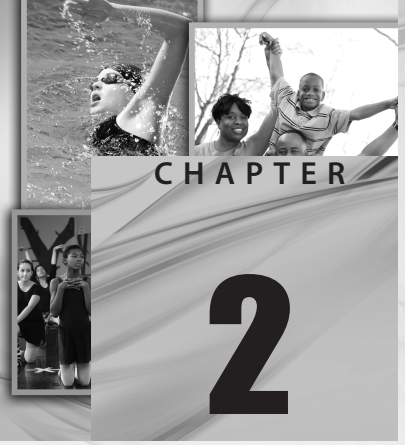


CHAPTER

2 Developmental Patterns

CHAPTER OBJECTIVES

After studying this chapter, the reader should be able to:

1. Identify the importance of the Principles of Motor Development and Principles of Physical Growth as factors that help to explain the developmental patterns observed in children.
2. Recognize the developmental patterns associated with the periods of infancy, early childhood, and later childhood.
3. Appreciate the close and significant relationship among physical growth, motor development, and the social, emotional, and cognitive development of children.
4. Identify common reflexes observed in infants, their time of onset and integration, and their importance as early indicators of potential neurological problems.
5. Analyze the common movement patterns, forms of locomotion, and manipulative patterns associated with various ages and levels of performance.
6. Appreciate the wide range of individual difference found among children of similar ages.

Knowledge of the patterns of development is critical for those engaged in providing services in physical activity for individuals with disabilities. The authors refer to typical development, with the understanding that the unique characteristics of the individual, the environment, and the task being asked of the performer will influence the movement performance of the individual (Davis & Burton, 1991). Historically, the difference in the execution of movement skills at early ages was attributed to the maturation of the central nervous system (CNS) and was used to identify stages of development (e.g., Gesell, 1928). Now current scholarship considers the contribution made by the ecology of the developing child (e.g., Bronfenbrenner & Crouter, 1983) in accurately describing both the current levels of motor development and, when developmental lag is detected, what interventions may be most appropriate. Instead of using a theoretical approach based solely on the maturation of the CNS, research has been conducted using a dynamic systems approach (e.g., Thelen & Smith, 1994), whereby developmental patterns are analyzed, taking into consideration the task being asked of the performer, the environment in which the task is performed, and the identification of the unique characteristics of the individual performer. The current assessment tools in early childhood often reflect a marriage of both dynamic systems theory and the neuromatural theoretical approach (e.g., Miller & Roid, 1994; Piper & Darrah, 1994).

A further extension of the ecological perspective is the tenet of individual differences, whereby each individual is unique. If two individuals have a similar motor impairment (e.g., spastic cerebral palsy), then the manner in which they engage in physical activity and their level of performance at a certain age is not predictable based on their motor impairment (e.g., Sherrill, 2004). Rather, it is understood by the contribution made by such realities as the child's particular life experiences, the family setting, and cultural values (e.g., Bronfenbrenner & Crouter, 1983). It is also important to realize that in the early ages of development, the domains are considered intertwined (e.g., Piaget, 1952), so much so that it is unrealistic to attribute delayed developmental status to just one variable or to believe that only one domain is affected by an intervention.

Within the study of motor development, the most rapid rate of development takes place in the first few years of the child's life (Gabbard, 2011; Haywood & Getchell, 2009).

The science contributing to the establishment of what is expected of a certain chronological age has relied on normative data. Normative data produces a "mythical average child." This notion acknowledges that researchers have tested hundreds sometimes thousands of children to the extract what percentage did what on the tasks. The average child is the norm for that data set associated with that assessment tool of movement skills or motor development. These averages are the patterns that textbooks on motor development describe in detail for the early skills of voluntary control that progress across developmental time. In light of the ecology of the developing child, this normative data needs to be considered as a guidepost. Working with children with atypical movement patterns and resulting motor development demands a larger picture. To adequately describe a child's motor development, we must take into account the unique person, the environment, and the task (Gabbard, 2011, Haywood & Getchel, 2009). The children should be assessed with a view toward all variables contributing to development.

Research has also validated that not all children follow the same developmental trajectory of skills. For example, some typically developing children did do not crawl in the fashion of two knees on the ground and two hands supporting that stance (Burton, 1999). Instead they assume other postures (bear crawl with no knees toughing the ground) or they skip crawling completely. Those that do not crawl are observed to scoot on their bottoms across on the floor. Later they pull up on furniture and experiment with cruising while holding onto furniture. Eventually they walk with assistance and finally are able to walk independently.

Crusing by walking and holding for support helps children gain in strength and confidence for walking independently.

Access to toys as simple as the cardboard box in situations where adults are actively engaged with the child promotes strong developmental structures in the brain (Shonkoff & Philips, 2000). Motor performance is also influenced by the child's gene pool including their personality. We must take into account how the shy child performs in an assessment versus the extroverted, high-energy child. Both children require a sensitive assessor.

In adolescence we accept that patterns of development have more variety based on the unique person and their interests, the home-life and values in the community in which they are being raised. We also consider the tasks being asked (e.g., shoot the basketball into the basket) and the interests and experience the child has in physical activity. In addition, the adolescence chief developmental goal is autonomy with their peers (e.g., Erickson) and we focus on healthy choices available for friendships, foods, and fun.

Therefore, for many reasons, the developmental patterns presented in this chapter both in early development on into adolescence are guideposts whereby there is greater detail to bring forward to understanding if development is typical or we need to intervene.

As discussed in chapter 1, the need to provide early intervention services to infants and toddlers with suspected or diagnosed disabilities is the intent of current federal educational law. Public Law 94-142 has been amended since 1975 and is currently referred to as Individuals with Disabilities Education Improvement Act of 2004. This law continues to highlight that preschool children and infants and toddlers with disabilities will benefit from early intervention services if the child is ". . . experiencing developmental delay . . . in one or more of the following areas: physical development, cognitive development, communication development, social or emotional development, or adaptive development." Federal laws do not specify the types of services to be provided, but leaves the decisions to the state, and more important, to the child's IEP or IFSP team.

Many professionals recognize that motor development activities should play an integral part in services for preschool children, including infants and toddlers (McCall & Craft, 2000; Pangrazzi, 2001; Saunders, 2002; Wessel & Zittel, 1995, 1998). Early brain development is fostered by physical activity (e.g., Eliot, 1999). When an infant moves and explores, the brain develops more neuronal connections. These movement experiences "grow" the brain and foster physical development. Harvard's Center on the Developing Child, Brain Map, depicts age guidelines and domain expectations (developingchild.harvard.edu). As the brain ages, greater growth in development takes place.

Tummy time is advocated by the American Academcy of Pediatrics to build neck and back strength. This strength is essential in developing infant motor skills. Too much "container time" (e.g., carriers) delays motor development.

The underlying assumption at Harvard is that when caretaking is optimal growth occurs and the developmental trajectory is positive.

Professional organizations are publishing new guidelines to support developmentally appropriate practice in facilitating and teaching young children's movement skills. For example, the Council on Physical Education for Children (COPEC) of the National Association for Sport and Physical Education (NASPE) published a position statement, *Appropriate Practices in Movement Programs for Young Children Ages 3–5* (2000; www.aahperd.org/nasped) containing information about quality movement programs, developing movement skills and concepts, and facilitating maximum participation. In addition, NASPE

Young children's physical activity interests are influenced by the family values and the community in which they live. Skill performance is influenced genes and a good amount of free play and some instructional time.

published *ACTIVE START: A Statement of Physical Activity Guidelines for Children Birth to Five Years* (2009; www.aahperd,org/naspe) and the National Association for the Education of Young Children (NEAYC) has published *Active for Life: Developmentally Appropriate Movement Programs for Young Children* (Saunders, 2002). New curricula have also been developed to facilitate movement skills in young children, such as the *I Can Primary Skills K-3* (Wessel & Zittel, 1998) and the *Smart Start: Preschool Movement Curriculum Designed for All Abilities* (Wessel & Zittel, 1995).

Given the importance of the early years of development (e.g., Shonkoff & Phillips, 2000), this chapter provides a basic overview of developmental patterns and the relationship between early and later movement experiences and successes.

It should be noted at this point that significant differences in development can be expected where children are approximately the same age. Although children of a given age can follow the same general developmental patterns, some progress at a faster or slower rate. It is also usually true, but not always, that the rate of intellectual and social development parallels physical development. The exceptions can be found among children with and without disabilities. Therefore, the account must be taken of the existence of the possible differences in rate of development when evaluating the effects of a disability upon development. If it is determined that a disabling condition is negatively influencing development, special steps can be taken to help the child improve. These might include activities to promote physical development, or if help is needed to overcome poor social development, attention can be directed toward instruction to increase the opportunities for social interaction in group play. These are only two

examples of the numerous ways in which the teacher can meet the special needs of students whose development has not kept pace with that of their peers. Other strategies will be explored more fully in later chapters.

Familiarity with the developmental patterns provides the teacher with a means of assessing progress toward achieving the degree of development for a given age period. This is particularly helpful with very young children who are difficult to test with standardized tools of evaluation and may not perform on the day required or have the interest in the test items (Neisworth & Bagnato, 1996). When this happens, the teacher may receive inaccurate information about the child. Although the comparison of a child's status of development with patterns that are generally characteristic of the age group is highly subjective and open to errors in interpretation, it is nevertheless a useful means of determining if and how much improvement has been made.

It is often difficult to determine if a child with disabilities is ready to learn a new skill. Readiness is that state of development in which the child has acquired the physical, mental, and emotional capacity to comprehend the requirements of a task and to execute them. Because a disabling condition may so alter the responses of the child as to cause misdiagnosis of his or her readiness for new learning experiences, teachers need other means of making the determination. The patterns of development can provide one of the means, because they indicate the abilities and potentialities usually evident in those of the same age group.

It is not likely that very many children will exhibit all of the patterns ascribed to their age group; it is possible that very few will evidence a particular pattern. Each child does, after all, grow and develop at his own individual rate, a rate that is influenced by factors such as inheritance, socioeconomic background, and educational environment.

Principles of Development

Investigators from several fields, including physical education, child development, medical sociology, and psychology, have identified developmental trends in children. Many of these trends will be discussed in this chapter. General principles have also been defined that help to explain some of these trends. The following principles will help professionals comprehend the process of motor development and guide them in developing appropriate movement experiences for youngsters with and without disabilities. The term "developmentally appropriate practice (DAP)" is a cornerstone guiding early childhood programs (e.g., www.naeyc.org; www.cec.org) and is concomitant with understanding the developmentally appropriate skills that a child can be practicing and learning.

Developmentally appropriate skills are ones that the child is capable of performing because they are *physically mature enough*. The skills themselves are ones found in the culture for that age group and based on *chronological age*. Therefore, a child with a cognitive impairment and 10 years of age does not play Duck Duck Goose (a young child's game) for the rest of his or her life. The activities chosen for him or her take into account his or her developmental age (as assessed by with developmental tools from many different fields) and framed by his or her chronological age. It is important to use this rule when developing guides for interventions when delay is identified. This rule helps the motivation for physical activity for both typically and atypically developing children. When the child becomes aware of what others are doing for play, he or she wants to do those activities too. When a child has a disability, it is important to communicate to the parent, "These are the activities we would expect Elizabeth to be learning now." And those expectations should mirror the community and the chronological age of the child.

It is unfortunate when the wrong developmental level is identified for a child and the child, quite naturally, fails at the skill performance. And logically, when the appropriate level is identified, the child typically experiences success with a skill. Thus, the child learns the new skill and can continue to develop other skills while experiencing fun and success. The following discussion will facilitate the understanding and implementation of the principles needed for teachers to facilitate motor development. This discussion will be grouped into two sections: *Principles of Motor Development* and *Principles of Physical Growth.*

Principles of Motor Development

Each of the following principles has implications for how a teacher understands the motor development of a child, particularly one who is very young. The teacher can use these principles to ascertain where the child's developmental level stands and any apparent delays warranting intervention. The following chapters will elaborate on these principles. Without these principles, it is easy to miss the appropriate developmental level, resulting in difficulty targeting accurate motor interventions. In general, it is nearly impossible to expect that a child can perform a motor skill or participate in a game if that child is not physically mature for the activity. The following information will assist in determining the appropriateness of physical activity for a given child.

Maturation

Early developmental patterns are dependent in part upon maturation. This means that certain physical and behavioral changes can be attributed to the innate process of growth. The maturational concept suggests, therefore, that

certain changes occur as growth proceeds. Characteristics subject to the maturational process, such as early infant reflex patterns, will occur at broadly predictable periods of time in normal children. If a significant delays in the maturational process is found, intervention is needed.

