingly being explored as an alternative to procedures such as chorionic villus sampling and amniocentesis (Kantak & others, 2014). At this point, NIPD has mainly focused on brain-imaging techniques, the isolation and examination of fetal cells circulating in the mother’s blood, and analysis of cell-free fetal DNA in maternal plasma (Cheng & others, 2015; Mersy & others, 2013).

Researchers already have used NIPD to successfully test for genes inherited from a father that cause cystic fibrosis and Huntington disease. They also are exploring the potential for using NIPD very early in fetal development to diagnose a baby’s sex and detect Down syndrome (Lim, Park, & Ryu, 2013).

Fetal Sex Determination Chorionic villus sampling has often been used to determine the sex of the fetus at some point from 11 to 13 weeks of gestation. Also, in a recent study, ultrasound accurately identified the sex of the fetus at 11 to 13 weeks of gestation (Manzanares & others, 2016). Recently, though, some noninvasive techniques have been able to detect the sex of the fetus at an earlier point (Mersy & others, 2015; Moise & others, 2013). A meta-analysis of studies confirmed that a baby’s sex can be detected as early as 7 weeks into pregnancy (Devaney & others, 2011). Being able to detect an offspring’s sex as well as the presence of various diseases and defects at such an early stage raises ethical concerns about couples’ motivation to terminate a pregnancy (Dickens, 2014).

INFERTILITY AND REPRODUCTIVE TECHNOLOGY

Recent advances in biological knowledge have also opened up many choices for infertile individuals (Asero & others, 2014). Approximately 10 to 15 percent of couples in the United States experience *infertility*, which is defined as the inability to conceive a child after 12 months of regular intercourse without contraception. The cause of infertility can rest with the woman or the man (Reindollar & Goldman, 2012). The woman may not be ovulating (releasing eggs to be fertilized), she may be producing abnormal ova, her fallopian tubes through which ova normally reach the womb may be blocked, or she may have a disease that prevents implantation of the embryo into the uterus. The man may produce too few sperm, the sperm may lack motility (the ability to move adequately), or he may have a blocked passageway (Takasaki & others, 2014; Xu & others, 2016).

In the United States, more than 2 million couples seek help for infertility every year. In some cases of infertility, surgery may correct the cause; in others, hormone-based drugs may improve the probability of having a child. Of the 2 million couples who seek help for infertility every year, about 40,000 try high-tech assisted reproduction. By far the most common technique used is *in vitro fertilization (IVF)*, in which eggs and sperm

are combined in a laboratory dish. If any eggs are successfully fertilized, one or more of the resulting zygotes is transferred into the woman’s uterus. As indicated in Figure 9, the success rate of IVF depends on the mother’s age.

The creation of families by means of the new reproductive technologies raises important questions about the physical and psychological consequences for children (Parke, 2013). One result of fertility treatments is an increase in multiple births. Twenty-five to 30 percent of pregnancies achieved by fertility treatments—including in vitro fertilization—now result in multiple births. A *meta-analysis* (a statistical technique that combines the results of multiple studies to determine the strength of the effect) revealed that twins conceived by in vitro fertilization have a slightly increased risk of low birth weight (McDonald & others, 2010) and another meta-analysis found that in vitro fertilization singletons have a significant risk of low birth weight (McDonald & others, 2009). To read about a study that addresses longer-term consequences of in vitro fertilization, see *Connecting Through Research*.

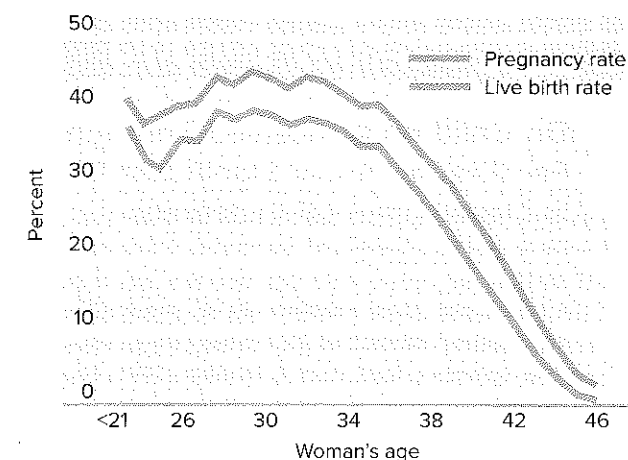


FIGURE 9
SUCCESS RATES OF IN VITRO FERTILIZATION VARY
ACCORDING TO THE WOMAN'S AGE

ADOPTION

Although surgery and fertility drugs can sometimes solve infertility problems, another choice is to adopt a child (Compton, 2016; Grotevant & McDermott, 2014). Adoption is a social and legal process that establishes a parent-child relationship between persons unrelated at birth.

The Increased Diversity of Adopted Children and Adoptive Parents A number of changes have characterized adoptive children and adoptive parents during the last three to four decades (Brodzinsky & Pinderhughes, 2002; Compton, 2016; Grotevant & McDermott, 2014; Thomas, 2016). In the first half of the twentieth century, most U.S. adopted children were healthy, non-Latino White infants who were adopted at birth or soon after; however, in recent decades as abortion became legal and contraception increased, fewer of these infants became available for adoption. Increasingly, U.S. couples adopted a much wider diversity of children—from other countries, from other ethnic groups, children with physical and/or mental problems, and children who had been neglected or abused (Compton, 2016; Pinderhughes, Zhang, & Agerbak, 2015).

