CHAPTER 5
Infancy—Physical Development

CHAPTER OUTLINE
I. Body growth and development Physical growth and motor skill development are among the most apparent signs of development in infancy. Growth refers specifically to the increase in physical size of the body. Development refers to the orderly patterns and levels of functioning associated with growth.

A. Norms of growth To determine whether rate of growth in an individual is proceeding as expected, physical characteristics such as weight and height are measured quantitatively in a sample of the population at different ages to establish norms. Such normative data indicate that while males and females grow at a similar rate in infancy and childhood, an adolescent growth spurt occurs in girls about two years earlier than it occurs in boys.

B. Patterns in body growth The rate of growth for various body systems differs as compared to the body as a whole. For instance, head size is 50% of body length two months after conception, but only 12% of body length in adulthood. The pattern of development for individual systems of the body is often cephalocaudal (parts of the body near the head grow more rapidly than parts more distant from the head) or proximodistal (parts of the body near the middle develop before those near the periphery). Considerable variability occurs in the rate of physical growth and development among individuals within a group as well as among ethnic and cultural groups.

II. The brain and nervous system Our knowledge of the brain and brain structure has increased tremendously over the past decade due in no small part to technological advances. Cognitive neuroscientists utilize a number of different procedures including positron emission tomography (PET), functional magnetic resource imaging (fMRI), and event-related potentials (ERP) to determine which regions of the brain are functioning during the processing of various kinds of information.

A. The developing brain The brain grows rapidly during the prenatal period and continues to grow after birth, though at a slower rate. Different brain areas grow at different rates; the brainstem and midbrain are almost complete at birth, while the cerebral cortex continues to develop postnatally. The brain consists of neurons and glial cells, which outnumber neurons by a factor of ten. Parts of many neurons become surrounded by myelin, a sheath of fatty material that insulates and speeds up neural impulses. Neuron proliferation, neuron migration, and neuron differentiation are all part of prenatal brain development. Migration often occurs in an inside-out pattern of development, in which layers of nerve cells nearer the outer surface are younger than layers deep in the cortex. After birth, additional brain development is due largely to neuron differentiation, which increases the number of connections between neurons. Experience (environmental influences) plays a role in determining the connections between neurons.

B. Plasticity in brain development Certain brain areas and the individual neurons within these areas possess plasticity, the ability of a brain structure to replace the functions normally controlled by other brain areas should these other areas become damaged. Some neurons are sensitive to experience-expectant information, such as in the development of depth or pattern vision in many animals. Other neurons are sensitive to experience-
dependent information. As organisms encounter events in the world, they become activated and fire together, helping maintain connections between them.

C. **Brain lateralization** The cerebral cortex is divided into right and left hemispheres. In general, each hemisphere has specialized functions. The process by which one hemisphere dominates the other is called lateralization. For example, in most right-handed people, the left hemisphere is especially involved in language, while the right hemisphere is involved in spatial processing. Studies suggest that infants display behaviors that indicate lateralization at birth; however, lateralization may increase later in development.

III. **Motor skill development** Two complementary patterns are evident in the emergence of motor activity. Differentiation is the enrichment of global and diffuse actions with more refined and skilled ones, and integration is the increasingly coordinated actions of muscles and sensory systems. As development occurs, motor skills become more efficient.

A. **The first actions: reflexes** The earliest movements of the newborn are reflexes, involuntary responses to environmental stimuli such as touch, sound, and light. Primitive reflexes are necessary for survival and include reflexes that provide nourishment, such as rooting and sucking.

B. **Motor milestones** During the first year of life, infants exhibit rhythmical stereotypes, repeated sequences of movements that do not appear to be goal directed but may be integrated into later voluntary behaviors. Directed, voluntary behaviors gradually emerge in the first year. Some of these behaviors can be described as motor milestones because they provide the infant with new ways to interact with the environment.

1. **Postural control.** Keeping the head upright and stable at about 2–3 months is one of the first milestones in infant development. Milestones often reflect a cephalocaudal progression; head control precedes leg control.
2. **Locomotion.** The ability to move about the environment is a major accomplishment for infants. Infants display a wide variety of locomotion types, varying from crawling, to creeping, to cruising. Eventually, about half of American children will walk on their own at about 1 year of age.
3. **Manual control.** Moving hand to mouth is one of the earliest goal-directed actions shown by children. Systematic reaching occurs at about 3 months, and ballistic reaching develops at 5–6 months. Children initially tend to keep their hands closed into fists when reaching, and gradually gain finer motor control. A pincer grasp (using opposing thumbs and fingertips) emerges at 9 months.