Cephalocaudal (Head to Tail)

Development is not haphazard. In physical and motor development, two directional sequences have been noted. The first of these implies that muscular control and coordination advances in an orderly sequence from head to foot. In the initial stages of motor development, children gain control of the muscles that support the head and upper body before they gain control of the lower musculature. The progression in muscle control proceeds from the neck, to the back, lower back, upper leg, lower leg, and foot. Therefore, if babies are lying prone on their stomach, they will voluntarily lift their head up off the ground before their feet.

This principle of development is very important to understand and to communicate to parents to off-set two common practices. One is to place babies on their backs to sleep. Since 1992, the American Academy of Pediatrics (AAP) has recommended that babies sleep on their back (supine) to prevent Sudden Infant Death Syndrome (SIDS) (www.aap.org). Because babies were spending sleep time on their back AND because they have been increasingly carried around in containers and left in these containers, babies have developed both a flat head and also lagged behind in their early movement skills. Thus, parents and caregivers have been strongly encouraged by the AAP to place babies on their tummies (prone) to encourage the development of strength in the neck, shoulders, and back, which leads to the ability to perform early movement skills (e.g., roll over). Referred to as "tummy time," babies begin a short time (seconds as opposed to minutes) on their tummies with toys and an engaged caregiver. Without this time, the baby cannot develop the neck and back muscle strength needed at these early ages and will be delayed in the acquisition of early movement skills.

AAP has also limited the amount of time that babies are held in containers. And the Council of Physical Activity for Children/NASPE recommends that most of a baby's day is spent in physical activity. This is to both grow the brain and develop strength necessary for movement skills. So this simple developmental principle of how development takes place from the head to the toes takes on enormous ramifications for today's child care and their physical growth.

Proximodistal (Point of Origin to End)

The second of the directional sequences suggests that controlling body parts proceeds from the center or torso of the body to the periphery in a proximodistal fashion (proximate location on the body to distant location). Efforts to control the torso and shoulder, therefore, precede controlled movement of the elbow, wrist, and finger. In the lower half of the body, control of the hips precedes efforts to control the legs, feet, and toes. Therefore, babies will be more proficient in moving their trunk and shoulders before they are voluntarily able to use their fingers.

It is important to note that developmental principles of cephalocaudal and proximodistal, while generally recognized and accepted, have been challenged by some researchers (Allen & Capute, 1990). Some speculate, for instance, that head control may be functional first because it does not rely on the development of other body segments (Damiano, 1993).

Again this is a principle that has implication for parent education on early development. For example, a baby will not walk before the upper body has developed many different skills such as rolling over and using a locomotion skill across the surface of the floor (e.g., crawl and scoot). Again and again in early development, this principle comes into play. A child will reach for a rattle before they are able to bring the rattle close to the center of the body and put it in the mouth. Because of this principle, when the baby is almost capable of rolling over, a little push to the hip assists the child versus doing anything with the feet. The feet are the last to engage in rolling over. The core of the body comes first.

Mass to Specific

An understanding of the proximodistal principle also suggests that motor function progresses from mass to specific. Therefore, control of gross motor movements will occur before fine motor movements. Skills that are simple and involve large muscles will be learned sooner than those that are refined and require the use of fine muscle movements. A very young child drawing with a crayon is performing a fine motor task that follows his controlled movement of the shoulder, wrist, and hand.

Bilateral to Unilateral

After the age of four, children normally exhibit preference for conducting activities using one side of the body. This is referred to as dominance. Thus, a child may eat and draw with the right hand, kick a ball with the right foot, and use the right eye to look through a kaleidoscope. Until this preference is established, the child will do various activities with either the right or left hand or foot. A recent concern of many specialists is that children be given the opportunity to explore activities bilaterally (i.e., kick with the left *and* right foot) and that they not be forced into unilateral preference (using only the left *or* right hand or foot). Fortunately, parents and teachers have become more sensitive

Figure 2.1 Riding a tricycle helps develop bilateral coordination.

to the needs of left-handed children and are providing them with greater opportunities to exhibit their preference in a right-handed culture. Some children take longer to develop preference, or dominance, and some are ambidexterous. As adults they may be able to write with their left hand and perform a physical task such as throwing with their right hand. Some activities encourage bilateral coordination (see figure 2.1).

Phylogenetic versus Ontogenetic

Traditionally, changes in behavior that occur rather automatically as the individual grows are referred to as phylogenetic behavior (developmental changes over time). Grasping, reaching, and crawling are examples of behavior that fit into this category. Behavioral changes that depend primarily on learning and environmental influences are called ontogenetic behavior. Unlike phylogenetic behaviors, ontogenetic responses do not occur automatically but are taught. Behaviors that are ontogenetic include such activities as throwing, catching, and riding a bicycle. This principle underscores the need for early childhood movement skill and game instruction. The access to free play (recess) for preschoolers does not support the learning of motor skills, particularly when children are delayed (McCall & Craft, 2000). Rather this age group skills will be developed with instruction and free play where equipment is available.

Individual Development

A discussion of developmental patterns is incomplete without an emphasis on the uniqueness of each individual. Although there may be patterns that apply to the whole species, each child is different and thus the rate and speed at which certain movement patterns appear varies. These differences may be attributed to the combination of heredity and the environment in which the young child develops. The style in which children learn, whether auditory, kinesthetic, or visual, varies and is inclined to be genetically based. Awareness of the individual difference principle will help teachers recognize that all children are not ready for the same experiences at the same age.

Dynamic Systems Theory

Dynamic systems theory is one of the newest perspectives currently being applied to the understanding of movement performance. The dynamic systems theorists believe that the role of the central nervous system (CNS) in the control of coordinated movement should be deemphasized with greater attention placed on information in the environment and the dynamic properties of the body and limbs.

The key to understanding this approach is to accept the important connection between the person, the task, and the environment. While this relationship is generally recognized and supported by most developmental theorists, proponents of the dynamic systems theory argue that too much attention has been placed on the control center (CNS) and not enough on the importance of the interaction between the environment, the task, and the person.

Despite the emphasis on a more contextual assessment of a child's development for understanding what skills development (e.g., Bronfenbrenner, 1972; Miller & Roid, 1994), day-to-day practice hangs onto "developmental milestones." For example, despite all the presentations given on the influence of chronic stress on a child's development (e.g., Russ et al., 2012; Garvi, Tarullo, VanRyzin, & Gunnar, 2012), these children are often assessed for developmental milestones and an evaluation made. The better approach is to assess the skills and to also do an assessment of the home situation. Occupational therapists have tools for this and can use a common tool is the Home Scales. These two pieces of data will greatly influence the understanding of the child's motor skills because the points taken into account are the uniqueness of each child, what skills were asked of them in what environment, what their developmental history has been, and what the culture is like where they are being raised.

This, of course, has significant implications for motor programs for children with special needs. Using a dynamic system perspective, movement patterns are not prescribed but emerge from interaction among body, task, and environment with little central input (Whitehall, 1988). The implication of this, of course, is to suggest that the traditional strict reliance on a neuromaturational theory of development may be a disservice

to infants and toddlers with developmental disabilities. This is not to suggest, however, that the traditional principles of development are unimportant, but it does mean that professionals should continually be open to new ideas and, most importantly, recognize the specific needs of the infant and the relationship of the task, the environmental stimuli and the self-initiated movement of the young child (Adolph, 1997). For older students with special needs, this approach is profound in the impact it can have on both assessing, as well as teaching, skills. For example, Davis and Burton (1991) reported that "body scaling" was important when asking children to throw a ball. If the ball chosen for the execution of the skill of throw was scaled to the size of the child's hand, then his or her accuracy was increased. The ball selection is accomplished by looking at the size of the hand in relationship to the ball: The assessor should give the performer a number of balls of different sizes. The one chosen by the performer is typically better scaled to the size of the student's hand. Eventually, the performer does select a ball that matches the hand size. If not, the teacher can coax/suggest a different ball size. Burton, Greer, and Wiese-Bjornstal (1992, 1993) reported variations in grasping patterns in children, as well as the resulting changes in overhand throwing patterns, as a function of ball size. In another study, children were accurate when researchers analyzed the size of the child scaled to the distance the researchers felt the child could perform a horizontal jump. The children correctly estimated how far out they could jump from a given point to another point.

It is important to remember that all the answers are not known regarding the best approaches to meet developmental and remedial needs. Thus, professionals will need to seek and be open to new ideas and suggestions for working with this population. Chapter 15 will provide additional suggestions and activities that have been found to be helpful in working with infants and toddlers. A more thorough discussion of dynamic systems theory will be found in chapter 3.

Infant (Zero to Two Years)

The best practice in the field of physical activity for very young children is to allow for time in a given day that is devoted to physical activity (NASPE, 2002). Not only is it important to the current level of health, it is felt to be a foundation to enjoyment of a happy, physically active life. Within this section, the development of the individual during the first two critical years of life will be discussed.

Physical Growth

The information on physical growth herein has assumed that the baby was born at a normal gestational age of 36–40 weeks. In traditional assessments, babies born prematurely are "age corrected" to test developmentally. The adjustment was based on *their time on earth*. Babies born 2 months early have 2 months (8 weeks) removed from their "age" on the assessment forms (in the space for age in months). This is done to account for the fact that they are still growing toward the 40 weeks. They did not come to earth at 40 weeks but rather at 32 weeks. Whether they are growing inside the mother or outside, they still need 40 weeks to start in developmental time for assessments. All the stages of development presented herein are based on 40-week gestation. After three years of age, this age correction is typically stopped.

In 2013, the American College of Obstetricians and Gynecologists (ACOG) issued new guidelines on what is considered a term pregnancy (www.acog.org). ACOG adjusted the weeks of pregnancy considered *term* based on new data that showed that neonatal outcomes vary depending on the timing of delivery. The breakdown now is **early term**: between 37 and 38 weeks, 6 days; **full term**: between 39 and 40 weeks, 6 days; **late term**: between 41 weeks and 41 weeks, 6 days; and **post term**: 42 weeks and beyond.

In releasing these guidelines, the ACOG endorsed and encouraged ". . . the uniform use of the work group's recommended new gestational age designations by all clinicians, researchers, and public health officials to facilitate data reporting, delivery of quality health care, and clinical research" (p. 1139). What is impressive here is an analysis of the outcomes of babies given their birth in gestational age. In due time, this will affect calculations on the age of the baby in developmental assessments. This in turn helps clinicians help the baby to do well. The debates will obviously take place in the medical field because these new dates considered normal bring to question any consideration of forcing an early delivery and probably much more.

The average full-term baby weighs approximately 7½ pounds and is approximately 20 inches long (CDC 2010). One fourth of the baby's length is attributed to the head, with the trunk size accounting for slightly more of the remaining length than the lower extremities. As the baby grows during the first six months of life, these proportions remain constant. After approximately six months of age, however, the relationship of body proportions begins to change: the growth of the head slows and a rapid increase occurs in the growth of the extremities, with the rate of development of the trunk remaining constant. As the infant approaches two years of age, the relationship of the lower limbs and trunk are approximately equal. This adjustment

in growth equips the two-year-old with the body size and proportion needed to successfully undertake the various locomotor skills.

Infant Reflexes

The earliest movements that can be observed in the infant are reflexes. These actions are involuntary behaviors elicited by various types of external stimuli. In typical development, infant reflexes appear and disappear at specific months of age. For educators working with young students with disabilities, familiarity with some of the more common infant reflexes is essential because the absent reflex, or one that persists for too long, may be an indication of neurological impairment. Thus, observing infant reflexes becomes a method of assessing the child's nervous system (Brazelton & Nugent, 1995). In specific disability areas such as cerebral palsy, these primitive reflexes do persist, and discussion of this is found in chapter 8. Haywood and Getchell (2005) point out that responses seen in reflexes are atypical if:

1. the reflex is exhibited when it should have disappeared; and
2. a reflex is not exhibited and it should be present.

Norberg (2001) would add that when an expected symmetrical reflex is asymmetric, such asymmetry is atypical.

According to developmental psychologists Lamb, Bornstein, and Teti (2002), infant reflexes are thought to be biologically meaningful as survival and adaptive skills. Such reflexes are defined as ". . . simple unlearned stimulus-responses common to all members of a species" (p. 122). Infant reflexes are traditionally divided as follows: approach reflexes (e.g., rooting, sucking, swallowing, breathing), avoidance reflexes (e.g., coughing, sneezing, blinking), and other reflexive responses that continue now but were important in the earlier development of humans (e.g., the palmer grasp, Babinski toe fanning, Moro responses). Clearly some reflexes diminish early in infancy, whereas others are sustained throughout a normal, healthy life.

The diminishing of reflexes that were important to the development of the species but now hold no apparent value have ". . . origins in the deepest and most primitive parts of the central nervous system. So long as these neurological structures dominate function, the reflexes endure. As higher cortical processes come into play . . . they appear to inhibit subcortical structures and thus prevent the expression of reflexes" (Lamb et al., 2002, p. 123).