Changes also have characterized adoptive parents in the last three to four decades (Brodzinsky & Pinderhughes, 2002). In the first half of the twentieth century, most adoptive parents were from non-Latino White, middle or upper socioeconomic status backgrounds who were married and did not have any type of disability. However, in recent decades, increased diversity has characterized adoptive parents. Many adoption agencies today have no income requirements for adoptive parents and now allow adults from a wide range of backgrounds to adopt children, including single adults, gay and lesbian adults, and older adults (Farr & others, 2016). Further, many adoptions involve other family members (aunts/uncles/grandparents); currently, 30 percent of U.S. adoptions are made by relatives (Ledesma, 2012). And slightly more than 50 percent of U.S. adoptions occur through the foster care system; recently, more than 100,000 children in the U.S. foster care system were waiting for someone to adopt them (Ledesma, 2012).

Three pathways to adoption are: (1) domestic adoption from the public welfare system, (2) domestic infant adoption through private agencies and intermediaries, and (3) international adoption (Grotevant & McDermott, 2014). In the next decade, the mix of U.S. adoptions is likely to include fewer domestic infant and international adoptions and more adoptions via the child welfare system (Grotevant & McDermott, 2014).

Outcomes for Adopted Children How do adopted children fare after they are adopted? A recent research review concluded that adopted children are at higher risk for externalizing (aggression and conduct problems, for example), internalizing (anxiety and depression, for example), and attention problems (ADHD, for example) (Grotevant & McDermott, 2014). However, a majority of adopted children and adolescents (including those adopted at older

connecting through research

Do Children Conceived Through In Vitro Fertilization Show Significant Differences in Developmental Outcomes in Adolescence?

A longitudinal study examined 34 in vitro fertilization families, 49 adoptive families, and 38 families with a naturally conceived child (Golombok, MacCallum, & Goodman, 2001). Each type of family included a similar proportion of boys and girls. Also, the ages of the young adolescents did not differ according to family type (mean age of 11 years, 11 months).

Children's socioemotional development was assessed by (1) interviewing the mother and obtaining detailed descriptions of any problems the child might have; (2) administering a strengths and difficulties questionnaire to the child's mother and teacher; and (3) administering the Social Adjustment Inventory for Children and Adolescents, which examines functioning in school, peer relationships, and self-esteem.

No significant differences between the children from in vitro fertilization, adoptive, and naturally conceiving families were found. The results from the Social Adjustment Inventory for Children and Adolescents are shown in Figure 10. Recent reviews by leading researchers conclude that children and adolescents conceived through new reproductive technologies—such as in vitro fertilization—are as

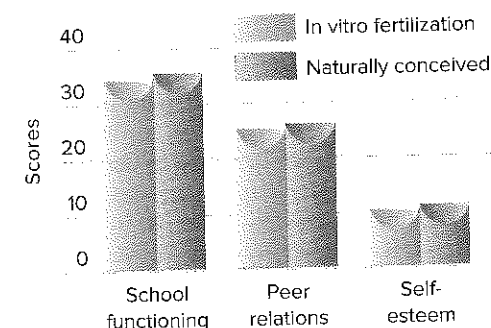


FIGURE 10
SOCIOEMOTIONAL FUNCTIONING OF CHILDREN CONCEIVED THROUGH IN VITRO FERTILIZATION OR NATURALLY CONCEIVED.

This graph shows the results of a study that compared the socioemotional functioning of young adolescents who had either been conceived through in vitro fertilization (IVF) or naturally conceived (Golombok, MacCallum, & Goodman, 2001). For each type of family, the study included a similar proportion of boys and girls and children of similar age (mean age of 11 years, 11 months). Although the means for the naturally conceived group were slightly higher, this is likely due to chance: There were no significant differences between the groups.

well adjusted as their counterparts conceived by natural means (Golombok, 2011a, b; Golombok & Tasker, 2010).

ages, transracially, and across national borders) adjust effectively, and their parents report considerable satisfaction with their decision to adopt (Brodzinsky & Pinderhughes, 2002; Castle & others, 2010; Compton, 2016).

Adopted children fare much better than children raised in long-term foster care or in an institutional environment (Bernard & Dozier, 2008). A study of infants in China revealed that their cognitive development improved two to six months following their adoption from foster homes and institutions (van den Dries & others, 2010).

Children who are adopted very early in their lives are more likely to have positive outcomes than children adopted later in life (Bernard & Dozier, 2008; Julian, 2013). A Danish study indicated that being adopted was not a risk for juvenile delinquency if the individual was adopted at 12 months of age or earlier (Laubjerg & Petersson, 2011). However, those adopted after 12 months of age had a three to four times higher risk of becoming a juvenile delinquent than their nonadopted counterparts. Also, a recent study found that the mother's adult secure attachment, but not the father's, predicted infant adoptees' secure attachment (Lionetti, 2014). Keep in mind that the changes in adoption practice over the last several decades make it difficult to generalize about the average adopted child or average adoptive parent.