C. **Determinants of motor development** Evidence consistent with a maturational view of motor development is suggested by the tendency in all children to undergo predictable and orderly patterns of motor development. Even developmentally disabled babies achieve milestones in the same sequence as normal babies, although somewhat more slowly. Greater concordance in motor skills with increasing genetic similarity supports a genetic influence on motor development. The serious developmental delays seen in institutionalized children who are severely deprived of experiences with motor activity demonstrate that environmental factors are also crucial for proper motor development. Some types of experiences may promote the acquisition of motor milestones. However, infants engaged in a range of physical activity often receive a sufficient variety of experiences to allow them to assemble the multiple processes that underlie the acquisition of complex motor behavior.

D. **Cross-cultural differences** Cross-cultural studies reveal a wide variety of motor skill development. Many factors may contribute, but findings strongly implicate differences in child rearing practices.

IV. **Sleep** Infants display a wide variety of behavioral states, ranging from sleep to alert activity. Part of physical development includes changes in sleep patterns that brings caregivers and infants in closer alignment.
A. **Patterns of sleep** Infants display two distinct sleep states. REM (rapid-eye-movement) sleep is an active sleep that includes muscle jerks and irregular breathing and heart-rate activity. NREM (non-REM) sleep is a quiet sleep in which few movements and more regular heart rate and breathing are present. Autostimulation theory suggests that REM sleep provides the infant’s central nervous system with essential amounts of stimulation that the infant may miss by not being awake for long periods of time. Sleep cycles are dependent on culture, although typically by 3–5 weeks the longest period of sleep takes place at night.

B. **Sleeping arrangements** Many cultures use a co-sleeping pattern in which infants and mothers sleep together, although the United States shows this pattern less often. Controversy exists as to the benefits of co-sleeping. Some researchers believe co-sleeping results in synchronized breathing between infants and caregivers, resulting in fewer episodes of apnea, or temporary stops in breathing. However, other research suggests co-sleeping can put the infant at risk, especially for younger infants and when mothers smoke or take other drugs.

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**Research Applied to Parenting: Helping to Reduce Sudden Infant Death Syndrome**

The ability to modify reflexes and integrate them with voluntary motor skills is an important developmental process. *Sudden infant death syndrome (SIDS)*, the abrupt, unexplained death of an otherwise healthy infant, may be a result of an unsuccessful integration of reflexive and voluntary control of breathing. Although no single cause has been identified, several factors have been correlated with SIDS. The steps parents can take to help reduce the likelihood of SIDS include placing the infant on his or her back to sleep, eliminating exposure to cigarette smoke, providing firm bedding, having the infant use a pacifier while sleeping, and avoiding overheating. Some researchers also suggest that having the infant sleep in the same room as the caregiver during the first few months of development also helps reduce the risk of SIDS.

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V. **Basic learning processes in infancy and childhood** Developmental psychologists have found evidence for a number of basic learning processes in early infancy and childhood.

A. **Habituation** Habituation is the gradual decline in responding following repeated occurrences of the same stimulus. When a response reoccurs after a change in the familiarized stimulus, an individual is displaying recovery from habituation, or dishabituation. Nearly all infants demonstrate habituation, but premature, brain-damaged, and younger infants show less rapid habituation and less rapid recovery from habituation than older, more mature infants.

B. **Classical conditioning** In classical conditioning, a neutral stimulus, called the conditioned stimulus (CS), becomes associated with a stimulus that spontaneously elicits an inborn response. It is the unconditioned stimulus (UCS) that normally elicits the unconditioned response (UCR). Following a number of pairings of the CS with the UCS, the CS alone will come to elicit a response similar to the UCR. The response that is elicited by the CS alone is called the conditioned response (CR). Infants as young as two hours have been shown to exhibit classical conditioning. Newborn infants’ limited behaviors, however, restrict the CRs they can learn. As infants become older, classical conditioning occurs more rapidly and involves a broader range of stimuli.

C. **Operant conditioning** Operant conditioning involves changes in a behavior as a result of the consequences that follow the behavior. In general, behaviors increase in frequency when followed by a positive reinforcement or by the removal of an aversive stimulus, or negative reinforcement. Behaviors decrease in frequency when they are followed by the removal of rewards (negative punishment) or the presentation of an aversive event (positive punishment). Experimental evidence also exists for operant conditioning in newborns within a few hours after birth.
D. **Imitation** Imitation is the process whereby an infant repeats a response that another individual, the model, has made. Some researchers have reported that one- or two-day-old newborns can imitate facial expressions. Other psychologists have questioned whether the infants’ behaviors are true imitations or biologically programmed responses to any external stimulation. Even before one year of age, the infant demonstrates deferred imitation, the ability to imitate a model’s behavior hours, days, or even weeks later. After a year of age, they also differentiate behaviors that are intentional compared to those that are unintentional.