To obtain accurate information about infants, it is important to obtain input from the infant's primary care provider, not only to validate the assessment outcomes but also to obtain additional information. It is critical to note whether the infant tested is alert or drowsy, and to recognize that infants can quickly change from one state to another. Also, differences can exist between behavioral data collected by eliciting the behavior or by observing the infant's spontaneous behavior (Lamb et al., 2002).

Moro Reflex

The Moro reflex can be elicited in infants by lifting the infant's head up in relation to the trunk, and then letting the head drop into the examiner's hand (Norberg, 2001). This response can also be elicited if infants are exposed to a loud noise or change of light. In the Moro reflex, the infant is typically in a relaxed position (figure 2.2*A*). Then if either the baby's head is dropped, or there is a sudden loud noise or change of light, then the infant's response will be that his/her arms and legs will extend in symmetric adduction (away from the midline) and the fingers and toes will spread out (figure 2.2*B*). Typically the infant cries in distress with his/her arms and legs outstretched, and then will bring the arms to midline as if to catch a caregiver. The Moro's vestigial origins are thought to have been a response to the baby being dropped. The Moro reflex is normally present at birth and is evident during the first 6 months of life. If the Moro reflex persists much past this age, it may be an early warning sign of neurologic problems.

Rooting and Sucking Reflex

The rooting and sucking reflexes are present in all normal newborns. The search reflex may be initiated by stimulating the infant's cheek and observing as the infant turns her head toward the source of stimulation, opens her mouth, and searches to suck. This allows the infant to ingest food

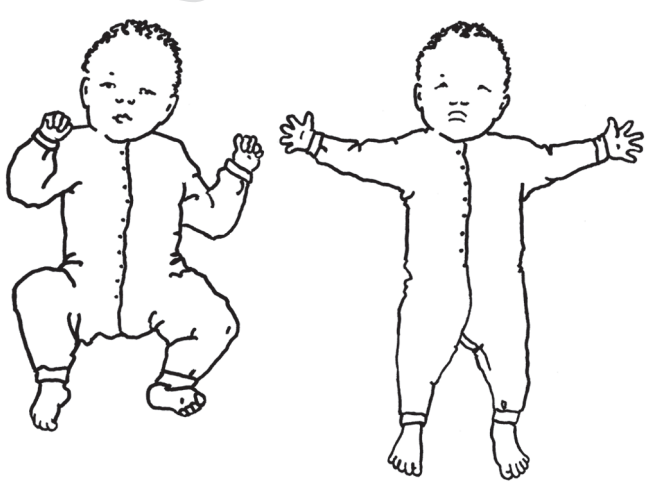
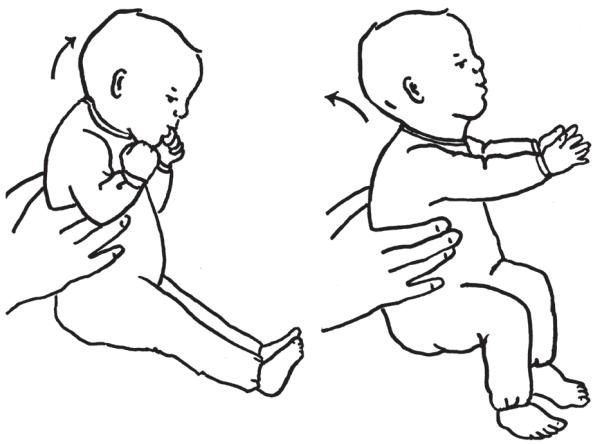


Figure 2.2 The (A) infant in a relaxed position and (B) Moro reflex extension phase.

Figure 2.3 Symmetrical Tonic Neck Reflex (STNR).



Infant Reflexes Involuntary

- Moro Reflex
- Rooting and Sucking Reflex
- Symmetrical Tonic Neck Reflex (STNR)
- Asymmetrical Tonic Neck Reflex (ATNR)
- Palmar or Grasp Reflex
- Babinski and Plantar Grasp Reflexes
- Labyrinthine Righting Reflex
- Parachute Reflex
- Righting Reflexes of the Head and Body
- Crawling Reflex
- Stepping Reflex
- Positive Support Reflex

and obtain nutrition. The sucking reflex persists well past the first year of life. In some newborns the suck is not fully developed and intervention must be directed toward stimulating this reflex.

Symmetrical Tonic Neck Reflex (STNR)

This reflex is elicited by extension and flexion of the neck and is characterized by two distinct patterns. When the neck is flexed, the arms go into flexion and the legs into extension (figure 2.3A). When the head and neck is flexed back beyond the midline, the arms go into extension and the legs into flexion (figure 2.3B). The symmetrical tonic neck reflex is present at birth and its primary function is to help the infant develop extension patterns. Normally, the reflex is suppressed by the seventh month. Therapists often use the terms STNR to refer to symmetrical tonic neck reflex, or the symmetrical response that occurs when both sides of the body (arms and legs) respond in the same pattern. This is to distinguish the reflex from the asymmetrical response described in the following text. Again, these reflexes are seen in older individuals with certain types of cerebral palsy and will be addressed in chapter 8.

Asymmetrical Tonic Neck Reflex (ATNR)

The apparent purpose of this reflex is to aid in the development of extension patterns. The primitive interpretation of this reflex is often associated with protection of the eyes by the baby or in early reaching for a desired or needed object. The reflex is often referred to as the fencing reflex, which mimics a fencer's stance with the arm extended with sword in hand and the other arm extended in the other direction and flexed upward. The ATNR reflex is elicited from a relaxed position of the infant (figure 2.4A) by rotation of the head to either side. When the head is turned, the arm and leg on the side of the body to which the face is turned are extended and the limbs on the opposite side are flexed (figure 2.4B). Usually the ATNR disappears by six months after birth.

Palmar or Grasp Reflex

Pressing against or stroking the infant's palm elicits a grasp reflex. The classic action is for an adult to place his/her finger horizontally at the base of the infant's fingers. Involuntarily the baby will hold onto the finger with a strong grasp. Attempts to remove the finger will produce a stronger grasp! The palmar reflex response becomes weaker by the sixth month of life. Delays in motor development may be apparent if this reflex persists or is asymmetrical (strong on one side and not the other).

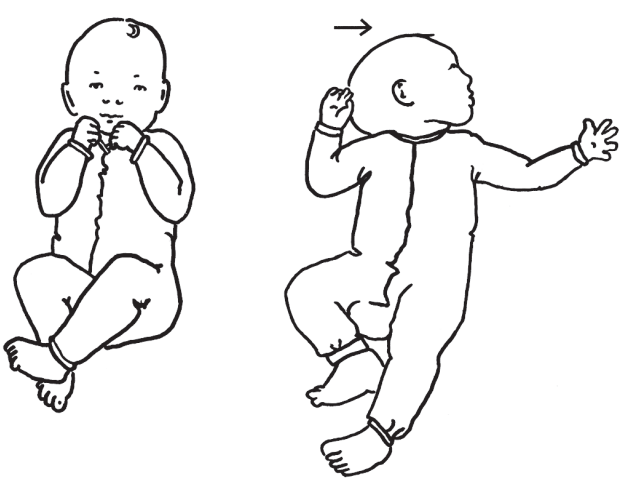


Figure 2.4 Asymmetric Tonic Reflex (ATNR).

Babinski and Plantar Grasp Reflexes

The Babinski reflex is elicited by stroking the sole of the foot of the newborn. The pressure causes an extension of the toes and they fan out. This reflex persists through the first year of life.

The plantar grasp reflex is elicited by pressing against the infant's foot directly below the toes (figure 2.5). The pressure causes the toes to contract. The plantar grasp reflex is usually present about the fourth month and persists to approximately the twelfth month. Persistence of the plantar grasp reflex beyond this point may interfere with the infant's early attempts at standing and walking.

Labyrinthine Righting Reflex

The labyrinthine righting reflex is important in helping the infant assume an upright head and body posture. This reflex can be initiated by holding the infant upright, then tipping the body forward. The infant's head will go back in an attempt to maintain an upright position. Angling/swaying the infant to the right or left will also initiate this response. The head will tend to move so as to maintain an upright position. The reflex may first appear at two months and becomes increasingly stronger until the fifth or sixth month. It is abnormal if this response fails to develop or is asymmetric.

Parachute Reflex

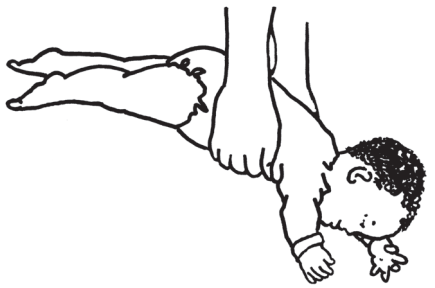
The parachute reaction may be elicited in several ways and is an effort by the infant to protect against sudden shifts in directions. As noted in figure 2.6, the infant, when gently tilted forward from a held position, extends the arms as a protective mechanism. The infant's lower limbs also extend, are tense, and abduct. The parachute reflex tends to persist beyond the first year and plays an important role in assisting the infant in learning to walk.

Righting Reflexes of the Head and Body

Within the first year of life, the infant has two involuntary reactions that help it to maintain a comfortable position in the crib. The first of these, the neck-righting reflex, is elicited by turning the head as the infant is on its back. The trunk will reflexively turn in the same direction. Likewise, if the hips are turned while the infant is in a prone position, the head will follow in the same direction.

Figure 2.5 Plantar Grasp Reflex.

Figure 2.6 Parachute Reflex



Crawling Reflex

The crawling reflex can be observed by placing the infant in a prone position on the floor and applying pressure to the sole of one foot (figure 2.7*A*). The infant will return the pressure by pushing with the affected foot while doing an extensor thrust with the nonaffected leg. Reflexive movement will occur, which resembles that of crawling. The crawling reflex is generally present at birth and disappears around the third or fourth month. The delay between reflexive crawling and voluntary crawling is approximately four months with most infants crawling around the seventh month. This reflex is interesting because it is one in a group of reflexes wherein newborns seem capable of activities that are not possible until later in their infant life. These movements of the newborn are involuntary as opposed to the voluntary movement such as crawling seen in later infant life (Haywood & Getchell, 2009). This reflex is often of great interest to caregivers.

Stepping Reflex

Another involuntary reflexive movement that interests parents and caregivers is defined when they see their one-month-old baby make a response that looks very much like the taking of steps. This action is very normal and can be elicited in infants as young as two weeks by holding the baby in an upright position with the feet touching a level horizontal surface (figure 2.7*B*). The walking pattern is very immature and involves only the action of the legs and knees. The stepping reflex normally disappears by the end of the fourth month.

Figure 2.7A Crawling Reflex.

Figure 2.7B Stepping Reflex.

Positive Support Reflex

With the positive support reflex, when the infant is held over a surface and the balls of the feet come into contact with the surface, the infant extends the legs (figures 2.8*A* and *B*). This reflex persists throughout the first year of life. For the child with cerebral palsy, the extension of the legs becomes very rigid with increased tone, and thus interferes with the development of standing and walking.

Early Voluntary Movement Patterns

Zero to two Years of Age

The precise process by which reflex actions are phased out and replaced by voluntary movements is not clearly understood. This is due, in part, to the differences found within individuals as well as to the lack of definitive timeliness indicating when reflexes will normally appear and disappear.

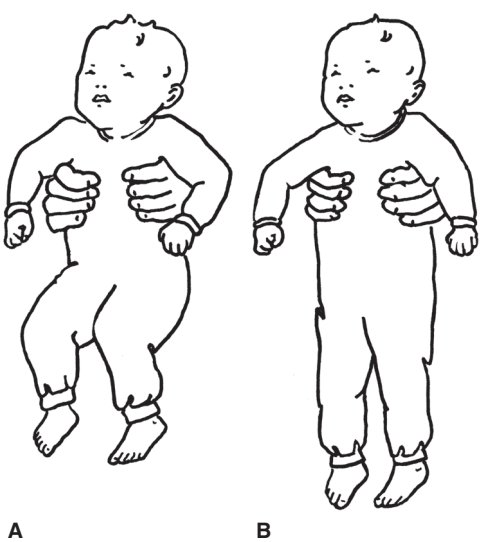


Figure 2.8 Positive Support Reflex.

Nevertheless, professionals interested in the motor performance of those with disabilities find it helpful to study the relationship between reflex action and voluntary movement. For instance, familiarity with the walking reflex will help movement specialists explain to parents that although it appears their child with developmental disabilities is ready to walk, the necessary *voluntary* responses may not be present. Also, for those working with children with developmental disabilities, it is useful to understand the relationship between the failure of infant reflexes to disappear in those who have cerebral palsy and the motor problems these individuals experience. (For further discussion, see chapter 8.)