An ongoing issue in adopting children is whether there should be any contact with children's biological parents (Farr & others, 2014; French & others, 2014; Grant-Marsney, Grotevant, & Sayer, 2016). Open adoption involves sharing identifying information and having contact with the biological parents; in contrast, closed adoption involves not having such sharing and contact. Most adoption agencies today offer adoptive parents the opportunity to have either an open or a closed adoption. A longitudinal study found that when their adopted children reached adulthood, adoptive parents described open adoption

connecting development to life

Parenting Adopted Children

Many of the keys to effectively parenting adopted children are no different from those for effectively parenting biological children: be supportive and caring, be involved and monitor the child's behavior and whereabouts, be a good communicator, and help the child learn to develop self-control. However, parents of adopted children face some unique circumstances (Grotevant & McDermott, 2014; Pace & others, 2015; Salcuni & others, 2015; Tan & others, 2016). These parents need to recognize the differences involved in adoptive family life, communicate about these differences, show respect for the birth family, and support the child's search for self and identity.

Following are some of the problems parents may face when their adopted children are at different points in development and some recommendations for how to handle these problems (Brodzinsky & Pinderhughes, 2002):

- **Infancy.** Researchers have found few differences in the attachment that adopted and nonadopted infants form with their parents. However, attachment can become problematic if parents have unresolved fertility issues or the child does not meet the parents' expectations. Counselors can help prospective adoptive parents develop realistic expectations.
- **Early childhood.** Because many children begin to ask where they came from when they are about 4 to 6 years old, this is a natural time to begin to talk in simple ways to children about their adoption status (Warshak, 2007). Some parents (although not as many as in the past) decide not to tell their children about the adoption. This secrecy may create psychological risks for the child if he or she later finds out about the adoption.



What are some strategies for parenting adopted children at different points in their development?
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- **Middle and late childhood.** During the elementary school years, children begin to show more interest in their origins and may ask questions related to where they came from, what their birth parents looked like, and why their birth parents placed them for adoption. As they grow older, children may develop mixed feelings about being adopted and question their adoptive parents' explanations. It is important for adoptive parents to recognize that this ambivalence is normal. Also, problems may arise from the desire of adoptive parents to make life too perfect for the adoptive child and to present a perfect image of themselves to the child. The result too often is that adopted children feel that they cannot release any angry feelings or openly discuss problems.

- **Adolescence.** Adolescents are likely to develop more abstract and logical thinking, to focus their attention on their bodies, and to search for an identity. These characteristics provide the foundation for adopted adolescents to reflect on their adoption status in more complex ways, such as focusing on how they look so different from their adoptive parents.

As they explore their identity, adopted adolescents may have difficulty incorporating their adopted status in positive ways into their identity. It is important for adoptive parents to understand the complexity of the adopted adolescent's identity exploration and be patient with the adolescent's lengthy identity search.

According to the information presented here and in the preceding text, how can mental health professionals help both adoptive parents and adopted children?

positively and saw it as serving the child's best interests (Siegel, 2013). Another longitudinal study found that birth mothers, adoptive parents, and adopted children who had contact were more satisfied with their arrangements than those who did not have contact (Grotevant & others, 2013). Also, in this study, contact was linked to more optimal adjustment for adolescents and emerging adults. Further, birth mothers who were more satisfied with their contact arrangements had less unresolved grief 12 to 20 years after placement. In a study of adoptees in emerging adulthood, perceptions of secure parent-child attachment relationships, as well as sensitive and open communication about birth parent contact, were linked to greater satisfaction with life (Farr, Grant-Marsney, & Grotevant, 2014).

To read more about adoption, see *Connecting Development to Life*, in which we discuss effective parenting strategies with adopted children.

Review Connect Reflect

LG3 Identify some important reproductive challenges and choices.

Review

- What are some common prenatal diagnostic tests?
- What are some techniques that help infertile people to have children?
- How does adoption affect children's development?

Connect

- Earlier we discussed the different methods for collecting data.

How would you characterize the methods used in prenatal diagnostic testing?

Reflect Your Own Personal Journey of Life

- If you were an adult who could not have children, would you want to adopt a child? Why or why not?

4 Heredity-Environment Interaction: The Nature-Nurture Debate

LG4 Explain some of the ways that heredity and environment interact to produce individual differences in development.

Behavior Genetics

Heredity-Environment Correlations

Shared and Nonshared Environmental Experiences

The Epigenetic View and Gene-Environment ($G \times E$) Interaction

Conclusions about Heredity-Environment Interaction



Twin studies compare identical twins with fraternal twins. Identical twins develop from a single fertilized egg that splits into two genetically identical organisms. Fraternal twins develop from separate eggs, making them genetically no more similar than non-twin siblings. *What is the nature of the twin study method?*

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Is it possible to untangle the influence of heredity from that of environment and discover the role of each in producing individual differences in development? When heredity and environment interact, how does heredity influence the environment and vice versa?

BEHAVIOR GENETICS

Behavior genetics is the field that seeks to discover the influence of heredity and environment on individual differences in human traits and development (Jaffee, 2016; Lickliter & Honeycutt, 2015; Nes & Roysamb, 2016). Note that behavior genetics *does not* identify the extent to which genetics or the environment affects an individual's traits. Instead, what behavior geneticists try to do is to figure out what is responsible for the differences among people—that is, to what extent people vary because of differences in genes, environment, or a combination of these factors (Carlson, Mendle, & Harden, 2014; Cloninger & Garcia, 2016; South & Jarnecke, 2016). To study the influence of heredity on behavior, behavior geneticists often use either twins or adoption situations.