VI. **Sensory capacities** Psychologists distinguish between sensation, the registration of basic information such as sights and sounds by the sensory receptors and the brain, and perception, the organization and interpretation of sensations.

A. **Measuring infant sensory and perceptual capacities** Most of the techniques that researchers have developed to study infant sensation and perception involve measures of attention. Infants often display preferential looking at some kinds of stimuli. Researchers have found that infants prefer complex visual patterns such as faces or bull’s-eye patterns over solid-colored circles. Habituation, when the infant pays less and less attention to a familiar object, has also been used to examine sensory capacities. Preferential and operant conditioning procedures have also been used to study infant perception. Infants are rewarded with food or other pleasant outcomes for the production of a response, such as sucking or head turning, in the presence of a particular stimulus. Physiological responses such as heart rate or neurological brain activity have also been used to examine the sensory and perceptual abilities of infants.

B. **Vision** The human infant is an active perceiver of the visual information in the environment. Visual accommodation is the process whereby the lens changes its shape so that objects at different distances from the eye can be brought into focus on the retina. Newborns have limited accommodation and best discriminate objects located approximately eight to twenty inches away. Saccades, rapid movements of the eye for inspection of objects or viewing in the periphery, occur immediately after birth. However, the newborn’s saccadic eye movements are slow and range over only small distances. By one month, infants’ saccades are similar to those of adults. Smooth visual pursuit consists of following a slowly moving target with smooth, continuous movements of the eyes. By six to eight months of age this capacity appears adultlike. Infants younger than two months do not show reliable vergence (rotation of the eyes to focus on withdrawing and approaching objects), but by three months they demonstrate this skill more reliably. How well an infant can see is determined by measures of visual acuity, the ability to make discriminations among contours, borders, and edges in the visual array. Visual acuity improves rapidly in the first six months after birth. The retina contains rods and cones, two types of receptor cells. Rods are sensitive to the intensity of light, whereas cones are sensitive to wavelengths of light that are responsible for color perception. By three months of age, and possibly before, infants possess adultlike color vision.

VII. **Atypical development: visual problems in infancy** Not all infants have normal visual development. Infants may be born with cataracts or have amblyopia, or lazy eye. A child with amblyopia (which may or may not be detectable by “cross-eyed” appearance) can lose vision and depth perception unless care is taken early to allow the weaker eye to strengthen. Infants may also be born with cataracts, a clouding of part or of the entire lens that impairs the capacity to see patterned stimuli.

VIII. **Audition** The fetus is listening well before birth. Low frequency sounds are detected sometimes as early as 23 weeks. Remarkably, newborns prefer sounds they heard prenatally. Prenatal familiarity helps to explain why newborns prefer to listen to a recording of their mothers’ voices rather than to a stranger’s voice. By six months, babies show near adult levels of hearing.

A. **Deafness** Not all babies are able to hear at birth. New screening techniques can be used with infants to detect the possibility of hearing loss. However, screening is not universal.
B. **Sound localization** Newborns display *sound localization*, the ability to locate a sound by turning the head or eyes in the direction of the sound; however, they are less precise in locating the position of a noise than children or adults.

IX. **Smell, taste, touch, and sensitivity to pain** Far less research has been conducted on smell, taste, and touch than on hearing and vision. Each of these senses does function at birth and has important survival functions.

A. **Smell** Newborns can detect many odors, as measured by their facial expressions in response to odor stimuli. By five days of age, breast-fed infants prefer their own mothers’ breast pads to other mothers’ breast pads. Extended experience with a particular odor within forty-eight hours of birth leads to preferences for that odor.

B. **Taste** Infants respond differentially to taste stimuli shortly after birth, making relaxed facial responses to sweet, lip pursings to sour, and mouth openings to bitter. Innate taste preferences may help infants meet nutritional needs and avoid harmful substances.

C. **Touch and temperature** Infants can clearly feel sensations on their skin, and for the most part like to be touched. Touch system also illustrates sensory communication between caregivers and infants. Newborns, however, have difficulty in regulating their body temperature.

D. **Sensitivity to pain** Traditionally, newborns and very young infants have seldom received medication to reduce pain. Infants were thought not to experience pain or to remember it if experienced. Furthermore, the consequences of exposure to pain-reducing medication for the infant have been a concern. Research indicates, however, that the neurological mechanisms for detecting pain develop early, and behavioral responses suggest sensitivity to pain, and even some memory of it, in young infants. The use of pain-reducing medications or alternative methods of reducing distress when exposing infants to painful procedures is now recommended.