Within this section, six voluntary movement patterns developing before the age of two will be discussed. According to Burton and Miller (1998), the term "early movement milestones" denotes locomotor and object control skills attained by the child before standing or bipedal locomotion. The transition from infancy into toddlerhood is noted by the acquisition of walking and is the first *fundamental movement skill.* As a word of caution it is important to emphasize that although we expect children at 24 months to have developed in a similar manner, differences in the rate of change and the quality of movement will be seen in young children and can be considered within the **range of normal** development.

The notion of *within the range of normal* is important to use when assessing babies and communicating the evaluation findings. At these early ages, we expect a range in months of the expression of the skill (e.g., roll over, sit, and walk). Two infants the same age may not exhibit the same skills. One may be walking while the other child is pulling to stand. A reference to developmental milestone chart is often helpful for parents who are not familiar with a range in developmental time. Clinicians and/or the State service personnel in early intervention will determine when a child is considered delayed and in need of early services as indicated by federal educational law.

Postural Control

Postural control and locomotion are two movement challenges that the newborn must resolve. Postural control refers to the ability of the infant to develop head control, sit

Examples of Voluntary Movement Patterns Zero–Two years of age:

- Locomotion
  - Rolling over
  - Sitting
  - Crawling
  - Walking
- Reach and Grasp
- Striking

without support, and pull to a standing position. Locomotion is defined as moving from point A to B and includes the pre-walking skills of rolling, crawling, and creeping as well as the notable achievement of walking alone.

In figure 2.9, progressions of change in postural control are reported for head control, sitting alone, and standing. The progressions are based on the normative data by Frankenburg and Dodds (1991) with the Denver Developmental Screening Test-II (DDST-II). The DDST-II describes developmental progressions and indicates where 25, 50, 75 and 90 percent of the normative sample achieved the skills. The descriptions that follow herein are based on the 50 percent normative sample. As noted in figure 2.9, head control, or the ability to keep the head steady, without support while being moved is achieved at approximately two months. Improvements in head control may also be noted when the infant's head does not lag while being pulled up from a supine position.

The movement behavior of sitting without support is generally achieved by five months, which indicates a basic control of head and trunk although only in a stationary position. As infants progress they develop the movement capability of getting to a sitting position from a supine or prone position. This means that by seven months the infant can change body position rather than being limited to the sitting position in which he/she is placed. As the ability to sit with no support is developed, the infant learns to do other things, including manipulating objects.

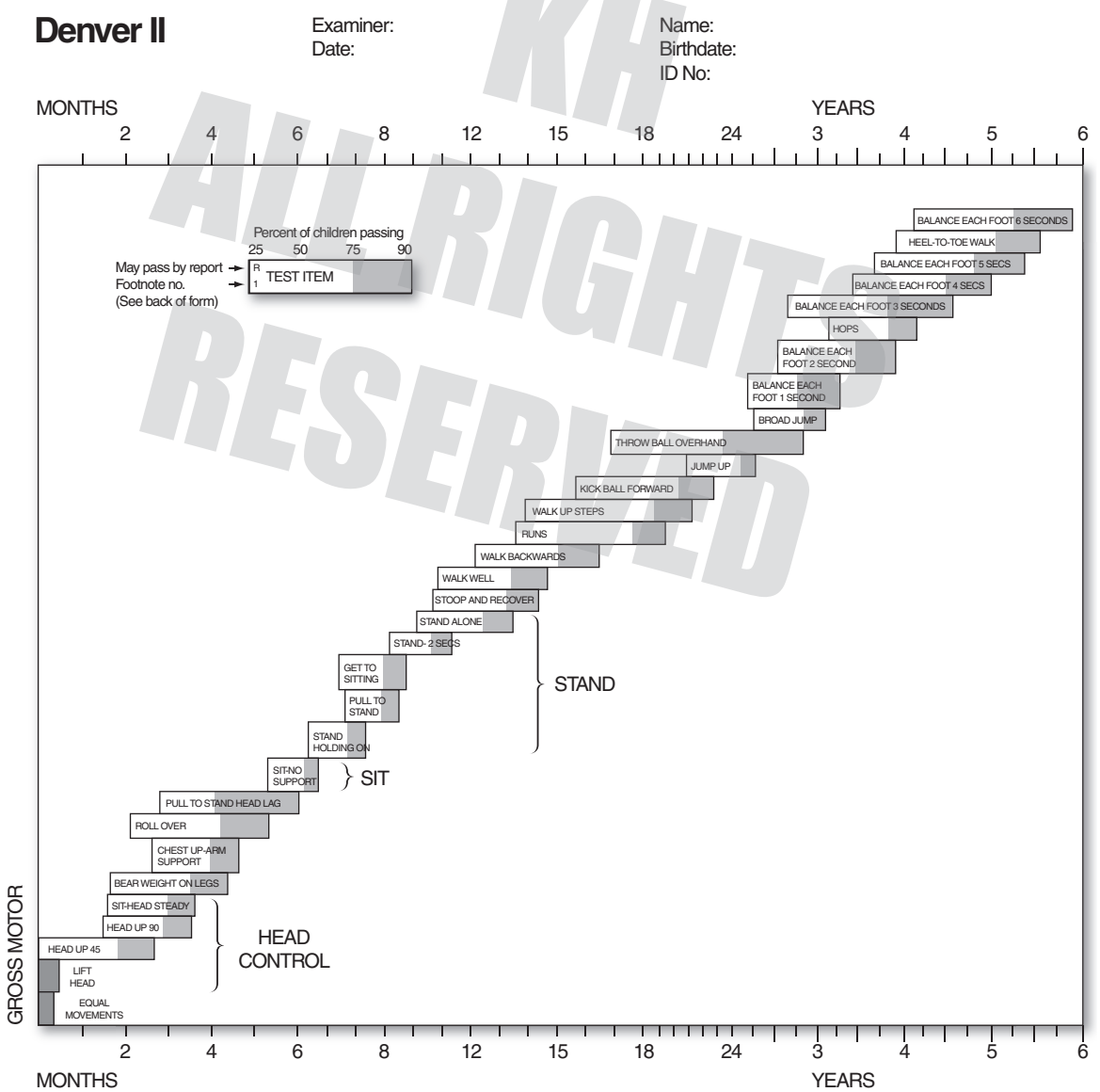


Figure 2.9 Progression of change: postural control (Adapted from William K. Frankenburg and Josiah B. Dodds, University of Colorado Medical Center, Boulder, Colorado.)

An early stage of an independent sit uses arms for support.

Pull to Stand

The third progression in postural control is for the infant to pull to a standing position. As noted in figure 2.9, this is generally achieved by approximately nine months of age. In developing this movement behavior, infants combine the skills of sitting without support, reaching, and pulling. As the infant becomes more and more accustomed to standing with support (by holding onto furniture, etc.) the necessary postural control emerges to stand alone. The ability to stand alone, normally seen at approximately 11 months, prepares the infant for walking.

Locomotion

During the first six months of life, infant development is rich but not very mobile. A typical newborn moves arms, legs, and head a great deal but full understanding of all this movement is not known. Initially, when placed prone or supine, the infant will remain in that position with little change in direction or location. This begins to change at approximately four months of age when the infant learns to move from the side to the back and back to side. Rolling over is the first progression of change in locomotion and is achieved at three and one-half months of age for 50 percent of DDST-II sample (figure 2.10). This voluntary movement is believed to be triggered by a sequence of reflex actions. The infant lying supine in the crib focuses on and follows an object with the eyes. Thus, the head turns, initiating the body righting reflex. The body turns in the same direction as the head, resulting in a roll over.

Crawling

The infant begins at approximately seven months of age to move forward from a prone position which resembles a "combat crawl." (In professional movement terminology this is referred to as creep and the later movement is referred to as creep; however, in the more classical parent and caregiver world, a creep is a crawl.) "Crawling" is the term used to indicate this early movement response. Crawling usually occurs spontaneously when infants are placed in front-lying positions for increasing periods of time.

From this position it is natural for the infant to look up and eventually reach for items. Movement occurs when both arms are used to reach for an item. When this happens, the head and chest will fall toward the floor, with the infant sliding forward. From this primitive beginning a more concerted effort is developed to use the arms systematically as an aid in crawling.

The rate at which children learn to crawl is highly dependent on individual development. Most, however, crawl at about the seventh month.

Crawling, a more sophisticated form of locomotion than creeping, requires that the infant use the hands and knees for support. From this position, the mature crawl pattern requires that the infant move the arms and legs in a contralateral pattern. Thus, as the left arm moves forward so does the right leg. Early efforts to crawl are not always this efficient. Some infants move only one limb at a time followed by a hesitation before the next limb is moved. Approximately 20 percent of all infants move the same side arm and knee forward when crawling. Burton (1999) reported a quadrupedal gait of infants walking on hands and feet. These infants are not yet walking independently. It is also observed that some infants use a three-point crawl and never proceed to a four-point crawl. Some children use a "scoot," whereby they move forward on their bottoms as a primary mode of locomotion (Burton & Miller, 1998) and never really use a crawl before progressing to a walk. The infant who crawls using a unilateral rather than a contralateral (opposite leg and arm move in motion) pattern may or may not experience future problems. As the child develops, further observations should be made to determine if other opposition problems exist. Development of crawling skills occurs at 10 to 11 months of age. According to Haywood and Getchell ". . . atypical development is not indicated if an infant doesn't creep [crawl]" (2009, p. 120).

Walking

There is a great deal of variation among infants as to the age at which independent walking begins. Some infants walk as early as nine months, whereas others may not walk until 18 months. Both early and late responses may be normal, depending on the individual's experiences and level of maturation. Figure 2.11 notes progressions in direction and skill with walking in the early years.

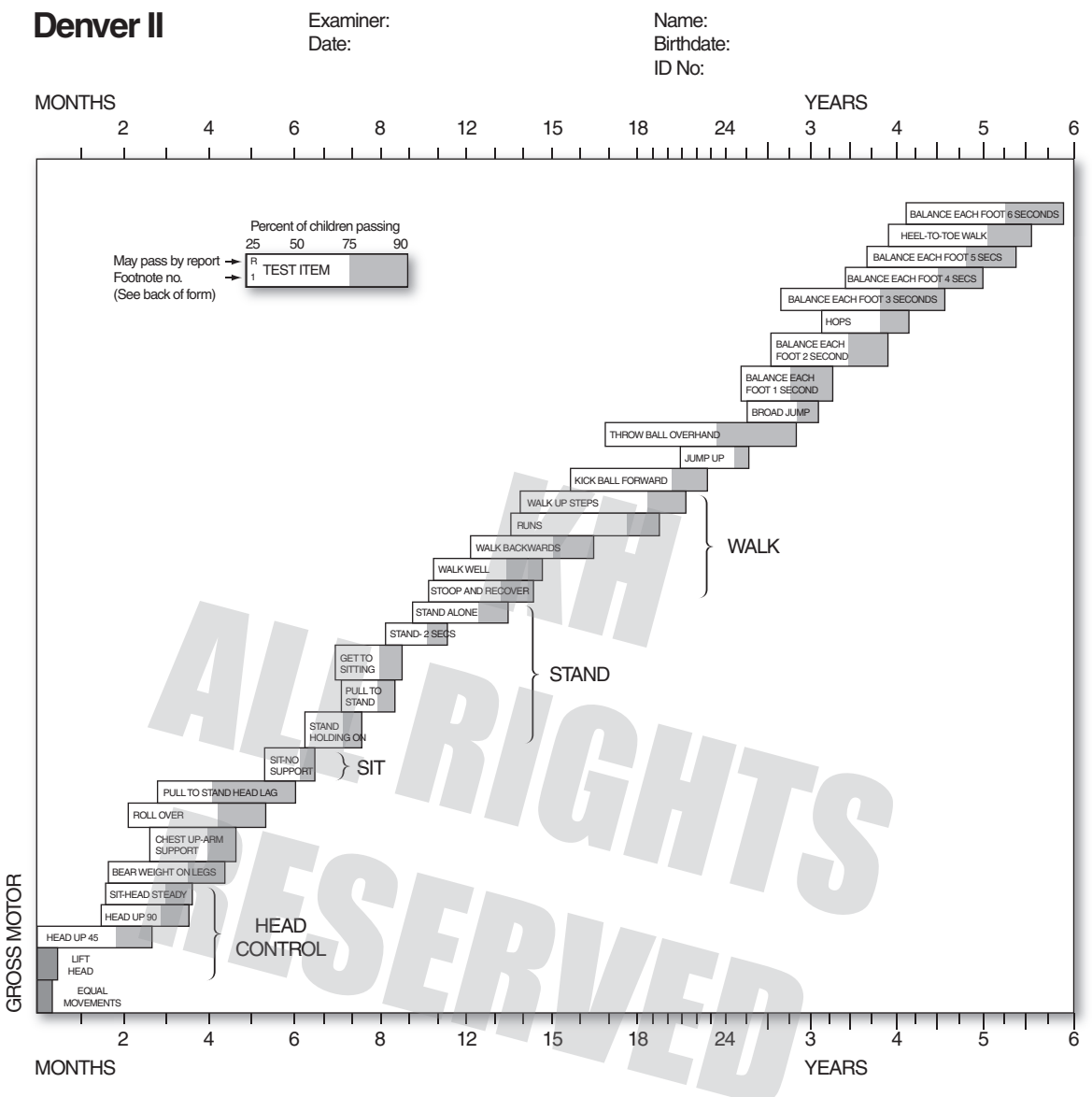


Figure 2.10 Progression of change: locomotion (Adapted from William K. Frankenburg and Josiah B. Dodds, University of Colorado Medical Center, Boulder, Colorado.)