In the most common **twin study**, the behavioral similarity of identical twins (who are genetically identical) is compared with the behavioral similarity of fraternal twins. Recall that although fraternal twins share the same womb, they are no more genetically alike than non-twin siblings. Thus, by comparing groups of identical and fraternal twins, behavior geneticists capitalize on the basic knowledge that identical twins are more similar genetically than are fraternal twins (Jansen & others, 2015; Tan & others, 2015). For example, one study found that conduct problems were more prevalent in identical twins than fraternal twins; the researchers concluded that the study demonstrated an important role for heredity in conduct problems (Scourfield & others, 2004).

What are some of the thoughts and feelings people have about being a twin? In college freshman Colin Kunzweiler's (2007) view,

As a monozygotic individual, I am used to certain things. "Which one are you?" happens to be the most popular question I'm asked, which is almost always followed by "You're Colin. No, wait, you're Andy!" I have two names: one was given to me at birth, the other thrust on me in a random, haphazard way . . . My twin brother and I are as different from each other

as caramel sauce is from gravy. We have different personalities, we enjoy different kinds of music, and I am even taller than he is (by a quarter of an inch). We are different; separate; individual. I have always been taught that I should maintain my own individuality; that I should be my own person. But if people keep constantly mistaking me for my twin, how can I be my own person with my own identity?

"Am I an 'I' or 'We'?" was the title of an article written by Lynn Perlman (2008) about the struggle twins have in developing a sense of being an individual. Of course, triplets have the same issue, possibly even more strongly so. One set of triplets entered a beauty contest as one person and won the contest!

Perlman, an identical twin herself, is a psychologist who works with twins (her identical twin also is a psychologist). She says that how twins move from a sense of "we" to "I" is a critical task for them as children and sometimes even as adults. For non-twins, separating oneself from a primary caregiver—mother and/or father—is an important developmental task in childhood, adolescence, and emerging adulthood. When a child has a twin, the separation process is likely more difficult because of the constant comparison with a twin. Because they are virtually identical in their physical appearance, identical twins are likely to have more problems in distinguishing themselves from their twin than are fraternal twins.

The twin separation process often accelerates in adolescence when one twin is likely to mature earlier than the other (Pearlman, 2013). However, for some twins it may not occur until emerging adulthood when they may go to different colleges and/or live apart for the first time. And for some twins, even as adults twin separation can be emotionally painful. One 28-year-old identical twin female got a new boyfriend but the new relationship caused a great deal of stress and conflict with her twin sister (Friedman, 2013).

In Lynn Perlman's (2008) view, helping twins develop their own identities needs to be done on a child-by-child basis, taking into account their preferences and what is in their best interests. She commented that most of the twins she has counseled consider having a twin a positive experience and while they also are usually strongly attached to each other they are intensely motivated to be considered a unique person.

However, several issues complicate interpretation of twin studies. For example, perhaps the environments of identical twins are more similar than the environments of fraternal twins. Adults might stress the similarities of identical twins more than those of fraternal twins, and identical twins might perceive themselves as a "set" and play together more than fraternal twins do. If so, the influence of the environment on the observed similarities between identical and fraternal twins might be very significant.

In an **adoption study**, investigators seek to discover whether the behavior and psychological characteristics of adopted children are more like those of their adoptive parents, who have provided a home environment, or more like those of their biological parents, who have contributed their DNA (Cvijetic & others, 2014; McAdams & others, 2015). Another form of the adoption study compares adoptive and biological siblings (Kendler & others, 2016).

HEREDITY-ENVIRONMENT CORRELATIONS

The difficulties that researchers encounter when they interpret the results of twin studies and adoption studies reflect the complexities of heredity-environment interaction. Some of these interactions are heredity-environment correlations, which means that individuals' genes may be systematically related to the types of environments to which they are exposed (Jaffee, 2016; Klahr & Burt, 2014). In a sense, individuals "inherit," seek out, or "construct" environments that may be related or linked to genetic "propensities." Behavior geneticist Sandra Scarr (1993) described three ways that heredity and environment can be correlated (see Figure 11):

- **Passive genotype-environment correlations** occur because biological parents, who are genetically related to the child, provide a rearing environment for the child. For example, the parents might have a genetic predisposition to be intelligent and read skillfully. Because they read well and enjoy reading, they provide their children with books to read. The likely outcome is that their children, because of both their own inherited predispositions and their book-filled environment, will become skilled readers.
- **Evocative genotype-environment correlations** occur because a child's genetically influenced characteristics elicit certain types of environments. For example, active, smiling

behavior genetics The field that seeks to discover the influence of heredity and environment on individual differences in human traits and development.

twin study A study in which the behavioral similarity of identical twins is compared with the behavioral similarity of fraternal twins.

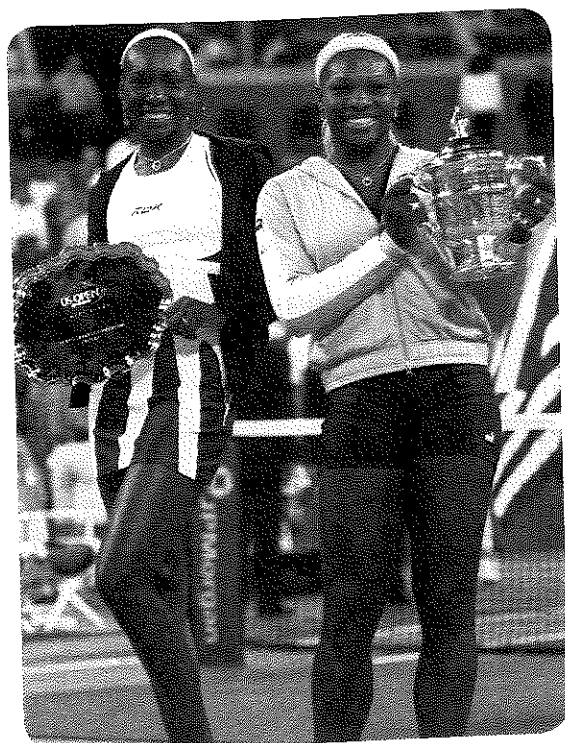
adoption study A study in which investigators seek to discover whether, in behavior and psychological characteristics, adopted children are more like their adoptive parents, who provided a home environment, or more like their biological parents, who contributed their heredity. Another form of the adoption study compares adoptive and biological siblings.

passive genotype-environment correlations Correlations that exist when the natural parents, who are genetically related to the child, provide a rearing environment for the child.

evocative genotype-environment correlations Correlations that exist when the child's genetically influenced characteristics elicit certain types of environments.

Heredity-Environment Correlation	Description	Examples
Passive	Children inherit genetic tendencies from their parents, and parents also provide an environment that matches their own genetic tendencies.	Musically inclined parents usually have musically inclined children, and they are likely to provide an environment rich in music for their children.
Evocative	The child's genetic tendencies elicit stimulation from the environment that supports a particular trait. Thus genes evoke environmental support.	A happy, outgoing child elicits smiles and friendly responses from others.
Active (niche-picking)	Children actively seek out "niches" in their environment that reflect their own interests and talents and are thus in accord with their genotype.	Libraries, sports fields, and a store with musical instruments are examples of environmental niches children might seek out if they have intellectual interests in books, talent in sports, or musical talents, respectively.

FIGURE 11
EXPLORING HEREDITY-ENVIRONMENT CORRELATIONS



Tennis stars Venus and Serena Williams. What might be some shared and nonshared environmental experiences they had while they were growing up that contributed to their tennis stardom?
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children receive more social stimulation than passive, quiet children do. Cooperative, attentive children evoke more pleasant and instructional responses from the adults around them than uncooperative, distractible children do.

- **Active (niche-picking) genotype-environment correlations** occur when children seek out environments that they find compatible and stimulating. *Niche-picking* refers to finding a setting that is suited to one's genetically influenced abilities. Children select from their surrounding environment certain aspects that they respond to, learn about, or ignore. Their active selections of environments are related to their particular genotype. For example, outgoing children tend to seek out social contexts in which to interact with people, whereas shy children don't. Children who are musically inclined are likely to select musical environments in which they can successfully perform their skills. How these "tendencies" come about will be discussed shortly under the topic of the epigenetic view.

Scarr observes that the relative importance of the three genotype-environment correlations changes as children develop from infancy through adolescence. In infancy, much of the environment that children experience is provided by adults. Thus, passive genotype-environment correlations are more common in the lives of infants and young children than they are in the lives of older children and adolescents who can extend their experiences beyond the family's influence and create or select their environments to a greater degree.

SHARED AND NONSHARED ENVIRONMENTAL EXPERIENCES

Behavior geneticists have argued that to understand the environment's role in differences between people, we should distinguish between shared and nonshared environments. That is, we should consider experiences that children share in common with other children living in the same home, and experiences that are not shared (Burt, 2014; Li & others, 2015; Waszczuk & others, 2015).

Shared environmental experiences are siblings' common experiences, such as their parents' personalities or intellectual orientation, the family's socioeconomic status, and the neighborhood in which they live. By contrast, **nonshared environmental experiences** consist of a child's unique experiences, both within the family and outside the family, that are not shared with a sibling. Even experiences occurring within the family can be part of the "nonshared environment." For example, parents often interact differently with each sibling, and siblings interact differently with parents. Siblings often have different peer groups, different friends, and different teachers at school, all of which contribute to their nonshared environments.

Behavior geneticist Robert Plomin (2004, 2011) has found that shared environment accounts for little of the variation in children's personality or interests. In other words, even though two children live under the same roof with the same parents, their personalities are often very different. Further, Plomin argues that heredity influences the nonshared environments of siblings through the heredity-environment correlations we described earlier. For example, a child who has inherited a tendency to be athletic is likely to spend more time in environments related to sports, and a child who has inherited a tendency to be musically inclined is more likely to spend time in environments related to music.

What are the implications of Plomin's interpretation of the role of shared and nonshared environments in development? In *The Nurture Assumption*, Judith Harris (1998, 2009) argued that what parents do does not make a difference in their children's and adolescents' behavior. Yell at them. Hug them. Read to them. Ignore them. Harris says it won't influence how they turn out. She argues based on data like Plomin's that genes and peers are far more important than parents in shaping children's and adolescents' development.