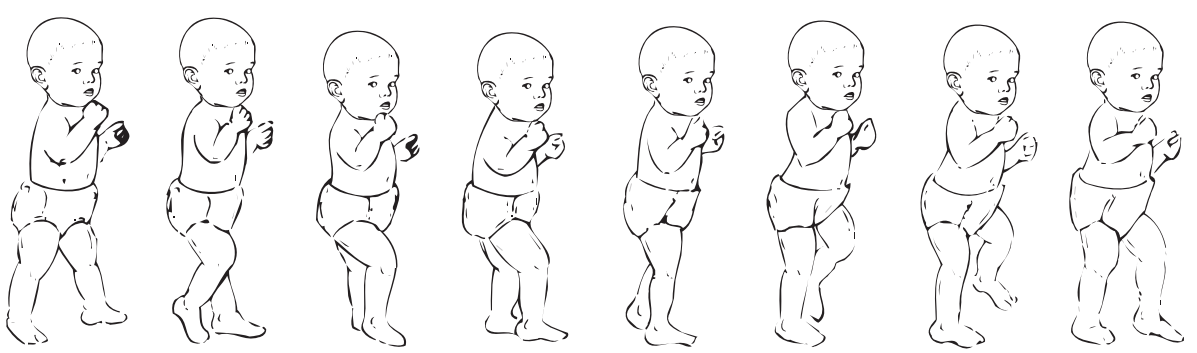


Figure 2.11 Early walking pattern of a 14½ -month-old infant. Note the high arm position, flat foot contact, and general tentative nature of the walking pattern. (Adapted from Wickstrom, *Ralph L.: Fundamental Motor Patterns, 3rd ed.,* Philadelphia, Lea & Febiger, 1983.)

Pull to stand. Babies use common furniture or structures to pull themselves up as a precursor to cruise and then to walk.

The development of the locomotor skill of walking is generally believed to follow from crawling and creeping. As proficiency in these skills increases, efforts to gain an upright posture will become more evident as the infant moves around the environment, using objects such as tables and chairs for aids in standing. The first attempts at walking involve the child standing and moving along a surface using one handhold to another. This is referred to as cruising. Many children use a table or chair as their support. Early attempts to step away from the adult handhold are frequently unsuccessful. This explains why some infants revert to creeping when learning to walk, because it is a more efficient form of locomotion. Infants soon discover, however, the numerous advantages of walking.

There are various stages through which young children progress as they move from an immature pattern to an integrated, efficient walking motion. Initially, the infant walks with a wide base of support in a flat-footed manner with the toes turned out. In addition, the arms tend to be held in a high-guard position. Little evidence of extension in the hip, leg, and ankle of the new walker is noted. A graphic representation of the walking pattern of an infant is presented in figure 2.11.

The walking pattern of young children becomes more refined as they become stronger and gain additional practice. When this occurs, the individual assumes a narrower gait, with the feet placed straight ahead and with a heel-to-toe step. The arms also swing forward and backward in opposition to the legs. The walking gait generally matures in infants between 11 and 18 months of age.

Reach and Grasp

The development of hand control is very important in the early months of life. In the first weeks of life infants' hands are in a fist with their fingers together. When touched, the infant will close the fist tighter, similar to a grasp. This is followed by a period in which the hands are open much of the time. In the second month of life infants develop the ability to put the hands together. The first successful reach and grasp of an object occurs at approximately three to four months. The first grasp of something like a cube is normally awkward with the infant holding the cube in the palm using the fingers. It is not until five to six months that the infant progresses to thumb opposition, where the thumb opposes the fingers to pick up an object. As the infant develops, the ability to pick up smaller objects is facilitated by the thumb working in opposition to the fingers. This refined form of opposition, known as the neat pincer grasp, is normally seen at nine to ten months. Development of the neat pincer grasp is important because it allows the fingers and thumb to work together in the manipulation of small and large objects.

The release of an object, normally seen at eight months, is another important landmark in being able to successfully manipulate objects. The initial release is crude in that the hand is opened and the object dropped. From this beginning, however, the important manual dexterity tasks, such as placing items in containers, begin to develop. Infants learn by the second year of life to make horizontal and vertical lines, color on paper, turn the pages of a book, and stack six to eight cubes.

Pincer grasp of a baby at around 9 months of age.

Social Development

Interaction with the caregiver and the world begins at birth. Each newborn is unique in the need for sleep and alertness as well as the capacity for interaction. Brazelton, a leading pediatrician from Harvard University, developed the Brazelton Neonatal Behavioral Assessment Scale (1979) to rate the state and interaction capacity of the infant. Based on his work, it is clear that some infants initiate chance interactions with their caregiver. For some newborns, the interaction will be more subdued due to a greater need to control stimulation and temperament of the infant (see M. A. Rothbart for reviews of temperament in early childhood). Caregivers need to be cognizant of the wide range of infant behavior and note that an infant does not always respond to adult initiated interaction.

In infancy, the domains of development (physical, social-emotional, and cognitive) are intertwined. It is amazing just how much babies know as soon as they are born. At just days old, the baby oriented to the mother's milk when breast pads containing her milk were place by the baby's head. One was mother's milk and the other was not (one on either side of the baby's head). Stern (1990) reported that this baby already had a connection to his or her mother. Being a child psychiatrist, he postulated an early emotional response.

Movement is the prominent domain that is observed in infancy. As the baby moves and the brain grows, the social and emotional experiences also grow.

Some of the earliest forms of social expression are the facial gestures seen in infants. Imitative smiling in response to a familiar face may occur as early as the first month of life.

Early forms of social interaction may also be observed in the play behavior of infants. For instance, most young children have enjoyed the games of pat-a-cake and peek-a-boo by 10 months of age. Caregivers and parents learn to understand their baby's communication. Some adults feel that because a baby does not communicate in sentences that he or she is not able to communicate. But babies are communicating all the time. For example, they communicate unhappiness and pleasure and when they are tired. A baby has a rhythm that is unique to him or her. Play time is important. The recommendations are that most of a baby's day is spent outside of containers and is physical (naspe.org). After the onset of walk, the baby in America is typically referred to as a toddler (Burton & Miller, 1998). As a toddler, their social skills are influenced by the increased locomotion and the exploration this affords them (Campos et al., 2000). In fact, Campos et al. report that their cognitive skill explodes with the onset of locomotion! This can be a trying time for parents. Most recommend that instead of saying "no" to this toddler, re-arrange the home for safety.

The new movement skills of toddlerhood dramatically increase self-initiated exploration. Cognitive skill explodes (Campos et al, 2000).

Drawers need security hooks on them. All fragile items are moved above the reach of the child. Toys and books have a place in the home that is easily accessible for the child.

Positive developmental trajectories are taking place when people are talking with the child in the home (Hart & Risley, 1995). Striking differences have been found in intelligence where this talking was absent. The type of communication of parent and child at these early ages includes describing things for them or elaborating on what they have said or what they understand. It is important that the toddler experience physical activity rich in description, variety, and positive regard.

Early Childhood (Two to Six Years)

The early childhood period, ages two to six, is another exciting time in the developmental process of the young. During this time frame, children build upon and expand their walking ability into a variety of other locomotor activities. The foundation for the later refinement of manipulative skills, throwing, catching, and striking, is also established in the early childhood years. Social interaction becomes more complex, with the preschool child engaging in a variety of simple games. Within this section, the physical growth, locomotor activity, and social development of the young child will be presented.

Examples of Voluntary Movement Patterns that are seen by Six years of age:

- Locomotion
  - Running
  - Climbing
  - Jumping
  - Hopping
  - Galloping and Skipping
- Throwing
- Catching
- Kicking
- Striking

Figure 2.12 Young children with developmental disabilities require special activities to help them develop basic movement patterns.

Physical Growth

The rapid gains in weight and height associated with the period of infancy taper off and slow down during the period of early childhood. From ages two to six a relatively uniform process of growth is observed, with the rate of gain in height nearly double that in weight. Body proportions also change, with the lower limbs growing rapidly in proportion to the trunk length. Thus, the young child loses the round, stocky body build characteristic of the infant and becomes more rectilinear in appearance. Few differences in growth between the sexes are noted during this time. Boys tend to be somewhat taller and heavier, but the proportional rate of growth remains similar for both sexes during this time.

Brain growth is about 75 percent complete by age three. The increase in myelin, a fatty substance around the neurons, permits the transmission of nerve impulses. With myelination, children will perform at higher levels both motorically and cognitively.

Similar to the brain, the sensory apparatus is still developing during early childhood. The eyeball does not reach its full size until age twelve with the macula being incomplete in its development until age six. This accounts for the hyperopia (farsightedness) generally associated with young children.

Locomotor Activity

As children become more proficient in their walking ability, they will begin to explore other forms of locomotion, such as walking sideways and, eventually, backward. Children will also learn that they can walk quickly and, as they gain additional strength, will initiate other exciting movement patterns, including running, climbing, jumping, hopping, galloping and skipping. These patterns of locomotion are discussed in the following paragraphs.

Running

The initial running pattern of young children is characterized by unstable and uncoordinated movements. As the young become more proficient in their walking ability, they tend to walk faster. At first, the increased rate creates a problem because of insufficient balance and experience. For this reason, many young children move from a mature walking pattern to a somewhat immature running pattern, in which the feet are turned out and the arms are held away from the body. The "flight phase" distinguishes a run from a walk. This is the period where both feet are off the ground. From ages two to six, observable changes take place in the running pattern. Some of the more observable changes (figure 2.13) include the following:

1. The stride lengthens as the amount of time in the flight phase increases.
2. The arms are held higher and used more effectively as they move in opposition to the legs.
3. The amount of forward lean increases (Gallahue & Ozmun, 2005).

Climbing

Once an independent walking pattern has been established, a young child may attempt to climb stairs in an upright position. Ascending a flight of stairs is negotiated sooner than the upright descent. A child will successfully ascend a flight of stairs, with alternate foot placement, between 29 and 41 months. Descending stairs proficiently may occur between 48 and 55 months.

Jumping

A jump is the act of propelling the body off the ground by extending one or both legs followed by a landing on one or both feet. This form of locomotion requires greater strength, coordination, and balance than are needed for

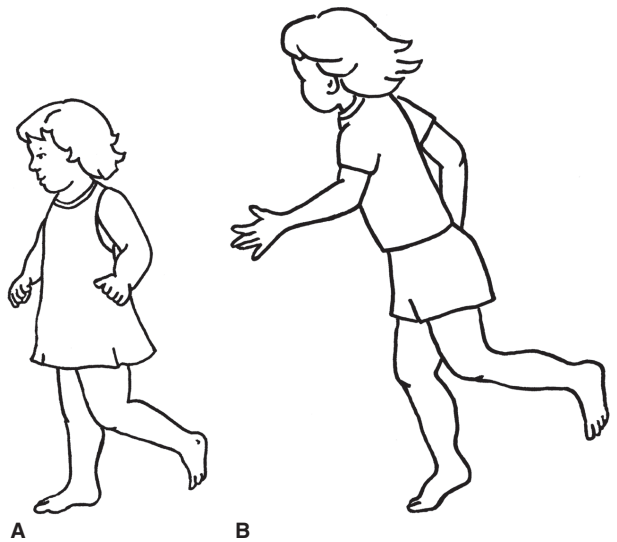


Figure 2.13 Obeservable changes in running pattern from ages two to six years. The arm action of (b) is more mature than (a).

running or walking. For this reason, jumping is viewed as a more difficult skill but is a locomotor pattern that most young children can master. Jumping is usually perceived as a very exciting skill by preschool children. The various type of jumps—vertical, horizontal, from objects, to objects, and over objects—all present different challenges to the young.

Although it is beyond the scope of this chapter to analyze the developmental phases of the various jumps, valuable information can be presented concerning the progressive difficulty of different forms of the jump. This information will help teachers of children with disabilities properly sequence instruction for students who have difficulty with jumping. From an analysis of table 2.1, it becomes clear that for many children jumping down is easier than jumping up. For example, jumping off a step is developmentally easier than jumping up to a step. Likewise, a jump down from one foot is an easier skill than a jump up from one foot. Jumping in the vertical plane up/down is less difficult than horizontal jumping (jumping out).

Most children will master the sequence in table 2.1 by five years of age. Further improvement in jumping performance will thus be found in the height and distance of the jump.

Hopping

Hopping is a locomotor skill similar to jumping but more difficult in that it requires a one-foot takeoff and landing on the same foot. Children do not hop successfully until they have gained sufficient strength and the necessary balance skills. By age four, however, most children can hop from four to six steps on their preferred foot. Rapid gains in the ability to hop greater distances and at faster rates of speed are made between the ages of four and six. Girls generally become more proficient hoppers at an earlier age than boys do, although there is wide variation in the ability to perform this skill within both sexes.

TABLE 2.1 Jumping

Types of Jumps Achieved by Children in Terms of Progressive Difficulty

Jump down from one foot to the other foot.
Jump up from two feet to two feet.
Jump down from one foot to two feet.
Jump down from two feet to two feet.
Jump forward from two feet to two feet.
Jump over object from two feet to two feet.
Jump from one foot to same foot rhythmically.

(Adapted from Wickstrom, 1983)

Galloping and Skipping

The skills of galloping and skipping are more advanced movement patterns that usually appear after children have learned to run, jump, and hop. Although galloping and skipping include variations of locomotor skills already learned, they are more difficult because of the balance and the movement sequences that must be learned.

Galloping, which includes the skills of walking and leaping, is a popular skill among children as young as four years. Proficiency in this pattern, however, is usually not observed until children reach the age of six. Skipping, a movement that includes a step and a hop on one foot followed by the same pattern on the opposite side, appears a little later than galloping. It is not until the age of six that children can accomplish this task with some degree of proficiency. Even at this age the variation in performance among children is great. And, some people never skip.

Manipulative Patterns

In the early childhood years, considerable energy is exerted by the young to explore their environment. Voluntary control of basic manipulative abilities leads to refined patterns enabling children to throw, catch, kick, and strike.

Throwing

Any activity that requires using one or two arms to thrust an object into space falls into the general category of throwing. Although this definition is very broad and includes all

of the major forms of throwing, only the developmental pattern of the overarm motion, the most commonly used motion, will be discussed here.

Sufficient evidence is available to document that children's throwing ability improves through childhood. Changes have been noted in the accuracy, distance, and form used by children of various ages. As distance and accuracy are dependent on the form used, the pattern of development of the throwing action is of primary importance. In 1938, Monica R. Wild conducted a thorough investigation of the developmental pattern of throwing. Although her work is dated, the developmental stages proposed by Wild are generally accepted today. The four stages she identified are summarized as follows:

Stage I. Children ages two and three years throw primarily with a forearm motion with no rotation of the body. The feet remain stationary throughout the throw but there is a slight forward body sway.

Stage II. As children become older, three and one-half to five years of age, several important changes occur in their throwing pattern. These changes include rotation of the body first to the right as the ball is brought backward and then to the left as the ball is delivered by the right hand. In preparation for the throw, the ball is brought backward further and held with a cocked wrist. The throwing arm also swings forward in an oblique horizontal plane. Similar to Stage I, the feet remain stationary.

Stage III. This stage, normally observed in children five and six years of age, is marked because of the addition of a forward step with the leg on the same side of the body as the throwing arm. Forward form is added to the throw by the shifting of weight that occurs during the step.

Stage IV. The final stage, the mature throw, is normally achieved by boys six and one-half years of age, with girls generally acquiring this pattern slightly later, unless they have had as much opportunity to observe and practice as the boys have, in which case they develop the pattern at the same age. In this stage the arm and trunk rotate backward in preparation for the throw. A contralateral step is then taken moving the body weight forward followed by rotation of the hips, trunk, and shoulder. The addition of opposition, coupled with the wider base of support, permits the throw to be completed with greater force.

Burton and colleagues (1992) documented that proficient throwing patterns were influenced by attending to the ratio of the hand size to the ball used for the throw. Smaller balls (relative to hand size) are easier for young children to throw.

Catching

Stopping the momentum of and controlling a thrown object using the arms and hands is referred to as catching. This skill, similar to those previously discussed, follows a developmental trend. As children become older, they become more proficient catchers. Children experience three stages as they learn to catch.

In the initial stage, children less than three and one-half years of age frequently avoid the thrown ball by turning the head or holding the arms in extension. Young children also tend to hold the palms up and try to trap the ball against the chest (see figure 2.14). During the second stage, the elementary level, children of approximately four years of age learn to follow the ball with the eyes. The earlier tendency to avoid the ball also disappears in this stage, although they tend to close the eyes only when the ball is about to make contact with the hands. Other changes include the position of the palms, which are held perpendicular rather than up as in the first stage. A mature catching pattern, the third stage, is achieved by many children at approximately six years of age. During this stage children track the ball from the time of release to when it is caught. The arms are held in a ready position, with the elbows flexed and the hands in a cupped position. As the ball is caught the arms give to help absorb the ball's momentum. These stages are presented in figure 2.14.

Kicking

Kicking is a manipulative pattern in which the foot is used to impart force to a ball. Although children as young as 24 months can kick, there have been few efforts to analyze the development of the kicking pattern. Gallahue and Ozmun (2002) have reviewed the available information and identified three progressive stages young children exhibit as they learn to kick.

In stage one, the ball is kicked with a straight leg action with little arm and trunk action. Little force is imparted to the ball because there is no backward movement of the kicking leg prior to the kick and the follow-through is limited. During the elementary stage, the arms are held outward for stability. The straight-leg kicking action observed in the first stage is replaced by a flexed knee position with the leg "uncocking" and extending forward to hit the ball. The beginning of a follow-through is also present during this stage. During the last stage, the mature kicking pattern emerges. In general, more total body action is found in this stage. The arms swing in opposition to each other during the kick. Length of the leg swing increases with a larger backswing and a higher follow-through. During the follow-through, the trunk flexes at the waist with the support foot raising to its toes. These stages are presented in figure 2.15 on page 40.

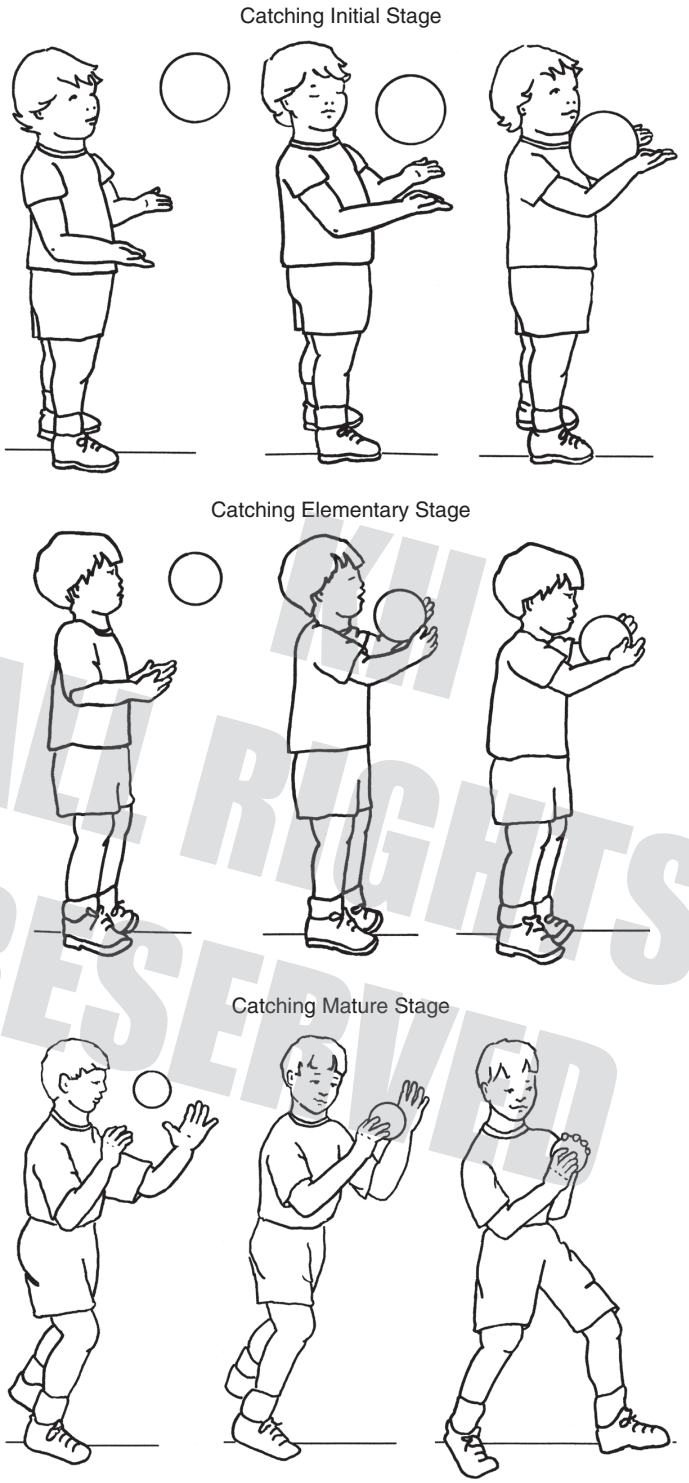


Figure 2.14 Catching (initial stage, elementary stage, mature stage).

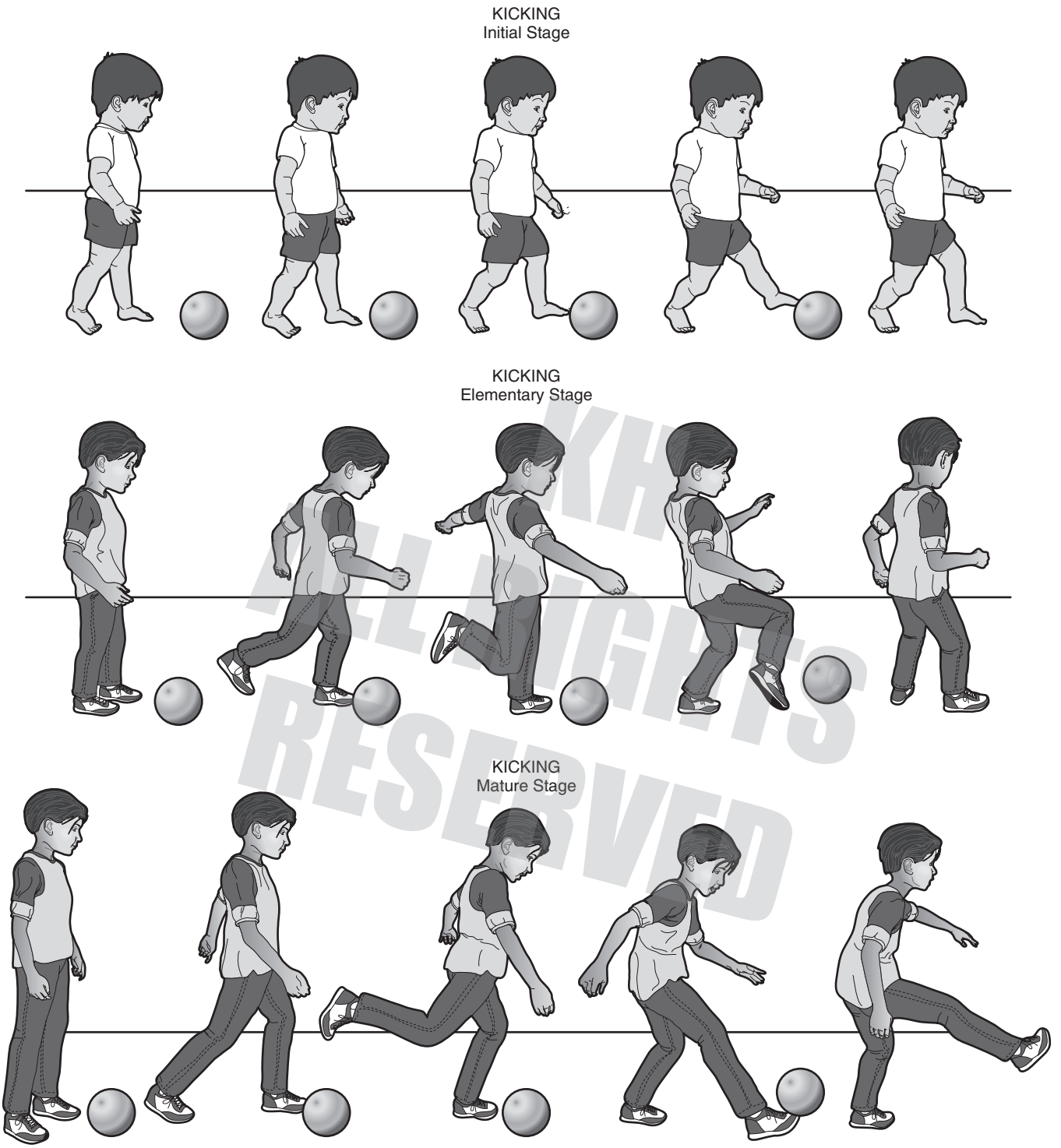


Figure 2.15 Kicking (initial stage, elementary stage, mature stage).