Genes and peers do matter, but Harris' descriptions of peer influences do not take into account the complexity of peer contexts and developmental trajectories (Hartup, 2009). In addition, Harris is wrong in saying that parents don't matter. For example, in the early childhood years parents play an important role in selecting children's peers and indirectly influencing children's development (Baumrind, 1999). A large volume of parenting literature with many research studies documents the importance of parents in children's development (Clarke-Stewart & Parke, 2014; Laible, Thompson, & Froimson, 2015; McBride Murry & others, 2015). We will discuss parents' important roles throughout this edition.

THE EPIGENETIC VIEW AND GENE $\times$ ENVIRONMENT ($G \times E$) INTERACTION

Critics argue that the concept of heredity-environment correlation gives heredity too much of a one-sided influence in determining development because it does not consider the role of prior environmental influences in shaping the correlation itself (Gottlieb, 2007). Consistent with this view, earlier in the chapter we discussed how genes are collaborative, not determining an individual's traits in an independent manner but rather in an interactive manner with the environment.

The Epigenetic View In line with the concept of a collaborative gene, Gilbert Gottlieb (2007) emphasizes the **epigenetic view**, which states that development reflects an ongoing, *bidirectional* interchange between heredity and the environment. Figure 12 compares the heredity-environment correlation and epigenetic views of development.

Let's look at an example that reflects the epigenetic view. A baby inherits genes from both parents at conception. During prenatal development, environmental experiences such as toxins, nutrition, and stress can influence some genes to stop functioning while others become more active or less active. During infancy, environmental experiences such as exposure to toxins, nutrition, stress, learning, and encouragement continue to modify genetic activity and influence the activity of the nervous system that directly underlies behavior. Heredity and environment operate together—or collaborate—to produce a person's well-being, intelligence, temperament, height, weight, ability to pitch a baseball, ability to read, and so on (Gottlieb, 2007; Lickliter & Honeycutt, 2015; Moore, 2015; Szyf & Pluess, 2016).

Gene $\times$ Environment ($G \times E$) Interaction An increasing number of studies are exploring how the interaction between heredity and environment influences development, including interactions that involve specific DNA sequences (Grigorenko & others, 2016; Hill & Roth, 2016; Philibert & Beach, 2016; Pluess & Meaney, 2016). The epigenetic mechanisms involve the actual molecular modification of the DNA strand as a result of environmental inputs in ways that alter gene functioning (Davies & Cicchetti, 2014; Moore, 2015).

One study found that individuals who have a short version of a gene labeled 5-HTTLPR (a gene involving the neurotransmitter serotonin) have an elevated risk of developing depression only if they *also* lead stressful lives (Caspi & others, 2003). Thus, the specific gene did not directly cause the development of depression; rather, the gene interacted with a stressful environment in a way that allowed the researchers to predict whether individuals would

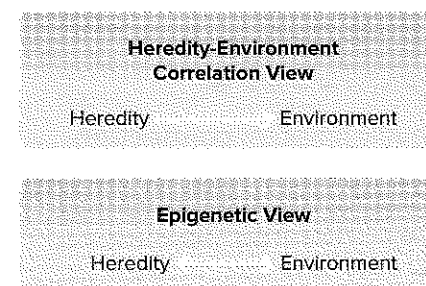


FIGURE 12
COMPARISON OF THE HEREDITY-ENVIRONMENT CORRELATION AND EPIGENETIC VIEWS

active (niche-picking) genotype-environment correlations Correlations that exist when children seek out environments they find compatible and stimulating.

shared environmental experiences Siblings' common environmental experiences, such as their parents' personalities and intellectual orientation, the family's socioeconomic status, and the neighborhood in which they live.

nonshared environmental experiences The child's own unique experiences, both within the family and outside the family, that are not shared with another sibling. Thus, experiences occurring within the family can be part of the "nonshared environment."

epigenetic view Emphasizes that development is the result of an ongoing, bidirectional interchange between heredity and environment.

developmental connection

Attachment

One study revealed links between infant attachment, responsive parenting, and the 5-HTTLPR gene. Connect to “Socioemotional Development in Infancy.”

developmental connection

Nature Versus Nurture

The relative importance of nature and nurture is one of the main debates in the study of life-span development. Connect to “Introduction.”

developmental connection

Life-Span Perspective

An important aspect of the life-span perspective is the co-construction of biology, environment, and the individual. Connect to “Introduction.”

gene $\times$ environment ($G \times E$) interaction The interaction of a specific measured variation in the DNA and a specific measured aspect of the environment.

develop depression. A recent meta-analysis indicated that the short version of 5-HTTLPR was linked with higher cortisol stress reactivity (Miller & others, 2013). Recent studies also have found support for the interaction between the 5-HTTLPR gene and stress levels in predicting depression in adolescents and older adults (Petersen & others, 2012; Zannas & others, 2012).

Other research on interactions between genes and environmental experiences has focused on attachment, parenting, and supportive child-rearing environments (Hostinar, Cicchetti, & Rogosch, 2014). In one study, adults who experienced parental loss as young children were more likely to have unresolved attachment issues as adults only when they had the short version of the 5-HTTLPR gene (Caspers & others, 2009). The long version of the serotonin transporter gene apparently provided some protection and ability to cope better with parental loss. Other recent research has found that variations in dopamine-related genes interact with supportive or unsupportive rearing environments to influence children’s development (Bakermans-Kranenburg & van IJzendoorn, 2011). The type of research just described is referred to as studies of **gene $\times$ environment ($G \times E$) interaction**—the interaction of a specific measured variation in DNA and a specific measured aspect of the environment (Grigorenko & others, 2016; Hill & Roth, 2016; Moore, 2015).

Although there is considerable enthusiasm about the concept of gene $\times$ environment interaction ($G \times E$), a recent research review concluded that the area is plagued by difficulties in replicating results, inflated claims, and other weaknesses (Manuck & McCaffery, 2014). The science of $G \times E$ interaction is very young and over the next several decades it will likely produce more precise findings.

CONCLUSIONS ABOUT HEREDITY-ENVIRONMENT INTERACTION

If an attractive, popular, intelligent girl is elected president of her senior class in high school, is her success due to heredity or to environment? Of course, the answer is “both.”

The relative contributions of heredity and environment are not additive. That is, we can’t say that such-and-such a percentage of nature and such-and-such a percentage of experience make us who we are. Nor is it accurate to say that full genetic expression happens once, around conception or birth, after which we carry our genetic legacy into the world to see how far it takes us. Genes produce proteins throughout the life span, in many different environments. Or they don’t produce these proteins, depending in part on how harsh or nourishing those environments are.

The emerging view is that complex behaviors are influenced by genes and environments in a way that gives people a propensity for a particular developmental trajectory (Asbury & Plomin, 2014). The actual development requires both genes and an environment. And that environment is complex, just like the mixture of genes we inherit (Cicchetti & Toth, 2015, 2016; Thompson, 2015, 2016). Environmental influences range from the things we lump together under “nurture” (such as parenting, family dynamics, schooling, and neighborhood quality) to biological encounters (such as viruses, birth complications, and even biological events occurring at the cellular level).

In developmental psychologist David Moore’s (2013, 2015) view, the biological systems that generate behaviors are extremely complex but too often these systems have been described in overly simplified ways that can be misleading. Thus, although genetic factors clearly contribute to behavior and psychological processes, they don’t determine these phenotypes independently from the contexts in which they develop. From Moore’s (2015) perspective, it is misleading to talk about “genes for” eye color, intelligence, personality, or other characteristics. Moore commented that in retrospect we should not have expected to be able to make the giant leap from DNA’s molecules to a complete understanding of human behavior any more than we should anticipate being able to make the leap from understanding how sound waves move air molecules in a concert hall to a full-blown appreciation of a symphony’s wondrous experience.

Imagine for a moment a cluster of genes somehow associated with youth violence (this example is hypothetical because we don’t know of any such combination). The adolescent who carries this genetic mixture might experience a world of loving parents, regular nutritious meals, lots of books, and a series of masterful teachers. Or the adolescent’s world might

include parental neglect, a neighborhood in which gunshots and crime are everyday occurrences, and inadequate schooling. In which of these environments is the adolescent likely to become a criminal?

If heredity and environment interact to determine the course of development, is that all there is to answering the question of what causes development? Are humans completely at the mercy of their genes and environment as they develop through the life span? Our genetic heritage and environmental experiences are pervasive influences on development (Grigorenko & others, 2016; Lickliter & Honeycutt, 2015; Moore, 2015; Simon, 2017). But in thinking about what causes development, recall from the “Introduction” chapter our discussion of development as the co-construction of biology, culture, and the individual. Not only are we the outcomes of our heredity and the environment we experience, but we also can author a unique developmental path by changing the environment. As one psychologist recently concluded:

In reality, we are both the creatures and creators of our worlds. We are . . . the products of our genes and environments. Nevertheless, . . . the stream of causation that shapes the future runs through our present choices . . . Mind matters . . . Our hopes, goals, and expectations influence our future. (Myers, 2010, p. 168)

Review Connect Reflect

LG4 Explain some of the ways that heredity and environment interact to produce individual differences in development.

Review

- What is behavior genetics?
- What are three types of heredity-environment correlations?
- What is meant by the concepts of shared and nonshared environmental experiences?
- What is the epigenetic view of development? What characterizes gene $\times$ environment ($G \times E$) interaction?
- What conclusions can be reached about heredity-environment interaction?

Connect

- Of passive, evocative, and active genotype-environment correlations,



To what extent are this young girl’s piano skills likely due to heredity, environment, or both?
© Francisco Romero/E+/Getty Images RF

which is the best explanation for the similarities discovered between the twins discussed in the chapter-opening story?

Reflect Your Own Personal Journey of Life

- Someone tells you that she has analyzed your genetic background and environmental experiences and concluded that environment definitely has had little influence on your intelligence. What would you say about this analysis?

topical connections looking forward

In the following chapters, we will continue to explore biological influences on development, especially in the chapters on physical development, but also in the chapters on cognitive and socioemotional development. For instance, biology’s influence on infants’ gross and fine motor skills may be obvious, but we will also discuss research questions such as “Is there a biological basis for sexual orientation?” In addition, we will examine reproduction when we look at adolescents and young adults who become parents. Finally, we will touch on the dual influence of nature and nurture in every period of life-span development.

Biological Beginnings

1 The Evolutionary Perspective

LG1 Discuss the evolutionary perspective on life-span development.