Striking

Striking in its earliest form develops from an overarm action that occurs in the anteroposterior (front-to-back) plane. The infant uses his/her hand as an implement to strike at suspended objects; this strike is usually restricted to a push rather than an actual hit. By 22 months, the child may still utilize an overarm striking pattern with an implement such as a small lightweight paddle. The striking action is still confined to extension of the forearm, and the child may exhibit one step forward. Mature striking movements do not occur until after the age of six or seven years.

In general, well-defined sidearm striking patterns will be utilized by children beginning at approximately three years of age. Legs and lower body portion are used in a mature striking pattern after the age of six or seven.

Social Development

The early childhood period is a time of rapid change in the social development of the young. From ages three to six, children move from a preference for parallel play to an interest in small group activities and games with simple rules. Changes are also noted in social behavior. Whereas two- and three-year-olds are very possessive of their play items and intolerant of others who intrude into their play space, five- and six-year-olds are more tolerant and show early interest in cooperative activities. Early attempts at leadership may also emerge in four- and five-year-olds.

The relationship between motor performance and social development is very important for the preschool child. Efforts to seek and gain approval occur frequently for the young as they utilize various movement patterns. Because motor skills are highly visible, they can easily be reinforced by the observant parent. The relationship of success in motor skills followed by parental praise encourages the child to explore other skills. Of course, the absence of success in play and game skills will lead to avoidance of these activities by young children, underlining the importance of structuring skills to ensure positive experiences.

Later Childhood (7 to 12 Years)

Children ages 7 to 12 are provided many opportunities to utilize the movement skills that were developed during the early childhood years. As children enter school, their environment expands and the basic movement patterns are used continuously in various interactions with their peers. The combined effects of experience, age, and maturation improve dramatically the elementary-school-age child's motor performance. In this section some of these changes will be discussed.

Later childhood expands on the basic movement patterns and includes social experiences important to this age group.

Physical Growth

We have reported in the past that height and weight in the age period from 6 to 12 were relatively slow and constant. But obesity has changed this. As a nation, we may be growing in height as we were in the past, but we now have a high incidence of obesity. Starting in 1999, this was named an epidemic by the CDC. By 2012, CDC is reporting that 18% of children are obese. These percentages are much higher for adults where no state in America has less than 20.5% of obese adults.

According to the Centers for Disease Control and Prevention (CDC, healthyyouth/obesity, 2013), *overweight* describes an excess of body weight for a particular height that comes from fat, muscle, bone, and water. Individuals may have either a combination of these variables contributing to the overweight or only one of the factors is contributing. *Obesity* is excess body fat. Although the CDC concedes that both conditions are caused by an intake of calories that exceeds the expended calories, they note that genetics, behavior, and environment contribute to the outcome.

The First Lady, Michelle Obama, established the "Lets Move" initiative to address the obesity epidemic in America by advocating for increased access to physical activity and healthy eating for children in America.

Trends of obesity show that from 2009 to 2010, 16.9% were obese and 31.8% were overweight and obese (Ogden, Carroll, Kit, & Flegal, 2010). Comparing this data to trends since the 1980s, CDC reports that obesity has doubled in children and tripled in adolescents. They now report that in 2013 the percentage of obese children and adolescents has tripled in the United States.

Differences in the pattern of *growth rate* for boys and girls may also be detected during the later childhood period. In general, gender differences in height are not significant until after approximately age 10, when girls reach puberty and achieve a size advantage that is apparent until about age 14. The hip-shoulder ratio for boys and girls also changes during this time, with the shoulder being wider than the pelvis for boys and the pelvis being wider than the shoulder for girls. The leg length of boys and girls also increases in proportion to the size of the trunk. This is particularly true for boys, so that by late childhood boys generally have legs proportionally longer than those of girls, which was not the case during infancy and early childhood.

Examples of Voluntary Movement Pattern Seven–Twelve years of age:

- Refinement of Movement Patterns
  - Jumping farther and higher
  - Running faster
- Throwing farther and more accurately
- Catching easier
- Mature striking movements
- Dribbling

Refinement of Movement Patterns

Development of the basic locomotor and manipulative patterns occurs primarily in early childhood. As previously discussed, children learn the process of how to perform essential skills at very early ages. Many changes in skill performance occur during the early years. For example, the process that six-year-old children use to throw a ball is vastly different and more efficient than the process exhibited by a three-year-old. Continued refinement of the skills learned in early childhood occurs between the ages of 6 and 12 years, the later childhood period. Improved performance is noted in this age group because of several factors, including maturity, practice, and changes in size. This last factor, size, is particularly important. Stronger children are capable of performing many movement patterns more efficiently and effectively than younger children.

The increase in functional complexity, noted in 7 to 12-year-olds, is attributed primarily to two different, but related processes—differentiation and integration (Gallahue & Ozmun, 2005). Differentiation is the gradual progression of movement patterns demonstrated by infants to the more refined movement patterns of later children. Integration refers to the coordinated interaction of muscle and sensory systems. The relationship of the two processes is illustrated by the efforts of a young child to catch a ball. Early efforts rely primarily on trapping the ball (figure 2.16) and progresses only when the more mature visually guided reaching and grasping behavior is evident. This

differentiation in the use of the arms, hands, and fingers followed by integration of the eyes and hands is crucial to success with hand-eye coordination tasks in normal development.

The intent of the following section is to discuss how the skills learned in early childhood are further developed and refined in later childhood. The data presented herein assume that cultural change in America with regard to female sports has contributed to change in girls skill performance. Data on fundamental skills have been shown to be stable over time (e.g., Burton & Rogerson, 2003; Gabbard, 2004), with recent data by Hauberstricker (1997, in Gabbard, 2004) showing that females continue to make improvements from 14 to 18 years of age.

Jumping

Interestingly, a 2013 report regarding the performance of preadolesent boys and girls in physical training found that those overweight had difficulty with the explosive strength and aerobic capacity that interfered with their ability to increase performance in training (Marta et al.). When we look at trend data versus training data of skill performance, in 1962 (Johnson), the vertical jump data showed a significant difference in distance between boys and girls. Then in 2004, Malina, Bouchard, and Bar-Or reported similar distances in the performance of the vertical jump combined with data for standing long jump for boys and girls from ages 4 through 11 with a slight falling off in comparison near age 12 for the girls. (From age 12 on, the girls increase some but plateau around age 15 through to age 18.) Both boys and girls improved dramatically from ages 5 through 14.

Running

The speed at which young children can run a short distance has frequently been used as an indication of running efficiency. As indicated in Figure 2.17, data gathered in the 1960s and 1980s show that both boys and girls improve their running speed across the ages 7–16. By 2004, the speed is less differentiated with girls hugging very closely to the growth curve from ages 5 through 14. After age 14, the boys pick up in speed (Malina, Bouchard, & Bar-Or, 2004).

Throwing

As children emerge from the early childhood period, most can throw using a reasonably mature movement pattern. During the next few years, significant gains are made in the distance and accuracy with which children 7 to 12 years of age can throw a ball. Figure 2.18 illustrates that improvements in

Figure 2.17 Running speed by age and sex. (Adapted from Espenchade, Anna S., and Eckert, Helen M.: *Motor Development*, 2nd ed. Columbus, OH, Charles E. Merrill Publishing Co., 1980; and Johnson, Warren R. (Ed.): S*cience and Medicine of Exercise and Sports*, 1960.)

throwing distance occur in a linear fashion for both boys and girls, with boys achieving at a higher performance level than girls at each age. This gender difference may be attributed to the greater arm-shoulder strength of boys. The data in figure 2.17 shows similar trends across researchers and is retained in current daga sets.

The accuracy with which older children can throw also improves in a linear fashion.

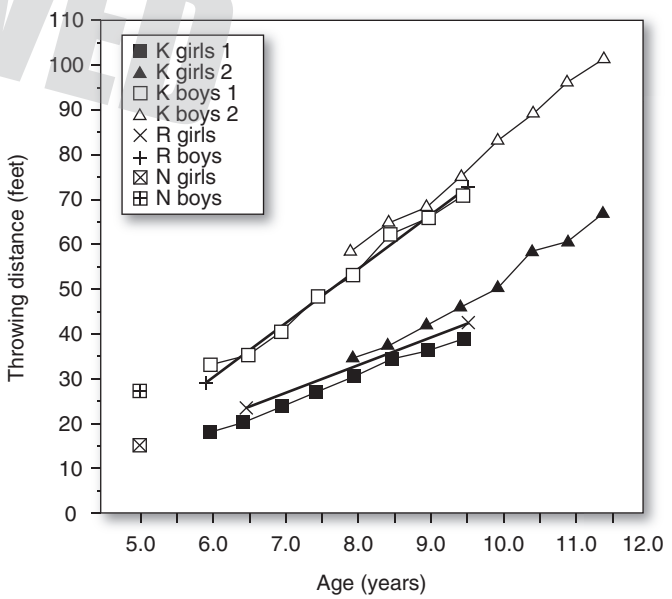


Figure 2.18 Mean throwing distance for boys and girls by age. Data from two longitudinal cohorts [1, 2] adapted from Keogh (1969) [K], Rippee *et al*. (1991) [R], and Nelson *et al*. (1986) [N].

Catching

Although few intensive studies have been conducted to analyze the developmental catching patterns of children ages 6 to 12 most recognize that with increasing age, children become more proficient in this skill. Catching is more difficult for children to master than throwing. Six-year-olds find catching a ball from a bounce easier than receiving a ball in flight. Similarly, larger balls are easier for the young to catch than are smaller balls. By age 12 however, most children can catch "on the fly" balls as small as a tennis ball.

Striking

Progress in the development of an effective striking pattern is indicated by the changes observed in patterns used at successive ages. These changes involve more definite use of body parts in the swing, the forward step, the hip and trunk rotation preceding the action of the arms in the swing, and the uncocking of the wrists during the swing. These changes begin to occur after six and one-half years, and it may be as long as two years before the child is capable of making mature striking movements. Haywood & Getchell (2009) notes that some adults do not have a mature strike.

Dribbling

Dribbling an object is a movement pattern that most children are exposed to and practice, yet it has not been studied extensively. Deach (1975), after studying children ages two to six, identified four stages of development. Stage 1 was a two-handed downward or diagonally forward overhand throw with no attempt to follow the ball. Stage 2 was an attempt to catch the ball after a single bounce. Stage 3 was an attempt to catch the ball after a single bounce, using one or more overhand swings with an outstretched arm. Stage 4 was a series of successive hits using a bent arm and palm/finger contact. In the final stage, the mature form is a rhythmic and a well coordinated series of pushes. Gallahue has identified the following elements as constituting the mature stage of dribbling (Gallahue, 1982; Gallahue & Ozmun, 2005):

- Feet placed in narrow stride position, with foot opposite dribbling hand forward
- Slight forward trunk lean
- Ball held waist high
- Ball pushed toward ground, with follow-through of arm, wrist, and fingers
- Controlled force of downward thrust
- Repeated contact and pushing action initiated from the fingertips
- Visual monitoring not necessary
- Controlled directional dribbling

The difficulty of the task of dribbling is compounded when the child moves while dribbling as contrasted to a stationary dribble. Dribbling while moving is a refined skill that should be introduced only after the child has successfully demonstrated the ability to perform a stationary dribble. This level of performance is normally not achieved prior to seven years of age.

In closing, the degree to which skill performance of youth has been influenced by the elimination of physical education in schools across the United States has not been reported. Federal legislation in 2001 referred to as No Child Left Behind (NCLB) has meant high stakes testing in math and reading, forcing many school districts to eliminate all but "essential academic areas." At the same time, the United States is experiencing an epidemic in obesity in children, youth, and adults. The American Academy of Pediatricians published a policy statement on the crucial role of recess in schools (2013) emphasizing the cognitive gains that children make. Research has also been reporting on variables that positively influence a child's participation in physical activity (e.g., Sallis, Prochaska, & Taylor, 2000). Solid data supports the re-establishment of access to physical education in schools.

Interest and Movement Activity

Children's interest in movement activities expands dramatically during the ages of 6 to 12. This is the period in which children move from participation in simple games and relays to lead-up activities for various sport experiences. Some are involved in organized teams. Participation in school physical education classes as well as involvement in community-sponsored programs helps to nurture this interest in physical activity.

The primary educational emphasis during this critical time should be to expose children to a wide variety of activities and to create successful learning experiences. Curricular experiences that are limited to the popular fall, winter, and spring sports that are repeated year after year contribute little to the educational growth of children. Likewise, educational programs directed toward "playing the game" without first attempting to improve and refine the basic skills creates an environment that is loaded with failure. A concerted effort, therefore, must be made to expose children to developmentally sequenced movement activities so that all children, including those with disabilities, can grow and benefit. Without such a system, children's interest in physical activity will decline, and withdrawal will be likely, particularly for those who feel they are not proficient.