Natural Selection and Adaptive Behavior

Evolutionary Psychology

- Natural selection is the process by which those individuals of a species that are best adapted survive and reproduce. Darwin proposed that natural selection fuels evolution. In evolutionary theory, adaptive behavior is behavior that promotes the organism's survival in a natural habitat.
- Evolutionary psychology holds that adaptation, reproduction, and "survival of the fittest" are important in shaping behavior. Ideas proposed by evolutionary developmental psychology include the view that an extended childhood period is needed to develop a large brain and learn the complexity of human social communities. According to Baltes, the benefits resulting from evolutionary selection decrease with age mainly because of a decline in reproductive fitness. At the same time, cultural needs increase. Like other theoretical approaches to development, evolutionary psychology has limitations. Bandura rejects "one-sided evolutionism" and argues for a bidirectional link between biology and environment. Biology allows for a broad range of cultural possibilities.

2 Genetic Foundations of Development

LG2 Describe what genes are and how they influence human development.

The Collaborative Gene

Genes and Chromosomes

Genetic Principles

Chromosomal and Gene-Linked Abnormalities

- Short segments of DNA constitute genes, the units of hereditary information that help cells to reproduce and manufacture proteins. Genes act collaboratively, not independently.
- Genes are passed on to new cells when chromosomes are duplicated during the processes of mitosis and meiosis, which are two ways in which new cells are formed. When an egg and a sperm unite in the fertilization process, the resulting zygote contains the genes from the chromosomes in the father's sperm and the mother's egg. Despite this transmission of genes from generation to generation, variability is created in several ways, including through the exchange of chromosomal segments during meiosis, through mutations, and through environmental influences.
- Genetic principles include those involving dominant-recessive genes, sex-linked genes, genetic imprinting, and polygenic inheritance.
- Chromosomal abnormalities produce Down syndrome, which is caused by the presence of an extra copy of chromosome 21. Sex-linked conditions include Klinefelter syndrome, fragile X syndrome, Turner syndrome, and XYY syndrome. Gene-linked abnormalities involve harmful or absent genes. Gene-linked disorders include phenylketonuria (PKU) and sickle-cell anemia. Genetic counseling offers couples information about their risk of having a child with inherited abnormalities.

3 Reproductive Challenges and Choices

LG3 Identify some important reproductive challenges and choices.

Prenatal Diagnostic Tests

Infertility and Reproductive Technology

- Ultrasound sonography, fetal MRI, chorionic villus sampling, amniocentesis, and maternal blood screening are used to determine whether a fetus is developing normally. Noninvasive prenatal diagnosis is increasingly being explored.
- Approximately 10 to 15 percent of U.S. couples have infertility problems, some of which can be corrected through surgery or fertility drugs. An additional option is in vitro fertilization.

Adoption

- A majority of adopted children adapt effectively. When adoption occurs very early in development, the outcomes for the child are improved. Because of the dramatic changes that occurred in adoption in recent decades, it is difficult to generalize about the average adopted child or average adoptive family.

4 Heredity-Environment Interaction: The Nature-Nurture Debate

LG4 Explain some of the ways that heredity and environment interact to produce individual differences in development.

Behavior Genetics

Heredity-Environment Correlations

Shared and Nonshared Environmental Experiences

The Epigenetic View and Gene $\times$ Environment ($G \times E$) Interaction

Conclusions About Heredity-Environment Interaction

- Behavior genetics is the field concerned with the influence of heredity and environment on individual differences in human traits and development. Research methods used by behavior geneticists include twin studies and adoption studies.
- In Scarr's heredity-environment correlations view, heredity directs the types of environments that children experience. She describes three genotype-environment correlations: passive, evocative, and active (niche-picking). Scarr argues that the relative importance of these three genotype-environment correlations changes as children develop.
- Shared environmental experiences refer to siblings' common experiences, such as their parents' personalities and intellectual orientation, the family's socioeconomic status, and the neighborhood in which they live. Nonshared environmental experiences involve the child's unique experiences, both within the family and outside the family, that are not shared with a sibling. Many behavior geneticists argue that differences in the development of siblings are due to nonshared environmental experiences (and heredity) rather than shared environmental experiences.
- The epigenetic view emphasizes that development is the result of an ongoing, bidirectional interchange between heredity and environment. Gene $\times$ environment interaction involves the interaction of a specific measured variation in the DNA and a specific measured aspect of the environment. An increasing number of $G \times E$ studies are being conducted.
- Behaviors are influenced by genes and environments in a way that gives people a propensity for a particular developmental trajectory. The actual development requires both genes and an environment, and that environment is complex. The interaction of heredity and environment is extensive. Much remains to be discovered about the specific ways that heredity and environment interact to influence development. Heredity and environment are pervasive influences on development, but humans can author a unique developmental path by changing their environments.

key terms

active (niche-picking) genotype-environment correlations
adoption study
behavior genetics
chromosomes
DNA
Down syndrome
epigenetic view

evocative genotype-environment correlations
evolutionary psychology
fertilization
fragile X syndrome
gene $\times$ environment ($G \times E$) interaction
genes

genotype
Klinefelter syndrome
meiosis
mitosis
nonshared environmental experiences
passive genotype-environment correlations

phenotype
phenylketonuria (PKU)
shared environmental experiences
sickle-cell anemia
Turner syndrome
twin study
XYY syndrome
zygote

key people

Paul Baltes
Albert Bandura
Thomas Bouchard

David Buss
Charles Darwin
Gilbert Gottlieb

Stephen Jay Gould
Judith Harris
Cynthia Kenyon

David Moore
Robert Plomin
Sandra Scarr