Social and Intellectual Changes

Social relationships and skills are widely extended during the 6 to 12 age period. Educators recognize that social growth, like physical growth, must be fostered through a developmental framework. At various stages the social needs of children change. Six-year-old children, for instance, prefer small group activities, whereas 12-year-olds seek identification with a peer group. Educational experiences should build upon these needs and be structured to foster social growth.

Individual differences in behavior patterns are observed during the ages of 7 to 12. It is difficult, therefore, to predict how the social behavior of a 9-year-old differs from that of an 11-year-old. For instance, although it is generally recognized that 11-year-olds enjoy team games, not all children of this age are socially mature enough to engage in team play. To force such children to participate in group games would be wrong and a violation of the principle of readiness. It should be noted that differences in behavior patterns are varied regardless of ability or disability. Adequate and appropriate opportunities are needed for the social development of the students both with and w/out disabilities.

One area of certainty is that children need and seek approval. The basic desire to feel important, wanted, and accepted is a primary need of children ages 6 to 12. Teachers must strive to ensure that each child is systematically recognized and valued as a unique individual.

Selected Readings

ACOG (American College of Obstetricians and Gynecologists). (2013). Definition of term pregnancy. *Obstetrics and Gynecology, 122*, 1139–1140.

Adolph, K. E. (1997). Learning in the development of infant locomotion. *Monographs of the Society for Research in Child Development*, 62(3, Se. No. 251).

Allen, M. C., & Capute, A. J. (1990). Tone and reflex development before term. *Journal of Pediatrics*, supplement, 393–398.

Authors. (1998). Baby. *World Book* (2nd ed.). Chicago: World Book.

Bayley, N. (1993). *Bayley Scales of Infant Development* (2nd ed.). San Antonio: Therapy Skill Builders.

Berkow, R. (1997). *The Merck manual of medical information* (Home ed.). New York: Pocket.

Berman, B. D. (1993). Difficult and challenging behaviors in young children: A neurodevelopmental perspective for assessment and intervention. *Infants & Young Children: An Interdisciplinary Journal of Special Care Practices*, 6(1), 26–34.

Brazelton, T. B., Als, A., Tronick, E., & Lester, B. M. (1979). Specific neonatal measures: The Brazelton Neonatal Behavior Assessment Scale. In J. Osofsky (Ed.), *The handbook of infant development*. New York: John Wiley and Sons, Inc.

Brazelton, T. B., & Nugent, J. K. (1995). *Neonatal Behavioral Assessment Scale* (3rd ed.). London: Cambridge University.

Bronfenbrenner, U., & Crouter, A. C. (1983). The evolution of environmental models in developmental research. In P. H. Mussen (Ed.), *Handbook in child psychology* (4th ed., pp. 357–414). New York: Wiley.

Burton, A. (1999). Hrdlicka (1931) revisited: Children who run on all fours. *Research Quarterly for Exercise and Sport*, 70, 84–90.

Burton, A. W., & Miller, D. E. (1998). *The assessment of movement skills*. Champaign, IL: Human Kinetics.

Burton, A. W., Greer, N, II, & Wiese-Bjornstal, D. M. (1992). Changes in overhand throwing patterns as a function of ball size. *Pediatric Exercise Science*, 4, 50–67.

Burton, A. W., Greer, N, II, & Wiese-Bjornstal, D. M. (1993). Variations in grasping and throwing patterns as a function of ball size. *Pediatric Exercise Science*, 5, 25–41.

Burton, A. W., & Rogerson, R. W. (2003). The development of throwing behavior. In G. Savelsbergh, K. Davids, J. van der Kamp, & S. Bennett (Eds.), *Development of movment coordination in children: Applications in the fields of egonomics, health sciences and sport.* (pp. 225–240). London: Routledge.

Campos, J. J., Anderson, D. I., Barbu-Roth, M. A., Hubbard, E. M., Hertenstein, M., & Wirtherington, D. (2000). Travel broadens the mind. *Infancy, 1*(2), 149–249.

Carta J. J., et al. (1997). Developmental outcomes associated with "in utero" exposure to alcohol and other drugs. In M. Haack (Ed.), *Drug dependent mothers and their children: Issues in public policy and public health* (pp. 64–90). New York: Springer.

Cox, L., & Lubbers, T. (1999). *Make it take it!: Creating movement challenge kits for play at home or school*. Kearney, NE: Tekna.

Damiano, D. I. (1993). Reviewing muscle cocontraction: is it a developmental, pathological, or control issue? *Physical and Occupational Therapy in Pediatrics*, 12, 3–20.

Davis, W. E., & Burton, A. W. (1991). Ecological task analysis: Translating movement behavior theory into practice. *Adapted Physical Activity Quarterly*, 8, 154–177.

Deach, Dorothy F. (1975). Doctoral dissertation series; Publication 2390. Ann Arbor, MI: University Microfilms.

Dunn, J. M. (Ed.) (1991, August). PL 99–457, Challenges and opportunities for physical education. *Journal of Physical Education, Recreation, and Dance*, 33–48.

Eisenberg, A., Murkoff, H., & Hathaway, S. (1996). *What to expect the first year*. New York: Workman.

Eveleth, P. B., & Tanner, J. M. (1976). *Worldwide variation in human growth*. London: Cambridge University Press.

Frankenburg, W. K., & Dodds, J. B. (1991). *The Denver II developmental screening test*. Denver, CO: University of Colorado Medical Center.

Gabbard, C. P. (2004). *Lifelong motor development* (4th ed.). San Francisco, CA: Benjamin Cummings.

Gallahue, D. L., & Ozmun, J. C. (2005). *Understanding motor development: Infants, children, adolescents, and adults* (6th ed.). Dubuque: McGraw-Hill.

Gallahue, D.L & Ozmun, J. C. (2005) *Understanding motor development*. (6th Ed.). Dubuque: McGraw-Hill.

Garvin, M. C., Tarullo, A. R., Van Ryzin, M., & Gunnar, M. R. (2012). Post-adoption parenting and socioemotional development in post-institutionalized children. *Development and Psychopathology, 24*, 35–48.

Gesell, A. (1928). *Infancy and human growth*. New York: MacMillan.

Haley, S. M., & Baryza, M. J. (1990). A hierarchy of motor outcome assessment: Self-initiated movements through adaptive motor function. *Infants and Young Children*, 3(2),1–14.

Hart, B., & Risley T. R. (1995). *Meaningful differences*. Baltimore, MN: Paul Brooks.

Haywood, K. M. & Getchell, N. (2009). Life span motor development (5th Ed.). Champaign IL: Human Kinetics.

Haywood, K. M., & Getchell, N. (2005). *Life span motor development* (4th ed.). Champaign, IL: Human Kinetics.

Johnson, R. D. (1962). Measurements of achievement in fundamental skills of elementary children. *Research Quarterly, 33*, 94–103.

Keogh, J., & Sugden, D. (1985). *Movement skill development*. New York: MacMillan Publishing Co.

King, C. M., & Dunn, J. M. (1989). Classroom teachers' accuracy in observing students' motor performance. *Adapted Physical Activity Quarterly*, 6(1), 52–57.

Kunau, T. (2003). Computing infrastructure for life sciences: Confessions of an open source zealot. Conference presentation: Bioinformatic Technology: San Diego.

Lamb, M. E., Bornstein, M. H., & Teti, D. M. (2002). *Development in infancy: An introduction*. New Jersey: Erlbaum.

Leitschuh, C. A., & Dunn, J. M. (2001). Prediction of gross motor development quotient in young children prenatally exposed to cocaine/polydrugs. *Adapted Physical Activity Quarterly*, 18, 240–256.

Lester, B., & Tronick, E. Z. (1994). The effects of prenatal cocaine exposure and child outcome. *Infant Mental Health Journal*, 15(2), 107–120.

Malina, R., Bouchard, C., & Bar-Or, O. (2004). *Growth, maturation and physical activity* (2nd ed.). Champaign, IL: Human Kinetics.

Marta, C. C., Marinho, D. A., Barbosa, T. M., Carneigo, A. L., Izquierdo, M., & Marques, M. C. (2013). Effects of body fat and dominant somatotype on explosive strength and aerobic capacity trainability in prepubescent children. *Journal of Strength and Conditioning Research/National Strength & Conditioning Association*. DOI: 10.1519/JSC.0000000000000252

McCall, R. M., & Craft, D. H. (2000). *Moving with a purpose: Developing programs for preschoolers of all abilities*. Champaign, IL: Human Kinetics.

Miller, J. M., & Roid, G. H. (1994). *The Toddler and Infant Motor Evaluation*. San Antonio: Therapy Skill Builders.

Minnesota Department of Children, Families and Learning. (2004). *Active learning: A resource guide for designing and implementing developmentally appropriate movement experiences for young children ages 3 to 5*. [Manual]. Roseville, MN.

National Association for Sport and Physical Education. (2000). *Appropriate practices in movement programs for young children ages 3–5*. [Brochure]. Reston, VA.

National Association for Sport and Physical Education. (2002). ACTIVE START: *A statement of physical activity guidelines for children birth to five years*. [Brochure]. Reston, VA.

Neisworth, J. T., & Bagnato, S. J. (1996). *Assessment for early intervention: Emerging themes and practices*. In S. L. Odom & M. E. McLean (Eds.), *Early intervention/early childhood special education: Recommended practices* (pp. 23–57). Austin, TX: Pro-Ed.

NIDA pregnancy and drug use trends. Retrieved July 25, 2004, from http://www.drugabuse.gov/Infofax/pregnancytrends.html.

Norberg, S. (2001, July/Aug). Early signs of impaired motor development in infants and toddlers. *A Pediatric Perspective. Newsletter of Gillette Children's Specialty Healthcare*, 10(5), 1–3.

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2012). Prevalence of obesity and trends in body mass index among US children and adolescents, 1999–2010. *JAMA, 307*(5), 483–490.

Pangrazzi, R. P. (2001). *Dynamic physical education* (13th ed.). Boston: Allyn and Bacon.

Piaget, J. (1952). *The orgins of intelligence in children*. New York: International Universities Press.

Piper, M. C., & Darrah, J. (1994). *Alberta Infant Motor Scale*. Orlando, FL: Saunders.

Russ, S., Herbert, J., Cooper, P., Gunnar, M. R., Goodyer, I, Croudace, T., & Murray, L. (2012). Cortisol levels in response to starting school in children 'at risk' for social phobia. *Psychoneuroendocrinology, 37*, 462–474.

Sallis, J. F., Prochaska, J. J., & Taylor, W. C. (2000). A review of correlates of physical activity of children and adolescents. *Medicine & Science in Sports & Exercise*, 963–975. 0195-9131/00/3205-0963/0

Saunders, S. W. (2002). *Active for life: Developmentally appropriate movement programs for young children*. National Association for the Education of Young Children, Washington, D.C. Champaign, IL: Human Kinetics.

Sherrill, C. (2004). *Adapted physical activity and sport: Crossdisciplinary and lifespan* (6th ed). Boston: McGraw-Hill.

Stern, D. (1990). *Diary of a baby*. New York, NY: Basic Books.

Streissguth, A. P. (1997). *Fetal alcohol syndrome: A guide for families and communities*. Baltimore: Brookes.

Tanner, J. M. (1978). *Foetus into man*. Cambridge, MA: Harvard University Press.

Thelen, E., Kelso, J. A. S., & Fogel, A. (1987). Self-organizing systems and infant motor development. *Developmental Review*, 7, 39–65.

Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. Cambridge, MA: MIT Press.

United States Department of Health and Human Services (USDHHS), HHS Strategic Plan FY 2004–2009. Retrieved July 26, 2004 from www.aspe.hhs.gov.

Van Dyke, D. C., & Lin-Dyken, D. C. (1993). The new genetics, developmental disabilities, and early intervention. *Infants and Young Children*, 5(4), 8–19.

Wessel, J. A., & Zittel, L. L. (1995). *Smart Start: Preschool movement curriculum designed for all abilities*. Austin, TX: Pro-Ed.

Wessel, J. A., & Zittel, L. L. (1998). *I Can primary skills* K-3. Austin, TX: Pro-Ed.

Whitehall, J. (1988). *A dynamical systems approach to motor development: Applying new theory to practice*. Paper presented at the International Early Childhood Physical Education Conference, Washington, DC.

Wickstrom, R. L. (1983). *Fundamental motor patterns* (3rd ed.). Philadelphia: Lea and Febiger.

Wild, M. R. (1938). The behavior pattern of throwing and some observations concerning its course of development in children. *Research Quarterly*, 9, 20–24.